Health inequality monitoring

Harnessing data to advance health equity

World Health Organization

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Foreword

Since its inception in 1948, the World Health Organization (WHO) has been a strong advocate for equity in health, working to advance the highest attainable standard of health as a fundamental right of every person. Health equity continues to be central to the WHO mission and mandate.

Reducing and eliminating health inequities is key to attaining the health-related Sustainable Development Goals (SDGs) and the promise to "leave no one behind". This includes SDG 3, to ensure healthy lives and promote well-being for all at all ages, and SDG 10, to reduce inequalities within and across countries.

The WHO Fourteenth General Programme of Work, approved by Member States at the World Health Assembly in 2024, aims to support countries to promote, provide and protect the health and well-being of their people. It acknowledges the need for an "exceptional focus on substantially enhancing equity in health and care service coverage and access".

WHO work to advance health equity is anchored in science, using the best available evidence to understand, inform and refine public health actions. Moving forward on commitments to advance health equity requires robust health inequality monitoring systems.

Health inequality monitoring: harnessing data to advance health equity is a key addition to the suite of WHO tools and resources that support capacity-building for health inequality monitoring. It synthesizes decades of research to provide an up-to-date compilation of foundational concepts and emerging developments.

A few aspects of this book stand out. First, it addresses the application of health inequality monitoring in diverse contexts and environments. Readers will explore health inequality monitoring in emergency contexts, refugee and migrant populations, rural and remote areas, and high- and low-income countries. The book also covers social determinants of health, health expenditure, climate change, urbanization and other topics.

Second, the book details a range of technical content related to data sources and summary measures for inequality monitoring. It includes forward-looking chapters that address emerging sources and methods, giving readers of all skill levels and experiences a wealth of information.

Third, the book situates monitoring activities in the broader landscape of evidence-informed decision-making. It describes the importance of integrating health inequality monitoring into health information systems, and how to use findings alongside other forms of evidence.

Fourth, the book is accessible to a wide range of readers. It can be used as a reference for years to come, as we seek to accelerate progress towards the SDGs and prepare for the post-SDG era.

This book is a valuable contribution to the field of health inequality monitoring and to moving towards a world in which health is not a luxury for some, but a right for all.

Dr Tedros Adhanom Ghebreyesus
Director-General
World Health Organization

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Endorsements

Gabriel Squeff, General Coordinator of Health Economics Information, Department of Health Economics and Development

Ministry of Health, Brasilia, Brazil

> The book offers a clear and detailed understanding of health inequalities and the importance of monitoring them. The monitoring approaches discussed in the book can be adapted to the reality in Brazil – or other countries. The book provides valuable guidance on how to coordinate different sectors of society for effective and coordinated action.

Theresa Tam, Chief Public Health Officer

Public Health Agency of Canada, Ottawa, Canada

> *Health inequality monitoring: harnessing data to advance health equity* is an essential resource for public health professionals, policy-makers and researchers committed to advancing health equity. Bringing together existing resources and the latest scientific knowledge, this book introduces innovations in health inequality monitoring that highlight the importance of stakeholder engagement, data governance, and advancements in methods, data collection and analysis. This comprehensive guide will serve as a tool to empower countries to make informed, inclusive and equitable decisions to improve the health and well-being of all people.

Ximena Aguilera, Minister of Health

Ministry of Health, Santiago, Republic of Chile

> As a minister of health, I find this book on health inequality monitoring invaluable for achieving universal health coverage and Sustainable Development Goals. This book is recommended for anyone committed to advancing health equity because it provides a comprehensive framework for identifying, measuring and addressing health disparities.

Anthony Adofo Ofosu, Deputy Director-General of Ghana Health Service

Ministry of Health, Accra, Ghana

> This book will help countries build capacity to better monitor inequalities and make targeted interventions to address them. I endorse this book as a useful tool for the use of countries in our drive towards achieving universal health coverage.

Benjamin Nyakutsey, Head of Policy Department

Ministry of Health, Accra, Ghana

> I find the book very relevant to the ideals and aspirations of ensuring a healthy population for national development by eliminating health inequalities through the principles of whole-of-government and whole-of-society. I therefore fully endorse this document as an important resource for improving determinants of health evidence generation and knowledge transmission for policy action.

Diana Atwine, Permanent Secretary

Ministry of Health, Kampala, Uganda

> This publication serves as an essential guide, providing a wealth of knowledge, tools and methodologies to better understand disparities in health and, more importantly, to take informed actions to reduce them. We commend the WHO for consolidating both foundational and cutting-edge knowledge on health inequality monitoring and strongly encourage health stakeholders around the world to utilize this resource to advance health equity for all.

Ola Rosling, President

Gapminder.org, Stockholm, Sweden

> I seriously believe that monitoring health inequalities is one of the best ways to improve the world. This book compiles all the practical guidance needed to modernize the production and use of detailed statistics for any country, region or district. When we monitor a problem, we can solve it – and making basic health care available to everyone would bring dignity to all of humankind and have enormous economic value.

Hope L. Johnson, Special Advisor to the CEO and Director of Measurement, Evaluation and Learning

Gavi, the Vaccine Alliance, Geneva, Switzerland

> Harnessing the power of data helps us identify and understand the barriers to health. This book brings together the fundamental data and tools across health in a useful stepwise approach. The system for monitoring inequalities will enable even the most marginalized to be routinely visible, and their challenges in accessing and receiving quality care known so they can then reach and live healthy and productive lives.

Vuyiseka Dubula, Head of the Community Rights and Gender Department

Global Fund to Fight AIDS, Tuberculosis and Malaria, Geneva, Switzerland

> This groundbreaking publication marks a significant milestone in our collective efforts to better understand and address health disparities that continue to affect the most marginalized communities worldwide. The resource equips multisectoral partnerships and stakeholders with the essential tools and frameworks to monitor and respond to the core drivers of health inequalities.

Sarah Hawkes and Kent Buse, Co-Chief Executive Officers

Global Health 50/50, Cambridge, United Kingdom of Great Britain and Northern Ireland

> This timely book offers a crucial contribution to advancing inequality monitoring and building government capacity to address it. Granular data are essential for creating socially just health policies. Measuring and addressing health inequalities is not just technical – it’s a political act, and health advocates must champion both data disaggregation and action for health justice.

Mary Mahy, Director of Data for Impact

Joint United Nations Programme on HIV/AIDS, Geneva, Switzerland

> The book's emphasis on evidence-informed decision-making and equity-oriented policy-making ensures that readers can apply the insights to drive meaningful change. Whether you're a public health professional, researcher or student, this book equips you with the tools and knowledge to make a significant impact on health equity.

Steve MacFeely, Chief Statistician and Director of the Statistics and Data Directorate

Organisation for Economic Co-operation and Development, Paris, France

> *Health inequality monitoring: harnessing data to advance health equity* makes an important contribution to our understanding of health inequalities by taking the dedicated reader through the data lifecycle, from concepts and definitions, data sources, measurement approaches, to analyses and interpretation. But even the casual reader will be rewarded, as they dip in and out of chapters, and reflect on the hypothetical scenarios and real-world examples that illustrate graphically why health inequality matters.

Paula Braveman, Professor Emeritus

University of California, San Francisco, United States of America

> This will be a tremendously useful resource for health researchers who wish to look beneath the surface of population averages to reveal and understand health inequalities. This is an important WHO contribution to efforts for greater equity.

Michael Marmot, Director of the Institute of Health Equity

University College London, London, United Kingdom of Great Britain and Northern Ireland

> Many of us have lamented the relative scarcity of evidence on health equity from countries, and the lack of expertise to address the problem. This book shows what needs to be done – it brings together the expertise – and should make a major contribution in stimulating gathering of the kind of evidence that is vital. It is a needed step in advancing the cause of social justice and health. How on earth did we get this far without it? This will be the definitive text on the subject.

Cesar Victora, Emeritus Professor

Federal University of Pelotas, Pelotas, Brazil

> Missed opportunities for measuring, interpreting and acting upon health inequalities seem to be the rule rather than the exception. The greatest contribution of this book is addressing such missed opportunities by bringing it all together – namely, by summarizing the literature on monitoring health inequalities that was previously scattered across multiple publications. With its broad scope and critical relevance to global health, this book will become an indispensable resource for policy-makers, researchers and public health professionals willing to implement evidence-informed, equity-oriented strategies.

Richard Banda, WHO Representative

WHO Namibia Country Office, Windhoek, Namibia

> This book is a good resource from several perspectives: the use of inclusive terminology, the provision of more granular and precise approaches, the focus on previously overlooked groups such as migrants, and the emphasis on intersectionality, which are strong additions to harness data to tackle inequalities.

WHO Uganda Country Office, Kampala, Uganda

> By systematically addressing the complexities of health inequality, this work will undoubtedly empower countries to implement more effective and targeted interventions, making it a valuable contribution to global health equity efforts. Its impact lies in its ability to translate complex data into actionable insights, thus guiding the practice of health inequality monitoring with precision and relevance.

Moeti Rebecca Matshidiso, Regional Director

WHO Regional Office for Africa, Brazzaville, Congo

> This essential resource equips countries with the tools needed to better utilize data in addressing health inequalities and ensuring that no one is left behind. It is an invaluable asset for anyone dedicated to leveraging data to promote health equity in the African Region, particularly in identifying populations that are significantly behind in meeting their health needs.

Sebastian Garcia Saiso, Director of Evidence and Intelligence for Action in Health

Pan American Health Organization, Washington, DC, United States of America

> This comprehensive and timely document on health inequality monitoring represents a key tool to position health equity at the centre of health policy development, implementation and monitoring. This resource is essential for policy-makers, researchers and public health professionals seeking to understand and redress global health inequities, ultimately contributing to a fairer and healthier world for all.

Manoj Jhalani, Director, Department of Universal Health Coverage/Health Systems

WHO Regional Office for South-East Asia, New Delhi, India

> As countries advance in reorienting their health systems towards primary health care, it becomes crucial to measure and monitor health inequalities over time and across different population groups. This book presents a compelling vision of health inequality monitoring as a shared responsibility across global, regional, national, subnational and community levels, while offering robust analytical tools to evaluate policy interventions at these multiple layers.

Arash Rashidian, Director of Science, Information and Dissemination

WHO Regional Office for the Eastern Mediterranean, Cairo, Egypt

> Bringing together decades of advancements across disciplines, this book provides clear guidance for measuring and understanding the inequalities in health between population groups. The book presents a strong rationale for health inequality monitoring and charts a way forward for better communication with policy-makers, community members and other key audiences.

Kidong Park, Director of Data, Strategy and Innovation and Hiromasa Okayasu, Director of the Division of Healthy Environments and Populations

WHO Regional Office for the Western Pacific, Manila, Philippines

> This resource provides a comprehensive framework for identifying and addressing health inequalities within and between countries. By leveraging the data collection and analysis techniques outlined, our Member States can better track progress towards health equity and inform policy decisions to address inequities more effectively – advancing towards a just society that upholds health for families, communities and societies.

Samira Asma, Assistant Director-General, Division of Data, Analytics and Delivery for Impact

WHO Headquarters, Geneva, Switzerland

> This publication is a game-changer for global health, offering practical tools to monitor and address inequalities – a key WHO priority. It equips bold leaders with evidence-based guidance to drive impactful change and hold systems accountable. By using this resource, professionals can transform data into action, making marginalized populations visible and ensuring fair access to health benefits. Equity demands both political will and technical expertise. As Brock Chisholm said, "scientific progress brings new efficiency to medicine, and social progress demands that these benefits reach the entire population."

Alia El-Yassir, Director of the Department for Gender, Equity, Diversity and Rights for Health

WHO Headquarters, Geneva, Switzerland

> We treasure what we measure. This book provides critical and timely guidance for using health inequality monitoring to close gaps in universal health coverage and to identify targeted interventions across sectors to address exclusion and discrimination that lead to inequitable health outcomes.

Etienne Krug, Director of the Department for Social Determinants of Health

WHO Headquarters, Geneva, Switzerland

> Supporting countries to monitor and address social determinants to improve health equity is at the heart of our work at WHO. This publication fills a critical gap in the current repertoire of tools for using health data to its full effect and is a valuable resource for global health analysts, policy-makers, practitioners, scholars and other enthusiasts.

For extended versions of these endorsements, plus additional endorsements, see https://www.who.int/data/inequality-monitor/tools-resources/book_2024.

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Acknowledgements

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Abbreviations

ACI	absolute concentration index
AIS	AIDS Indicator Survey
BCG	Bacillus Calmette–Guérin
BGSD	between-group standard deviation
BGV	between-group variance
BMI	body mass index
CI	confidence interval
COV	coefficient of variation
CRVS	civil registration and vital statistics
DAG	directed acyclic graph
DHS	Demographic and Health Surveys
DPHS	digital public health surveillance
DQA	Data Quality Assurance
DTP	diphtheria, tetanus toxoid and pertussis
DTP3	three doses of the combined diphtheria, tetanus toxoid and pertussis vaccine
EPI	Expanded Programme on Immunization
GATHER	Guidelines for Accurate and Transparent Health Estimates Reporting
GIS	geographic information system
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria
GPS	Global Positioning System
GYTS	Global Youth Tobacco Survey
HDI	Human Development Index
HeRAMS	Health Resources and Services Availability Monitoring System
HHFA	Harmonized Health Facility Assessment
HiAP	Health in All Policies
HPV	human papillomavirus
ICD	International Classification of Diseases

IDIS	index of disparity
IDISU	unweighted index of disparity
IDISW	weighted index of disparity
IOM	International Organization for Migration
ITN	insecticide-treated net
LSMS	Living Standard Measurement Study
MCV1	one dose of measles-containing vaccine
MDB	mean difference from best-performing subgroup
MDBU	unweighted mean difference from best-performing subgroup
MDBW	weighted mean difference from best-performing subgroup
MDM	mean difference from mean
MDMU	unweighted mean difference from mean
MDMW	weighted mean difference from mean
MDR	mean difference from reference point
MDRU	unweighted mean difference from reference point
MDRW	weighted mean difference from reference point
MICS	Multiple Indicator Cluster Surveys
MIRA	Multi-cluster/sector Initial Rapid Assessment
MLD	mean log deviation
MSNA	Multi-sector Needs Assessment
NUTS	Nomenclature of Territorial Units for Statistics
O–B	Oaxaca–Blinder
OECD	Organisation for Economic Co-operation and Development
PAF	population attributable fraction
PAHO	Pan-American Health Organization
PAR	population attributable risk
PIN	population impact number
PRICSSA	Preferred Reporting Items for Complex Sample Survey Analysis
RCI	relative concentration index
RHIS	routine health information systems
RII	relative index of inequality
SAGER	Sex and Gender Equity in Research

SARA	Service Availability and Readiness Assessment
SDGs	Sustainable Development Goals
SDH	social determinants of health
SDI	Service Delivery Indicators
SDS	socioeconomic deprivation status
SGDI	subnational gender development index
SII	slope index of inequality
SPA	Service Provision Assessment
TB	tuberculosis
TI	Theil index
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children’s Fund

Glossary

absolute inequality	a magnitude of difference in health between subgroups. Absolute measures of inequality, such as absolute difference, retain the same unit of measurement as the health indicator.
accessibility	in the context of data quality, the ease with which users can find, retrieve, understand and use data.
accuracy	in the context of data quality, the degree of closeness estimates are to the true values.
adverse health indicator	a health indicator that has an inverse relationship with health such that lower values are generally regarded as better. Indicators that measure the burden of disease, non-use of essential services, lack of knowledge, and unhealthy behaviours and attitudes are usually adverse health indicators.
affected population	the individuals, populations and communities (typically defined by geographical area, age or life stage) that are the focus of inequality monitoring analyses, and for whom equity-oriented actions seek to benefit.
benchmarking	comparisons of inequality across similar areas or populations to get a sense of how one area or population performs in relation to others. Benchmarking promotes a broader understanding of the state of inequality.
between-country health inequality	differences in health across two or more countries. Analysis of between-country health inequality may entail comparisons between single countries, or between defined groups of countries (e.g. low-income versus high-income countries).
census	a periodic enumeration of a population that systematically records identities of all individuals in every place of residence, along with information about age or birth date, sex, socioeconomic status, marital status, race or ethnicity, household composition and size, and geographical area. In some cases, other items of information may be collected.
change over time	in the context of health inequality monitoring, a comparison of the situation of inequality at multiple points in time, demonstrating the extent to which inequalities have increased, stayed the same or decreased.
civil registration	the continuous, permanent, compulsory and universal recording of the occurrence and characteristics of vital events pertaining to the population, as provided through decree or regulation in accordance with the legal requirements in each country.
civil registration and vital statistics	*see* Civil registration *and* Vital statistics.

common identifier	individual or small-area information that is present in multiple data sources and can be used to link data; *see also* Data source linking.
community-based monitoring	mechanisms that service users or local communities use to gather, analyse and use information on an ongoing basis to improve the access, quality and impact of services, and to hold service providers and decision-makers to account.
completeness	in the context of data quality, all required data for the health indicator and inequality dimension are present and, if applicable, representative of the population of interest.
complex summary measure of inequality	a measure that draws on disaggregated data from all population subgroups, yielding a single number that expresses the level of inequality. For example, complex measures of inequality can express inequality across all five wealth quintiles, or across all districts in a country.
composite indicator	an index composed of several indicators within a health topic to represent that topic. A composite indicator may combine indicators from across several health topics to represent a broader concept, such as universal health coverage.
compounded advantage	a scenario where certain demographic, socioeconomic and geographic conditions act together to enhance advantage.
compounded vulnerability	a scenario where certain demographic, socioeconomic and geographic conditions act together to exacerbate vulnerability.
confidence interval	a range of values used to quantify the imprecision in the estimate of a particular value. Specifically, it quantifies the imprecision that results from random variation in the estimation of the value. It does not include imprecision resulting from systematic error (bias).
confounding variable	an additional variable related to the independent and dependent variables and that distorts the relationship between them.
covariates	variables, including non-health data, used in a statistical model to improve the estimation of the health indicator of interest. These variables are population-specific and are available for every population included in the analysis. A common covariate is gross domestic product per capita.
credibility	in the context of data quality, confidence that users place in the statistics.
data governance	a framework or mechanism that builds and maintains trust in data (and the institution producing and holding the data) by managing transparently the access, use and reuse (including matching and linking), quality and security of those data to maximize the net benefits.
data sources	for the purposes of health inequality monitoring, data sources contain quantitative information about health indicators or dimensions of inequality for a population of interest. In some cases, monitoring will involve the use of a single data source that contains all relevant information. In other cases, data may be drawn from several different sources.

data source linking	merging information about health indicators and dimensions of inequality from different data sources using individual or small-area identifiers.
data source mapping	a systematic process for cataloguing and describing all data available for health inequality monitoring in a given context. The process can be broken down into four sequential stages: list available data sources by type; for each data source, determine the availability of data for dimensions of inequality; for each data source, determine the availability of data about health indicators; and combine the lists about health indicators and dimensions of inequality.
decomposition analysis	breaking down the separate contributions of measurable characteristics (e.g. education, place of residence, socioeconomic status) to inequality in a health indicator.
denominator	the lower portion of a fraction used to calculate a rate or ratio. In a rate, the denominator is often defined as the population at risk.
deprivation index	a composite measure that combines information about multiple indicators within one or more dimensions of inequality, often at the small-area level.
determinants of health	factors that combine to affect the health of individuals and communities. Determinants of health include the social and economic environment, the physical environment, and the person's individual characteristics and behaviours.
digital health	systematic application of information and communications technologies, computer science and data to support informed decision-making by individuals, the health workforce and health systems to strengthen resilience to disease and improve health and wellness.
dimensions of inequality	criteria upon which population subgroups are categorized for inequality monitoring. Examples of dimensions of inequality include age, economic status, education level, place of residence, sex and subnational region.
disaggregated health data	data on health or determinants of health, by population subgroups defined by one or more dimensions of inequality. Disaggregated data can show underlying inequality patterns that are not evident from overall averages across a population.
double disaggregation	the practice of filtering data according to two dimensions of inequality simultaneously. Double and multiple disaggregation permits a quantitative exploration of intersectionality.
ecological analysis	analysis based on aggregated or grouped data, such as analysis of the relationship between a health indicator and a health determinant or exposure at a population level.
ecological fallacy	an erroneous inference that may occur because an association observed between variables on an aggregate level does not necessarily represent or reflect the association that exists at an individual level. A causal relationship that exists on a group level or among groups may not exist among the individuals in the group.
equity stratifier	*see* Dimensions of inequality.

estimate	indicator value calculated based on a single data source, such as a household survey or institution-based data source, taking into account relevant assumptions and limitations of the data source.
evaluation	a process that attempts to determine as systematically and objectively as possible the relevance, effectiveness and impact of activities in the light of their objectives.
evidence-informed decision-making	a systematic and transparent approach that applies structured and replicable methods to identify, appraise and make use of evidence across decision-making processes, including for implementation.
favourable health indicator	a health indicator that has a positive relationship with health, such that higher values are generally regarded as better. Indicators that measure the use of essential services, healthy behaviours and attitudes, family and community connectedness, and positive health outcomes are usually favourable health indicators.
geographic information system (GIS)	a system that creates, manages, analyses and maps geospatial data.
geospatial data	data about objects, events or other features that have a location on the surface of the earth.
health equity	absence of unfair, avoidable or remediable differences in health among population subgroups defined socially, economically, demographically or geographically.
health facility census	periodic enumeration of all public and private health-care facilities within a country about the facilities and the services they provide.
health facility survey	periodic enumeration of a representative sample of public and private health-care facilities within a country about the facilities and the services they provide.
health indicator	a measurable quantity that can be used to describe a population's health or its determinants.
health inequality	measured difference in health between population subgroups. Health inequalities can be measured and monitored. For the past three decades, the term has been used globally to refer to health differences associated with social advantage and disadvantage.
health inequity	unfair, avoidable or remediable differences in health among groups of people. In some cases, the absence of a difference between groups (i.e. a situation of equality) might be considered inequitable. Health inequity is rooted in the unfair distribution of, and unfair access to, power, wealth and other social resources, and is linked to forms of disadvantage that are socially produced, such as poverty, discrimination and lack of access to services or goods.
health information system	a system that integrates data collection, processing, reporting and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services.

household health survey	a data source that collects information from a representative sample of a study population about a variety of health indicators and a range of dimensions of inequality. Survey data are used to generate disaggregated estimates based on a specified sampling design within a population.
impact indicator	an indicator that measures long-term outcomes that programmes are designed to affect, including changes in mortality and morbidity.
indicator	*see* Health indicator.
input indicator	an indicator that measures human and financial resources, physical facilities, equipment and operational policies that enable programme activities to be implemented. This includes health financing, health workforce, health infrastructure, and health information and governance.
institution-based data source	a source that contains information collected in the course of administrative and operational activities. Examples include records kept by health facilities or institutions outside the health sector.
interaction	when the relationship between two variables depends on the value of another variable (also referred to as effect modification).
intersectionality	a concept describing how interconnected dimensions of inequality (especially gender, income/wealth and race/ethnicity) interact to create different experiences of privilege, vulnerability or disadvantage.
intersectoral action	*see* Multisectoral action.
intervention	an action or programme that aims to bring about identifiable outcomes or changes.
Leave No One Behind	a guiding principle of the Sustainable Development Goals encompassing a commitment to eradicating poverty in all forms, ending discrimination and exclusion, and reducing inequalities and vulnerabilities that undermine the potential of individuals and humanity on whole.
linking	*see* Data source linking.
median	the middle point of a set of ordered numbers, such that half of the values are higher and half of the values lower than the median.
metadata	data that define or describe other data. They are the information needed to explain and understand the data or values being presented. In the context of inequality monitoring, metadata often include detailed information related to data collection, spatial and temporal coverage of data sources, indicators, dimensions of inequality, methods of data disaggregation and summary measure calculation.
methodological soundness	in the context of data quality, the application of the available international standards, guidelines and good practices in the production of data.

modelled estimates	indicator values that draw from different sources of data, information and expertise and use established, standardized methods to produce estimates that are comparable across settings.
monitoring	systematic and routine collection of information to assess performance and progress towards specific targets and over an established period of time.
multiple disaggregation	the practice of filtering data according to more than two dimensions of inequality simultaneously. Double and multiple disaggregation permits a quantitative exploration of intersectionality.
multiple regression	a statistical technique used to analyse the relationship between a single dependent variable and several independent variables. In the context of health inequality analyses, multiple regression can provide information about the dimensions of inequality that are most associated with a health indicator.
multisectoral action	the involvement of several sectors in developing and implementing public policies intended to improve health, equity, well-being and other policy outcomes.
non-ordered dimension of inequality	inequality dimensions that are not based on criteria that can be logically ranked. For example, ethnicity, region and religion dimensions of inequality typically contain non-ordered subgroups.
ordered dimension of inequality	inequality dimensions that have an inherent positioning and can be logically ranked. For example, education has an inherent ordering of subgroups, because people with less education unequivocally have less of something compared with people with more education.
outcome indicator	an indicator that measures whether a programme is achieving the expected effects or changes in the short, intermediate and long term. Some programmes refer to their longest-term or most distal outcome indicators as impact indicators. This usually includes coverage of interventions, risk factors and behaviours.
output indicator	an indicator that measures the results of the processes in terms of service access, availability, quality, safety and health security.
pairwise summary measure of inequality	the comparison of health between two subgroups using difference or ratio. Pairwise measures of inequality are unweighted.
population share	the percentage of people in the affected population that is represented in a given population subgroup.
population shift	a phenomenon that occurs when the distribution of the population across subgroups (i.e. the population share) changes over time.
population size	the absolute number of people in the affected population that is represented in a given population subgroup.

population subgroup	a subset of a larger population that shares a certain characteristic. For the purposes of health inequality monitoring, population subgroups are defined by a dimension of inequality.
population-based data source	a data source that contains information on every individual in an affected population or a representative sample of an affected population.
primary health care	a whole-of-society approach to health that aims to maximize the level and equitable distribution of health and well-being by focusing on people's needs and preferences as early as possible along the continuum, from health promotion and disease prevention to treatment, rehabilitation and palliative care. Primary health care encompasses three mutually dependent components: integrated primary care services and essential public health functions; multisectoral policy and action; and individual empowerment and community engagement.
process indicator	an indicator that measures a programme's activities and outputs (direct products or deliverables of the activities). Together, measures of activities and outputs indicate whether the programme is being implemented as planned (e.g. health workforce training, constructing a health facility, registering births and deaths).
progressive universalism	an approach to reaching universal health coverage that ensures disadvantaged populations realize equal or greater gains until the goal of universalism is eventually approached.
proxy indicator	an indicator that stands in for another indicator or topic that is difficult to measure or for which data are limited.
public health significance	the relevance or meaning from a public health perspective.
reference point	a defined value, such as a subgroup estimate, overall measure or target, against which subgroups are compared.
regression	a statistical technique that relates a dependent variable to one or more independent (explanatory) variables.
relative inequality	the proportional difference in health among population subgroups. Relative measures of inequality, such as ratio, are unitless.
relevance	in the context of data quality, the degree to which data meet users' needs.
reliability	in the context of data quality, the consistency of the data when collected repeatedly using the same procedures and under the same circumstances.
resolution issues	misleading situations that arise when comparing summary measures of inequality based on disaggregated data with variable numbers of subgroups.
sample size	the number of people upon which a disaggregated (subgroup) estimate is based – that is, the denominator used to calculate a disaggregated estimate.

simple summary measure of inequality	*see* Pairwise summary measure of inequality.
small-area identifier	information attributed to small areas, such as postal codes or census tracts, that is present in multiple data sources and can be used to link data; *see also* Data source linking.
social determinants of health	the conditions in which people are born, grow, work, live and age, and people's access to power, money and resources.
statistical significance	a mathematical measure of the probability that a result is likely due to chance or another factor (i.e. the null hypothesis).
subgroup	*see* Population subgroup.
summary measure of inequality	a measure of the level of inequality between two or more subgroups, expressed as a single number. Summary measures of inequality can be characterized as absolute or relative, and weighted or unweighted, and can draw from two subgroups (pairwise measures) or more than two subgroups (complex measures).
surveillance system	a system for detecting, reporting and responding to specific notifiable conditions – usually epidemic-prone communicable diseases. Surveillance systems draw data from a range of other data sources.
survey	an investigation about the characteristics of a given population by means of collecting data from a sample of that population and estimating their characteristics through the systematic use of statistical methodology.
timeliness	in the context of data quality, the availability and reliability of data at the time they are needed to construct indicators.
tracer indicator	an indicator chosen as an example to represent a broader health topic.
uncertainty measure	a measure that indicates the accuracy with which an estimate from a sample represents the population. Common uncertainty measures include 95% confidence intervals and standard error.
universal health coverage	a health system goal in which all people have access to the full range of good-quality health services they need, when and where they need them, without financial hardship. It covers the full continuum of essential health services, from health promotion to prevention, treatment, rehabilitation and palliative care.
unweighted summary measure of inequality	a pairwise or complex measure of inequality that treats each subgroup as equally sized.

vital events	events concerning life and death of individuals and their family and civil status, including live births, adoptions, legitimations and recognitions; deaths and fetal deaths; and marriages, divorces, separations and annulments of marriage.
vital statistics	a systematic record of vital events to generate data and statistics. The components of a vital statistics system are legal registration; statistical reporting of vital events; and collection, compilation and dissemination of statistics pertaining to those events.
weighted summary measure of inequality	a complex measure of inequality that takes into account the population size of each subgroup.
within-country health inequality	differences in health across two or more subgroups of a national or subnational population.

Notes

Terms are defined according to their intended application to the health inequality monitoring concepts discussed in this book; terms may have other meanings in other contexts. Many of the terms are used across World Health Organization health inequality monitoring tools and resources, available here:

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Introduction

Health is a universal human right, and health inequality monitoring is integral to its attainment.

Over the past two decades, there have been remarkable improvements to human health around the world. Globally, life expectancy increased by more than six years between 2000 and 2019 (before the start of the COVID-19 pandemic[1]), from 66.8 years to 73.1 years *(1)*. Over this period, the burden of disease due to communicable diseases such as HIV and diarrhoeal diseases dropped by over 50% *(2)*. Encouragingly, the proportion of the population that is not covered by essential health services decreased by about 15% between 2000 and 2021 – an impressive pace of progress in expanding universal health coverage, especially before 2015 *(3)*.

Overall measures, however, can mask notable differences between and within populations. For example, in 2019 there was a gap in life expectancy of more than 30 years between the countries with the highest and lowest life expectancies (84.5 years in Japan and 51.8 years in Lesotho, respectively) *(1)*. The burden of HIV and diarrhoeal diseases was concentrated in lower-income countries *(2)* and among socially disadvantaged populations *(4, 5)*. In many countries, progress towards universal health coverage had stagnated – with only minimal increases in coverage after 2015[2] – and remained challenged by inequalities *(3)*. For example, within low- and middle-income countries, reproductive, maternal, newborn and child health service coverage was lower among people with lower economic status and education levels compared with people with higher economic status and education levels, and lower in rural areas than in urban areas. People living in poorer households, rural areas and households with older family members (aged 60 years and over) were more likely to experience poverty due to out-of-pocket health spending *(3)*.

Health inequalities are a formidable challenge in the face of new health threats such as COVID-19, and they impede progress in aspects of health that are persisting or worsening, such as many noncommunicable diseases. For example, people from socially disadvantaged populations were less likely to receive a COVID-19 vaccination in 2021 *(6)* or to access early screening and vaccination for cervical cancer in 2020 *(7)* – low-cost interventions that save lives.

Looking ahead, substantial opportunities for further global improvements in health lie in understanding and addressing health inequalities – observable differences in health between advantaged and disadvantaged populations. This requires characterizing with better granularity and precision how health and health determinants are experienced across and within populations. This evidence can be used to inform changes that are oriented towards

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[1] Coinciding with the first years of the COVID-19 pandemic, the 2019–2021 period saw substantial setbacks in health, including declines in global life expectancy and healthy life expectancy.

[2] Between 2019 and 2021, there was no reported change in terms of global progress towards universal health coverage.

advancing health equity – the absence of unfair, avoidable or remediable differences in health among populations *(8)*.

Health inequality monitoring serves the core functions of quantifying situations of inequality and trends in inequality over time, informing strategies to redress inequities, and enhancing accountability for the advancement of health equity (including assessing the effectiveness of policies, programmes and practices). In some situations, health inequality monitoring may be done in response to new or renewed interest in a particular health topic or health equity-related issue. Practically, this may mean there is political and financial support for health inequality monitoring activities and the responses they prompt. Health inequality monitoring may also be done to bring attention to issues that are not (but should be) prioritized – that is, to advocate for greater visibility of a particular equity issue.

> A key reason to conduct health inequality monitoring is to evaluate whether and how a health policy, programme or intervention is equity-oriented. This helps to determine which groups of people the policy, programme or intervention is reaching, and which groups are being left out.

Equity-oriented and evidence-informed action by the health sector is needed to ensure high-quality and effective services are available, accessible and acceptable in a timely manner to everyone, everywhere. Health and other sectors have a role to play in acting on wider structural determinants of health, including tackling the unfair distribution of power, wealth and other social resources.

About this resource

This book is a comprehensive and contemporary resource for health inequality monitoring, consolidating foundational and emerging knowledge in the field. It aims to support the expansion and strengthening of health inequality monitoring practices across different applications around the world, in service of the broader goal of advancing health equity.

The book is organized into four parts. Part 1 establishes the importance of health inequality monitoring and describes the components of the approach to monitoring detailed in the book:

- Chapter 1 introduces and differentiates between the concepts of health inequality and health inequity and showcases the importance of health inequality monitoring and its functions within the broader goal of advancing health equity.
- Chapter 2 describes the attributes of the approach to within-country inequality monitoring that is the primary focus of the book, explaining how they are distinct from complementary approaches to monitoring.
- Chapter 3 describes considerations and resources to guide the selection of health topics, health indicators and dimensions of inequality for health inequality monitoring.
- Chapter 4 describes the purpose and contributions of health inequality monitoring across global, regional, national and subnational levels, highlighting the range of stakeholders involved in monitoring.
- Chapter 5 discusses challenges and opportunities for health inequality monitor-ing in selected contexts, including lower- and higher-resourced settings, rural and remote settings, refugee and migrant populations, and emergency contexts.

Part 2 offers insights into how health inequality monitoring can generate impact through integration with health system planning and policy processes, engagement with different audiences, and action beyond the health sector:

- Chapter 6 demonstrates how health information systems can be oriented to promote and enable routine inequality monitoring in the health sector.
- Chapter 7 aims to facilitate a deeper understanding of strategies to effectively convey key messaging about health inequalities to different audiences.
- Chapter 8 introduces considerations, contexts and approaches for equity-oriented policymaking, including descriptions of primary health care, universal health coverage, and the priority public health conditions analysis framework.
- Chapter 9 aims to recognize the importance of social determinants of health in understanding and addressing health inequalities, to initiate discussion about actions on social determinants of health, and to propose strategies for building and sustaining multisectoral partnerships.
- Chapter 10 explores how selected themes – human rights, discrimination, colonialism and corruption – intersect with health inequalities, with examples indicating the role monitoring could play in driving and tracking their redressal.

Part 3 addresses data for health inequality monitoring, describing the characteristics of established and emerging data sources:

- Chapter 11 provides foundational information about disaggregated data for health inequality monitoring, including data source quality and data security considerations. It also gives an overview of common data sources used for health inequality monitoring.
- Chapter 12 describes the characteristics of household health surveys, civil registration and vital statistics systems and censuses, and discusses how each can be used for health inequality monitoring.
- Chapter 13 covers the general characteristics of various institution-based data sources within the health sector (individual, service and resource records) and sources outside the health sector.
- Chapter 14 discusses the main characteristics of surveillance systems and health facility assessments, highlighting how they may be used for health inequality monitoring. It also acknowledges the possibility of using data from a variety of other sources.
- Chapter 15 addresses considerations for how to select data sources for health inequality monitoring, introducing techniques such as data source mapping and data source linking.
- Chapter 16 introduces the key characteristics of a selection of emerging data sources, including geospatial data and technologies, mobile and web-based surveys, health tracking applications and digital public health surveillance.

Part 4 details technical aspects of monitoring related to analysis, interpretation and reporting of health inequality data, focusing on disaggregated data and summary measures of health inequality:

- Chapter 17 presents technical considerations related to the preparation of disaggregated health data for analysis, with a focus on health indicator data and dimensions of inequality data, and multiple disaggregation and analysis of disaggregated data across distinct measurement levels (individual, household and small area).

- Chapter 18 aims to facilitate a rigorous understanding of the conclusions derived from inspecting and comparing disaggregated health data, presenting strategies and fundamental considerations for interpreting disaggregated data.

- Chapter 19 builds a theoretical understanding of the general applications and strengths and limitations of summary measures of health inequality as an extension of disaggregated data analysis.

- Chapter 20 provides in-depth descriptions of pairwise summary measures of health inequality (difference and ratio) calculations, with illustrative examples of their applications.

- Chapter 21 describes several complex summary measures and provides detailed information about the calculation and interpretation of selected measures.

- Chapter 22 covers some of the assumptions and considerations inherent in understanding results derived from summary measures of inequality, especially when results are compared across populations and datasets.

- Chapter 23 aims to enable technically rigorous, complete and visually impactful reporting of health inequality data and measurements, focusing on the technical considerations for reporting the results of inequality analysis.

- Chapter 24 describes approaches and considerations for using evidence about health inequalities to inform equity-oriented decision-making.

- Chapter 25 explores examples of health inequality monitoring research questions and demonstrates the application of common analytical approaches to answering them.

The epilogue provides concluding reflections on the salient messages from the book, the current reality of health inequality monitoring and future directions.

This book was developed for a diverse readership, including technical experts (e.g. statistical, planning, and monitoring and evaluation officers), public health professionals, researchers, analysts and students. Parts 1 and 2 are aimed at general audiences, but readers of Parts 3 and 4 will benefit from having a basic statistical knowledge and familiarity with monitoring-related processes and tools.

Contents are organized into 25 concise chapters, designed to be navigated by readers according to their interests and needs. The chapters do not need to be read sequentially. Concepts are illustrated through hypothetical scenarios and real-world examples. The book includes a variety of examples, recommended resources, supplementary materials, and a glossary of terms to deepen readers' engagement with the content. The book is aligned with a broader package of tools and resources developed by the World Health Organization (WHO) to support health inequality monitoring (Box I.1).

Content development

The WHO Health Inequality Monitoring team led the conceptualization and development of the book. An Expert Review Group was established at the inception

BOX I.1. WHO resources for health inequality monitoring

As part of its commitment to advancing health equity, WHO has developed several resources to promote and strengthen health inequality monitoring activities *(9)*. The following resources are freely available online from the Health Inequality Monitor *(10)*.

A series of step-by-step manuals and accompanying workbooks provide practical guidance on the application of a five-step cycle of inequality monitoring in the context of national monitoring, and topics such as immunization and sexual, reproductive, maternal, newborn, child and adolescent health.

WHO State of Inequality and Explorations of Inequality reports showcase examples of high-quality, detailed technical reports on health inequality, in many cases serving as an inaugural global assessment of inequalities in the topic area.

Health Inequality Monitoring eLearning courses are free, self-directed online courses to build capacity for monitoring across diverse topics, stakeholders and settings *(11)*. The courses cover the foundations of health inequality monitoring, applications to specific health topics, and skills-building courses.

The WHO Health Equity Assessment Toolkit (HEAT) is a free software application for analysing, interpreting and reporting inequality data *(12)*. The software has an interactive interface that supports exploration of disaggregated data, calculation of summary measures of inequality, benchmarking between settings, and creation of graphs, maps and tables. There are two editions of the software: HEAT, built-in database edition (which has the Health Inequality Data Repository preinstalled), and HEAT Plus, upload database edition (which allows users to upload their own data).

The Health Inequality Data Repository aims to support expanded health inequality monitoring by facilitating access to disaggregated datasets across multiple health topics and settings *(13)*. Accordingly, it is the largest publicly available collection of disaggregated data on health and its determinants. As of 2024, it contains more than 2400 indicators and 24 inequality dimensions across all world regions. Datasets can be explored interactively online using the WHO HEAT application, or they can be downloaded for external use.

Statistical codes for Excel, R, SAS, SPSS and Stata support the production of disaggregated estimates from household survey data, and the calculation of summary measures of health inequality *(14)*.

of the development, consisting of health inequality experts holding positions external to WHO. This included individuals from universities, ministries of health, government health agencies, global health partner organizations, and foundations. These experts made the following contributions: advising on the purpose, objective, components and content of the book; reviewing, revising and providing inputs to chapter drafts; and supporting the release of the book. All members of the experts group completed and submitted a declaration of interest disclosing potential conflicts of interest that might affect, or might reasonably be perceived to affect, their objectivity and independence in relation to the subject matter of this publication. WHO reviewed each of the declarations and concluded that none could give rise to a potential or reasonably perceived conflict of interest related to the subjects covered in this publication. All the experts participated in their individual capacities and not as representatives of their countries, governments or organizations.

A preliminary outline of contents was developed and refined, with input from the Expert Review Group and experts across WHO departments and regions. The Health Inequality Monitoring team drafted the chapter contents, with solicited input from experts, as required. Chapters were reviewed on a rolling basis by ERG members and relevant WHO experts, as well as other experts external to WHO, where applicable. All chapters went through at least two rounds of review. The final round of review was open to all ERG members, as well as members of the WHO Data Hub and Spoke Collaborative (which represents all areas of technical expertise across all levels of WHO).

The contents of the book build on the 2013 *Handbook on health inequality monitoring in low- and middle-income countries (15)*. Content development was informed by WHO acquired expertise and experiences leading capacity building activities for health inequality monitoring with Member States and global health partners over the past 20 years. Academic and grey literature was reviewed systematically.

Efforts were made to ensure the examples represent a diverse range of health topics and geographical settings to demonstrate the wide applicability of health inequality monitoring.[3] Key sources included technical reports and publications, academic journal articles and reputable webpages maintained by government health agencies, international organizations and authoritative institutions. In some chapters, the book adapted materials developed for the WHO Health Inequality Monitoring eLearning channel *(11)*. The data featured in examples were primarily sourced from the WHO Health Inequality Data Repository *(13)*.

The contents of this book are accessible online through a dedicated webpage (https://www.who.int/data/inequality-monitor/tools-resources/book_2024).

A note on terminology

Throughout the book, we have endeavoured to use language and terminology that reflect inclusivity and respect for all individuals and population subgroups. In our discussions of population subgroups, we acknowledge the inherent diversity within these groups, and the intersectional nature of the characteristics that influence and shape health experiences. When referring to subgroups that experience “disadvantage”, the intention is to recognize specific historic and systemic factors linked to relative social disadvantage, such as lower economic status or education level. This and other terminologies are not meant to convey negative stereotypes, stigmatization or blame.

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PART

1

A primer

1

What are health inequalities and why monitor them?

Overview

Health inequalities are measurable differences in health or the determinants of health between population subgroups, which may be defined according to characteristics such as age, economic status, education level, place of residence, sex or subnaitonal region. Health inequalities can be measured and monitored over time using data. They can be measured between countries or groups of countries, or between population subgroups within a country. Interpreted literally, "health inequalities" refers to any health differences among any individuals; for the past three decades, however, the term has been used globally to refer to differences linked to social advantage or disadvantage.

Health inequalities exist in diverse aspects of health, well-being and access to good-quality health services. They may reflect different forms of disadvantage. For example, children in lower-income countries are more likely to be unvaccinated or under-vaccinated than children in higher-income countries. As another example, within many countries, people from wealthier households are more likely to access essential health services than people from poorer households.

Characterizing and monitoring health inequalities is a first step towards assessing whether a particular situation is considered fair and acceptable or should be flagged for remedial action. In this way, evaluating health inequality is integral to the advancement of health equity – or the absence of unfair, avoidable or remediable differences in health.

This chapter explores the concepts of health inequality and health equity and introduces the general applications of health inequality monitoring. It considers the following questions: How is health inequality related to and distinct from the notion of health equity? What do health inequalities reveal about the state of population health? How can monitoring health inequality be part of creating more equitable societies? And why does this matter?

The objective of this chapter is to showcase the importance of health inequality monitoring and its functions within the broader goal of advancing health equity. After looking at how inequality data (i.e. disaggregated data) can expose patterns masked by overall averages, the chapter introduces and differentiates between the concepts of health inequality and health inequity. It then describes core functions of inequality monitoring.

> Disaggregated health data are data on health or determinants of health, by population subgroups defined by one or more characteristics such as age, economic status, education level, place of residence, sex or subnational region. Disaggregated data can show underlying inequality patterns that are not evident from overall averages across a population.

Looking beyond averages

Health information is often communicated by summarizing the situation across the entire population. The mean (average) and median (middle value) are ways to measure the overall level of health in a population. Dispersion provides information about the distribution of health in a population (Box 1.1). Such measures, however, do not show how health varies between subgroups of the population. Assessments of health inequality, which are derived from disaggregated health data, provide more detailed information by accounting for the situation in population subgroups.

BOX 1.1. Measures of dispersion

Measures of dispersion demonstrate the distribution of a health indicator among individuals in a population. These measures are described as univariate because they consider only one variable (health) and do not consider social groupings or positioning. (By contrast, bivariate measures of health inequality require information about a health variable and a relevant dimension of inequality.) Measures of dispersion include standard deviation, variance and the Gini index (see Chapter 25).

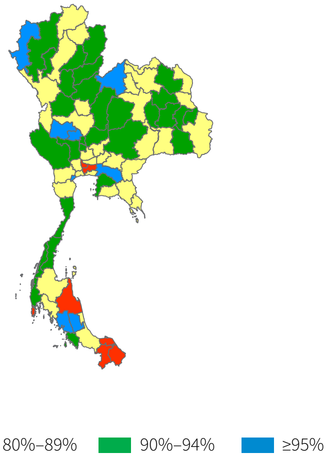
To see what can be derived by looking beyond overall averages, consider the following examples, which illustrate measles immunization coverage in Thailand, childhood stunting in Ghana, and the primary reliance on clean fuels and technologies for cooking in different regions of the world.

Overall, 87% of children in Thailand received two doses of measles-containing vaccine in 2019 (Figure 1.1, Panel A). This map of national average data makes it seem like measles immunization is spread evenly across the country. The map in Panel B, however, reveals variation in coverage across provinces. The disaggregated data

FIGURE 1.1. Measles-containing vaccine second-dose immunization coverage, Thailand

Panel A. National average

Panel B. Data disaggregated by province



Source: World Health Organization Regional Office for South-East Asia *(1)*, with data from 2019 sourced from the WHO South-East Asia Region annual Expanded Programme on Immunization reporting.

demonstrate there are several provinces where almost all children are vaccinated and other provinces with coverage below 80% *(1)*. Given that childhood immunization is essential to the reduction of mortality among children aged under five years and disease eradication and elimination, the disaggregated data in Thailand suggest a need for further effective targeting of immunization interventions to regions where coverage is low.

Another example can be drawn from data about childhood stunting in Ghana. Stunting in childhood indicates impaired growth and development caused by poor nutrition, repeated infection, chronic diseases and inadequate psychosocial stimulation *(2)*. It is measured in children using data about height-for-age.

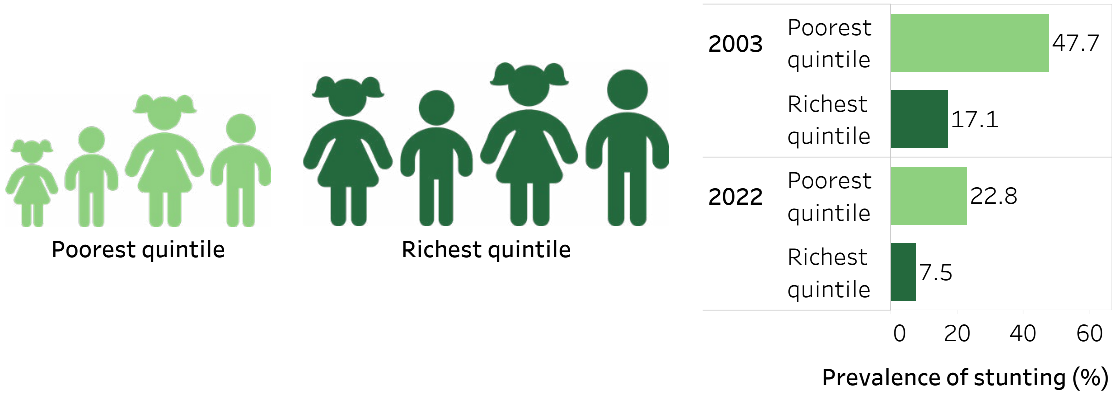
Across the entire population of the country, there is variation in height-for-age among children aged under five years, which can be assessed by considering dispersion (Figure 1.2, Panel A). This does not, however, show inequality in stunting between subgroups within the population.

Inequality in childhood stunting can be measured by disaggregating the population into subgroups based on their relative household wealth and comparing the proportion of stunted children – measured using the threshold of height-for-age more than two standard deviations below the WHO Child Growth Standards median *(2)* – between the poorest and richest subgroups (Figure 1.2, Panel B). These data demonstrate large gaps between the richest and poorest children in 2003 and 2022, with

FIGURE 1.2. **Prevalence of stunting in children aged under five years, by economic status, Ghana**

Panel A. Dispersion across the population

Panel B. Data disaggregated by household economic status



In panel B, stunting measured as height-for-age more than two standard deviations below the WHO Child Growth Standards median *(2)*.
Source: derived from the WHO Health Inequality Data Repository Child Malnutrition dataset *(3)*, with data from the 2003 and 2022 Demographic and Health Surveys.

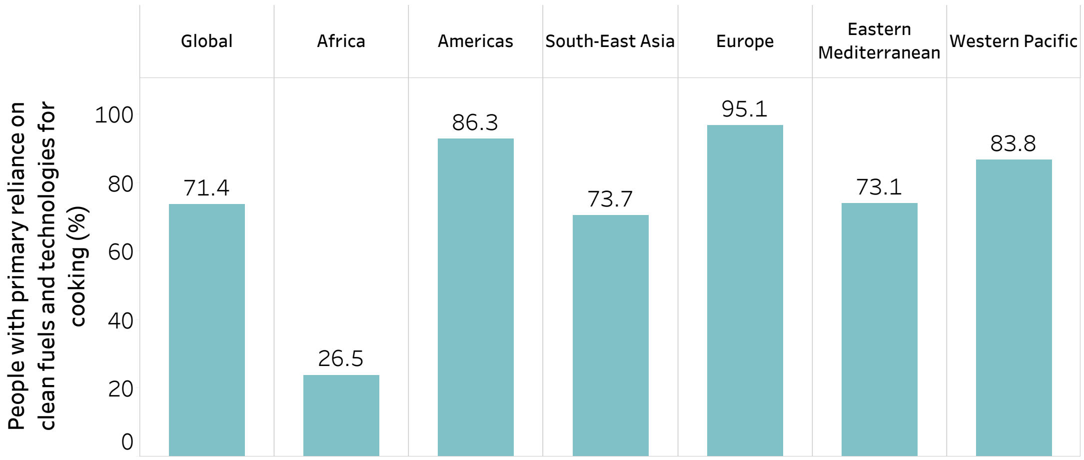
higher prevalence of stunting in the poorest quintile compared with the richest quintile. The gap between the richest and the poorest (in absolute terms) was smaller in 2022 compared with 2003 *(3)*.

A final example considers inequality in the primary reliance on clean fuels and technologies (e.g. electricity, natural gas, liquified petroleum gas, biogas, ethanol, solar) for cooking. This has emerged as a global concern due to the established negative health impacts of using unclean fuels, including respiratory, eye, cardiovascular and metabolic issues. Globally, household air pollution caused 3.2 million premature deaths per year in 2019 *(4)*.

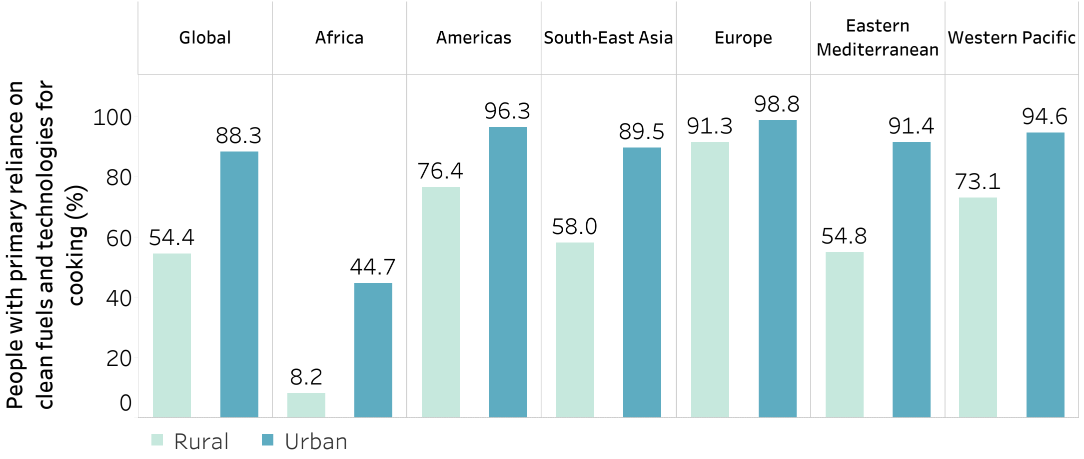
Overall, 73.6% of people cook using clean fuels and technologies, ranging from 23.8% in Africa to 96.8% in Europe (Figure 1.3, Panel A). Across all regions of the world, people living in rural areas are less likely to use clean fuels and technologies for cooking than people living in urban areas (Panel B). This difference is most pronounced in Africa, where

FIGURE 1.3. **Proportion of people with primary reliance on clean fuels and technologies for cooking, globally and by WHO region**

Panel A. Overall average



Panel B. Data disaggregated by place of residence



Source: derived from the WHO Global Health Observatory *(5)*, with data from 2022.

cleaner technologies are used for cooking by only 8.2% of people in rural areas, compared with 44.7% of people in urban areas *(5)*.

These data indicate a need for strategies to promote clean cooking and address barriers to using clean fuels and technologies, targeted particularly at rural areas. Such strategies can improve health and also mitigate climate change. Since household energy use is a cross-cutting issue, designing and implementing ways to improve it involves collaboration across multiple sectors, including energy, environment, finance, food and agriculture, health, land and natural resources, science and technology, and trade and industry.

Health inequality and health inequity

From the WHO perspective, health inequality is distinct from – but related to – the concepts of health inequity and health equity *(6)*. Health inequalities are observed differences in health between population subgroups formed on the basis of dimensions of inequality (Box 1.2). Health inequities refer to unfair, avoidable or remediable differences in health among groups of people. Health equity – or the absence of health inequity – is achieved when every individual and population group has a fair chance of attaining their full potential for health and well-being *(7)*.

Authors across various contexts use terminology related to health inequality, health inequity and health equity – or other terms, such as health disparity – to signify and emphasize different points. In some contexts, health disparity, health inequality and health inequity may carry the same meaning and be used interchangeably *(8)*. Generally, however, health inequality and health disparity are more appropriate to use in a measurement context; they refer to differences associated with social disadvantage *(9)*. Health inequity, by contrast, is explicit about the presence of injustice. See Box 1.3 for more on the conceptual difference between health inequality and other forms of inequality.

> Why is it important to differentiate between health inequality and health inequity? A common understanding of these terms – including how they overlap and how they are different – allows for a more nuanced engagement with the contents of this book. Clarity around these key concepts facilitates greater precision and intentionality when designing, implementing and interpreting health inequality monitoring activities.

BOX 1.2. Dimensions of inequality

Dimensions of inequality are the criteria upon which population subgroups are defined for inequality monitoring. Dimensions of inequality encompass demographic, socioeconomic and geographic characteristics. Some examples of dimensions of inequality that are commonly applied in health inequality monitoring include age, economic status, education level, place of residence, sex and subnational region.

The selection of dimensions of inequality for health inequality monitoring is discussed in Chapter 3, and their measurement and categorization are addressed in Chapter 17.

Defining "inequitable"

Differences in health between population groups – health inequalities – are considered inequitable when they are unfair, avoidable or remediable through reasonable actions. Fairness describes circumstances deemed to be right, reasonable and free from discrimination. (Justice and fairness are similar, but justice carries a more explicit connotation of social justice – that is, concern for groups that have been marginalized or excluded in the past.) The word "avoidable" refers to that which can be reasonably prevented, while "remediable" denotes a condition that could be rectified (even if it may be difficult to avoid).

A key characteristic of health inequities is that they are subject to interpretation and value judgements because they involve discerning whether a difference in health is unfair, avoidable or remediable *(9)*. People may hold different opinions about what is considered fair, avoidable or remediable through reasonable actions *(10)*. In contrast, health inequalities are not necessarily subject to this same type of interpretation, although there may be differing views related to the underlying data and measurement approaches. See Chapter 22 for more on how technical decisions regarding measurement approaches convey value judgements.

> Measuring health inequalities is part of monitoring progress towards achieving health equity.

Health inequities are a result of the decision-making processes, policies, social norms and structures that exist at all levels in society *(11)*. They go hand in hand with disadvantages that are socially produced, such as social exclusion, poverty, discrimination, and limited access to public services or goods. As part of human rights commitments, states have an obligation to ensure access to health services that are available, accessible, acceptable and of good quality. States must remove obstacles to some of the underlying determinants of health, such as safe and potable water, sanitation, food, housing, health-related information and education, and information about health problems affecting an individual's community. See Chapter 10 for more on human rights as a foundation for health equity.

BOX 1.3. Health inequality and other forms of inequality

Health inequalities are conceptually distinct from other forms of social and economic inequality, such as gender inequality, income inequality and racial inequality.

Health inequalities are defined by a dimension of inequality – that is, health data are compared across population subgroups. For example, when examining education as a determinant of inequality, health inequalities may be described as "education-related inequalities in health" or "inequalities in health according to education".

Other forms of economic or social inequality denote unequal access to resources, opportunities, capacities and freedoms. Income inequality, for example, might describe how income is distributed unevenly within a population. Gender inequality and racial inequality refer to unequal capacities and opportunities to access and control all social, economic and political resources (e.g. health services, education, voting rights).

Although there may be debate about whether health inequalities are determined as inequitable or not, social inequalities are by their very nature unjustifiable, because they refer to access to opportunities, capacities and freedoms.

> The right to health is a basic human right. Everyone must have access to the health services they need, when and where they need them, and without financial hardship.

Measuring health inequalities provides a starting point for exploring health inequities by quantifying indicators of health across population subgroups.

Differences in health often indicate a potential situation of inequity, but in some cases the absence of a difference between groups – a situation of equality – may be considered inequitable. For example, the equal distribution of preventive health services may be considered unfair if one subgroup has higher needs than another. Box 1.4 provides an example of how a situation of equality pertaining to a malaria control indicator may be considered inequitable.

BOX 1.4. When is equality inequitable?

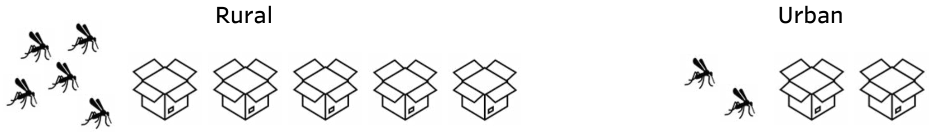
If two groups experience different levels of disease risk, the equal distribution of a prevention measure may be considered inequitable. Insecticide-treated nets (ITNs) are one of the main vector control measures recommended by the WHO Global Malaria Programme *(12)*. The deployment of ITNs is applicable for all populations at risk of malaria in most epidemiological and ecological settings. A programme evaluation might entail measuring and comparing the per capita distribution of ITNs in rural versus urban areas (as depicted in a hypothetical illustration in Figure 1.4). Suppose the data show that the per capita distribution is about the same in both places of residence (Panel A). This is a situation demonstrating no inequality in per capita ITN distribution.

A consideration of health equity, however, might account for the different risk of malaria in the two places of residence. The transmission of malaria is generally lower in urban areas than rural areas *(13)* (as depicted in Figure 1.4, Panel B). Therefore, one perspective might argue that an equal distribution (Panel A) is unfair because the need for ITNs (and their potential impact on public health outcomes) is greater in rural areas. According to this perspective, an approach rooted in health equity would entail distributing ITNs unequally (Panel B), with greater per capita distribution in rural areas, resulting in a more equitable distribution that favours the rural population.

FIGURE 1.4. **Hypothetical illustration of per capita distribution of insecticide-treated nets (ITNs) in rural and urban areas**

Panel A. Equal per capita distribution of ITNs in rural and urban areas

Panel B. Unequal per capita distribution of ITNs in rural and urban areas, showing malaria risk



Core functions of health inequality monitoring

Monitoring is the process of repeatedly making observations of a situation to look for changes over time. The overarching purpose of monitoring health inequalities is to inform the implementation of changes that advance health equity and improve the health of all people, including people from populations facing disadvantage. Inequality monitoring may be conducted as part of evaluation processes and should be embedded in health information systems (see Chapter 6).

> Evaluation is a process that attempts to determine as systematically and objectively as possible the relevance, effectiveness and impact of activities in light of their objectives *(14)*.

When undertaken regularly, health inequality monitoring can help to identify population subgroups that experience poorer health and lower access to health services. It can serve to determine which groups benefit from policies, programmes and practices, and which groups may be missing out on the benefits of – or experiencing worsening health due to – existing or new interventions (e.g. removal or reduction of social protection measures). Health inequality monitoring can also help to inform actions to improve the health of people experiencing the most disadvantage and the population overall and enhance accountability for these actions.

Inequality monitoring as a warning system

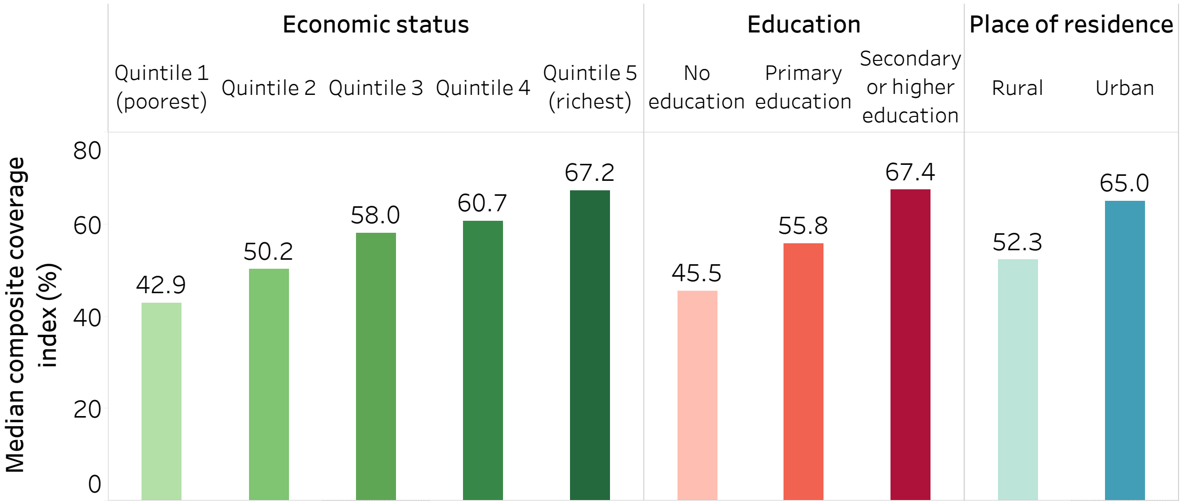
Taking into account the variable level of health across population subgroups, health inequality monitoring serves as a warning system for identifying and acting upon situations of health inequity. It helps to ascertain which dimensions of inequality are relevant to a particular aspect of health (see Chapter 18 for information on technical considerations for comparing inequalities based on different dimensions of inequality). For example, are differences in health observed between people with higher versus lower levels of education, rural versus urban residents, or the richest versus the poorest households? Health inequality monitoring can provide information about the direction of inequality, showing which subgroup has better or worse health. Further, it gives a sense of the extent of the inequality – that is, the magnitude of the difference between subgroups.

As an example, Figure 1.5 illustrates the coverage of reproductive, maternal, newborn and child health interventions, measured using the composite coverage index across various dimensions of inequality. The data, which reflect the status of inequality between 2012 and 2021, suggest higher coverage across richer and more educated subgroups, and higher coverage in urban compared with rural areas.

When health inequality monitoring is repeated over time, it reveals trends in inequalities, showing how inequalities have increased or narrowed. These trends can be interpreted alongside population-level averages to generate insight into whether the situation is improving, staying the same or getting worse (Box 1.5). Evaluating trends in inequality over time can help to determine the impact of policies, programmes and practices, and to start to understand whether they are having their intended effect. It can serve as one form of evidence to inform where changes are necessary to further reduce inequality.

> Inequality monitoring should be part of health-sector plans and strategies to promote regular monitoring and continued improvement from baseline measures towards targets (see Chapter 6).

FIGURE 1.5. Reproductive, maternal, newborn and child health composite coverage index, by multiple dimensions of inequality, 21 low-income countries



The reproductive, maternal, newborn and child health composite coverage index is a weighted score of the coverage of eight interventions: demand for family planning satisfied (modern methods); antenatal care coverage (at least four visits); births attended by skilled health personnel; Bacillus Calmette–Guérin (BCG) immunization coverage among children aged one year; measles immunization coverage among children aged one year; immunization coverage with a third dose of the diphtheria, tetanus toxoid and pertussis vaccine (DTP3) among children aged one year; children aged under five years with diarrhoea receiving oral rehydration therapy and continued feeding; and children aged under five years with pneumonia symptoms taken to a health facility *(15)*.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(3)*, with data sourced from the most recent Demographic and Health Survey or Multiple Indicator Cluster Survey between 2012 and 2021.

BOX 1.5. Trends in inequality over time

In general, a situation of overall improving population-level health alongside narrowing inequalities tends to indicate a desirable trend. This would be the case, for instance, if a country reported overall improved health service coverage over a 10-year period, with faster increases in coverage in disadvantaged rural areas compared with urban areas.

Conversely, the least desirable situation would be declining population-level health alongside widening inequalities. This would occur, for example, if there were decreased overall national coverage of health services, with sharper declines in rural areas compared with urban areas.

For more on evaluating scenarios with various trends in overall health and inequality, see Chapter 22.

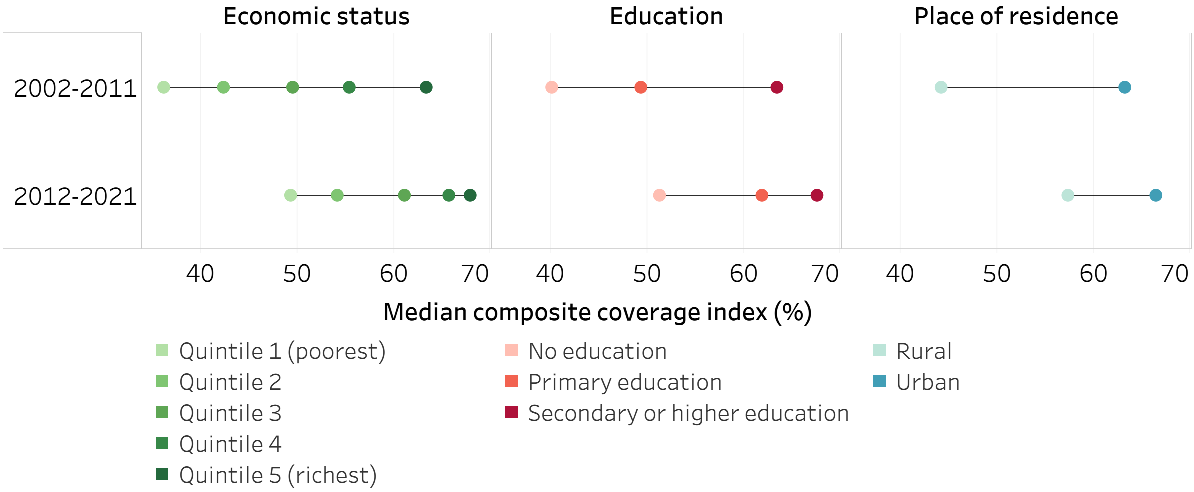
Building on the previous example of inequality in reproductive, maternal, newborn and child health composite coverage index, Figure 1.6 illustrates how economic-related, education-related and place of residence inequality in 2012–2021 compared with the previous decade. Between these two time periods, coverage increased in all subgroups across the three dimensions of inequality, while the gaps between the most and least advantaged subgroups narrowed.

Inequality monitoring to strengthen equity-oriented interventions

Equity-oriented interventions for health are designed to achieve the highest possible standard of health for all people, with special attention paid to the needs of people at greatest risk of poor health *(11)*. In the health sector, this means that all people everywhere should have timely access to high-quality, acceptable and effective services *(7)*.

Health inequality monitoring provides evidence to help inform equity-oriented actions and programmes. Together with other forms of evidence, this can aid in the efficient and equitable allocation of resources. This approach not only targets disadvantaged groups but also enhances overall population health by reducing health inequities. Box 1.6 illustrates how inequality monitoring was used to inform and strengthen equity-oriented HIV testing service delivery in Bulgaria. For more information about leveraging health inequality monitoring to generate impact, see Part 2.

FIGURE 1.6. Reproductive, maternal, newborn and child health composite coverage index, by multiple dimensions of inequality, 17 low-income countries: change over time



Horizontal lines show the range between the lowest and highest subgroup estimates.

The reproductive, maternal, newborn and child health composite coverage index is a weighted score of the coverage of eight interventions: demand for family planning satisfied (modern methods); antenatal care coverage (at least four visits); births attended by skilled health personnel; Bacillus Calmette–Guérin (BCG) immunization coverage among children aged one year; measles immunization coverage among children aged one year; immunization coverage with a third dose of the diphtheria, tetanus toxoid and pertussis vaccine (DTP3) among children aged one year; children aged under five years with diarrhoea receiving oral rehydration therapy and continued feeding; and children aged under five years with pneumonia symptoms taken to a health facility *(15)*.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(3)*, with data sourced from Demographic and Health Survey or Multiple Indicator Cluster Survey between 2002 and 2011 and between 2012 and 2021.

BOX 1.6. **Equity-oriented responses to address HIV prevalence in key populations in Bulgaria**

The following example was adapted from the *Compendium of good practices in the health sector response to HIV in the WHO European Region (16)*.

Although the overall HIV prevalence in Bulgaria is low (<0.1% among adults aged 15 and older in 2023), disaggregated data demonstrate higher prevalence in certain key population subgroups. For example, as of 2023, HIV prevalence was 2.5% among people who inject drugs, and 6.2% among men who have sex with men *(17)*.

Prior to 2001, a particular challenge among key populations was low coverage of HIV testing services *(16)*. Beginning in 2001, HIV testing services, available to the general public through health-care facilities, were expanded to enable greater accessibility for people from key populations. This was pursued by building a network of low-threshold testing service sites. A variety of approaches was used, including on-site HIV rapid tests via mobile medical units in drop-in centres used by people from the target populations and difficult-to-reach places. HIV testing services were also established in prisons and near popular seasonal resorts.

Ongoing monitoring across these key populations has shown remarkable increases in the number of people receiving HIV testing services between 2001 and 2015, including a 40-fold increase between 2003 and 2009 *(16)*.

Inequality monitoring to enhance accountability

One way that inequality monitoring supports the success of equity-oriented policies, programmes and practices is through enhanced accountability. In this context, accountability refers to the responsibility of individuals, organizations, institutions and societies to uphold their commitments to actions that advance health equity. By integrating health inequality targets and indicators into core health priorities and accountability mechanisms, monitoring can be used to track and drive progress towards achieving equity goals. When information about health inequalities is reported in a transparent and public manner, there may be increased awareness and demand for remedial action.

For example, equity is reflected in global efforts to expand immunization coverage. The Immunization Agenda 2030 emphasizes the use of data to track coverage by age, gender, location and socioeconomic status, and includes an indicator of immunization coverage in the 20% of districts with the lowest coverage *(18)*. The implementation of the Agenda is supported through a global-level partnership model for ownership and accountability, which involves technical advisory bodies through an independent review of monitoring results, and reporting to the World Health Assembly *(19)*. Communities and civil society organizations are also part of holding national and subnational authorities accountable for the equitable delivery of immunization services *(18)*.

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2

Approaches to health inequality monitoring

Overview

Monitoring health inequalities provides evidence on who is being left behind, with the purpose of informing equity-oriented health policies, programmes and practices. Varied approaches to monitoring draw from different types of information, yielding complementary forms of evidence that together inform a more holistic view on the state of health inequality than any one approach in isolation.

The objective of this chapter is to introduce attributes of the approach to within-country inequality monitoring that is the primary focus of the book by explaining how it is distinct from complementary approaches. The chapter begins by differentiating between qualitative and quantitative approaches to exploring health inequalities, and then contrasts measures of between-country and within-country inequality. Finally, a five-step cycle of inequality monitoring is described, offering a framework for conducting within-country health inequality monitoring.

Qualitative and quantitative explorations of health inequality

Health inequalities can be assessed using qualitative and quantitative methods, which offer distinct and complementary perspectives. Qualitative approaches tend to explore the nature of inequalities and their drivers through non-numerical data derived from document study, observations, interviews and focus groups. Qualitative approaches can provide rich information about how inequalities are experienced and help to guide policy recommendations that reflect how people live their lives. The findings of qualitative studies are particularly useful to illustrate what is or is not working well in a specific context; give information about the accessibility, affordability and equitability of services; and provide insight on opportunities for intervention.

Quantitative approaches rely on numerical data and statistical analysis techniques to measure and quantify inequalities in health. Using data derived from sources such as surveys, censuses, statistical records and registers, quantitative methods facilitate comparisons of inequalities between populations and evaluation of trends over time.

Parts 3 and 4 of this book are primarily focused on guidance for quantitative methods of assessing health inequalities, but qualitative approaches are also part of health inequality monitoring. For example, a priori qualitative analysis is important to guide the selection of relevant indicators and dimensions of inequality (see Chapter 3). The integration of both qualitative and quantitative approaches is needed to form a comprehensive and well-rounded understanding of health inequalities and their implications for equity-oriented decision-making (see Chapter 24).

Between-country versus within-country inequality

Between-country and within-country inequality are two distinct ways of measuring health inequalities, each reflecting a different scope of monitoring. Measures of between-country inequality consider differences across two or more countries, providing insights into regional or global trends. Such comparisons may be based on a health indicator measurement or a socioeconomic measurement, such as gross national income per capita or multidimensional vulnerability index.

Between-country inequality may entail comparisons between single countries – for example, how does a health indicator measurement in one country compare with the measurement in another country? It may also entail comparisons between defined groups of countries that share a common characteristic – for example, comparing a health indicator in low-income and high-income countries.

> The United Nations multidimensional vulnerability index was created as a complement to gross national income to measure structural vulnerability and lack of resilience across multiple dimensions of sustainable development at the national level *(1)*.

Measures of within-country inequality consider differences across two or more subgroups of a national or subnational population. This approach to monitoring reveals inequality trends within countries and is the predominant approach to monitoring inequalities addressed in this book.

Between-country and within-country inequality measurements are not mutually exclusive. Comparisons of within-country inequality can be made between countries (Box 2.1). For more discussion about the purpose and contributions of health inequality monitoring across global, regional, national and subnational contexts, see Chapter 4.

Five-step cycle of inequality monitoring

This book focuses on the assessment of within-country health inequality. To this end, a five-step cycle of health inequality monitoring provides a simplified depiction of the process (Figure 2.2). The cycle begins with determining the scope of monitoring (Step 1) and obtaining the data (Step 2). The data are analysed (Step 3), and the results are reported to relevant target audiences (Step 4). Step 5 addresses knowledge translation, facilitating the uptake of monitoring results to inform changes. To continue to monitor the effects of these changes, more data must be collected that describe the ongoing health of the population. Thus, the cycle of monitoring is continuous. This five-step cycle of health inequality monitoring can be applied across any health topic and population (Box 2.2).

Step 1: determine the scope of monitoring

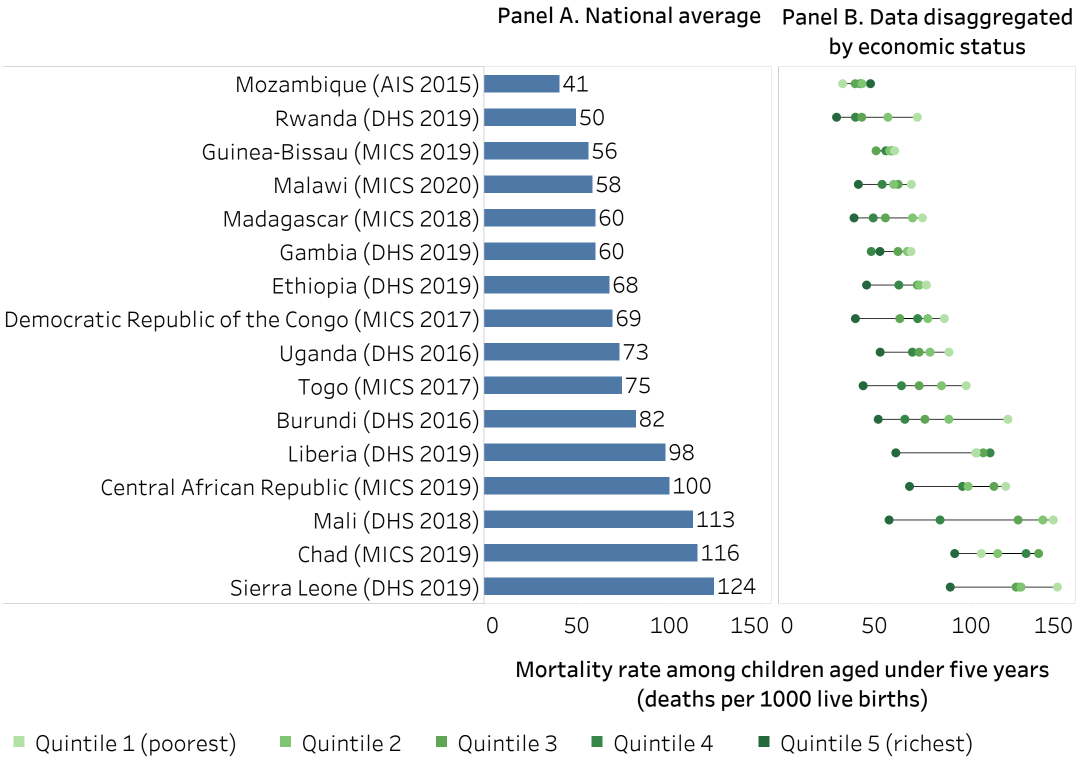
Step 1 establishes the general purpose and scope of the monitoring exercise. This step entails putting in place the parameters that guide the subsequent steps of monitoring. Step 1 is broken down into three sub-steps, which can be approached concurrently, guided by the overarching purpose of monitoring and with consideration of existing priorities and resources.

BOX 2.1. Between-country and within-country inequalities: mortality among children aged under five years, low-income African countries

The following example draws on household survey data about mortality among children aged under five years in 16 low-income countries in the WHO African Region (Figure 2.1). Panel A shows the national average under-five mortality rate for the 16 countries, demonstrating between-country inequality. Of the countries with available data between 2015 and 2020, Mozambique had the lowest national average rate of under-five mortality and Sierra Leone had the highest.

Panel B contains data on under-five mortality for wealth quintiles in each country, showing within-country economic-related inequality. The extent of within-country inequality is indicated by the length of the horizontal line connecting the two dots representing the quintiles with the highest and lowest mortality. A between-country comparison of within-country inequality could conclude that economic-related inequality was the narrowest in Guinea-Bissau and the widest in Mali.

FIGURE 2.1. Mortality rate among children aged under five years (deaths per 1000 live births), 16 low-income countries in the WHO African Region



AIS, AIDS Indicator Survey; DHS, Demographic and Health Survey; MICS, Multiple Indicator Cluster Survey.

Horizontal lines show the range between the lowest and highest subgroup estimates for each country.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(2)*, with data sourced from the most recent AIS, DHS or MICS between 2015 and 2020.

FIGURE 2.2. Five-step cycle of health inequality monitoring

Step 1A asks the key question: which health topic and population (or populations) will the monitoring activity encompass? Populations (groups of people) are often defined based on geographical or administrative boundaries – global, regional, national, provincial, district, municipal and so on. Monitoring should ideally encompass all members of the affected population within the area, through whole-population or representative sampling.

Step 1B – identify relevant health indicators – looks at which range of health indicators is best suited to inequality monitoring. In selecting health indicators for monitoring inequality, an initial consideration is the desired breadth of the health topic. Will the topic be narrowly defined, and therefore include indicators that are directly linked with that topic? Or will a broad lens be adopted, incorporating a wider selection of health indicators across aspects of the health sector and other health-related indicators?

Step 1C considers relevant dimensions of inequality. Dimensions of inequality are the categorizations on which subgroups are formed for inequality monitoring. They generally reflect sources of discrimination or social exclusion that negatively impact health, including social, economic, demographic and geographical factors. Applying a single dimension of inequality may not always be sufficient to meaningfully capture inequality within a population. Double disaggregation involves applying two dimensions of inequality simultaneously, while multiple disaggregation applies more than two dimensions.

Chapter 3 includes more information on the selection of health topics and indicators and dimensions of inequality.

Step 2: obtain data

Step 2 obtains two streams of data: data about health indicators and data about dimensions of inequality. Step 2A involves mapping data sources – a systematic approach to assessing which sources contain data about relevant health indicators and dimensions of inequality (see

BOX 2.2. Step-by-step manuals for health inequality monitoring

WHO has a series of step-by-step manuals and workbooks that aim to build capacity for implementing the five-step cycle of monitoring. *National health inequality monitoring: a step-by-step manual* provides general guidance on the application of the cycle within national contexts *(3)*. Subsequent versions of the Manual contextualize the steps within the topics of immunization *(4)* and sexual, reproductive, maternal, newborn, child and adolescent health *(5)*. The health inequality monitoring workbooks contain exercises that facilitate the application of the five steps *(6, 7)*. The step-by-step process of health inequality monitoring is further supported through a series of eLearning courses *(8)*.

Chapter 15). The results of this mapping exercise indicate whether data are available to proceed with inequality monitoring, a determination that is made in Step 2B. In some situations, there may be multiple sources that contain relevant data. Weighing the strengths and limitations of the different options can help in deciding which source to use. If data are limited, non-representative, unavailable or of poor quality, other action will be needed to reassess the scope of monitoring (returning to Step 1) or to advocate for expanded or improved data collection. Data sources for health inequality monitoring are discussed in more detail in Part 2.

Step 3: analyse data

Step 3 generates numerical descriptions of the patterns and magnitude of inequality. Preparing disaggregated data is the first sub-step of data analysis, Step 3A (see Chapter 17). Disaggregated data can be inspected to get an initial sense of patterns in the data across the population subgroups, which are defined by dimensions of inequality.

In Step 3B, summary measures of health inequality are calculated to concisely represent the level of inequality across subgroups. There are numerous summary measures of health inequality, ranging from simple pairwise measures that compare two subgroups, to complex measures that take into account data from multiple subgroups. More information about health data disaggregation and summary measures of health inequality can be found in Part 4.

Step 4: report results

Reporting reflects aspects of all the previous steps of the inequality monitoring cycle, conveying information about the overarching purpose and scope of monitoring, the data sources and the key results. Reporting activities should begin with a thorough understanding of the results from the data analysis. Interpreting results, identifying key findings, and deriving conclusions and recommendations are iterative and often collaborative processes. They rely on a solid understanding of the technical aspects of analysis and broad knowledge about the population, context and target audience.

Reporting the results of health inequality analyses can be approached through five sub-steps. First, the specifics of reporting should be guided by a specific purpose (goals and objectives) and target audience for the reporting activity: defining these aspects of reporting is Step 4A. Multiple reporting outputs may be prepared with different purposes and audiences in mind. Once these parameters are established for a specific reporting output, the scope of reporting (Step 4B), the technical content (Step 4C) and the methods of data presentation (Step 4D) can be determined. Finally, reporting outputs should adhere to high standards of reporting, containing all the necessary technical and nontechnical information to contextualize the main messages, recommendations and conclusions (Step 4E). See Chapters 7 and 23 for more about reporting as part of health inequality monitoring.

Step 5: knowledge translation

Step 5 pertains to knowledge translation. Knowledge translation is the synthesis, exchange and application of knowledge by relevant stakeholders to accelerate the benefits of global and local innovation in strengthening health systems and improving people's health. Ideally, multiple forms of knowledge and evidence – including qualitative and quantitative studies, lived experiences, programme and policy expertise, and practitioner perspectives – should be considered alongside the results of inequality monitoring.

When knowledge translation happens effectively, the evidence generated from health inequality monitoring is taken up to effect change and achieve greater equity. Monitoring is then poised to continue from the first step, adapting to new circumstances and evolving situations. For more information on knowledge translation, see Part 2 and Chapter 24.

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3

Health indicators and dimensions of inequality

Overview

Central questions when undertaking health inequality monitoring activities include: Which health topics should be included in monitoring? Within a selected topic, what indicators should be included? And, for selected health indicators, according to which characteristics (i.e. dimensions of inequality) should inequality be assessed?

The answers to these questions may not be straightforward. The selection of a health topic for health inequality monitoring requires consideration of background and contextual information related to the purpose of monitoring, the anticipated impact of monitoring, and its relevance to policy and programme priorities. Familiarity and engagement with the needs and interests of diverse stakeholders, including affected populations, can yield further insights into potential indicators and dimensions of inequality for inclusion in monitoring. Additionally, there are practical considerations related to timing, resource availability (including data availability and quality), and opportunities for meaningful engagement with relevant stakeholders, including communities and groups.

The objective of this chapter is to introduce considerations and resources to guide the selection of health topics, health indicators and dimensions of inequality for health inequality monitoring. Building on Chapter 2, this chapter underscores the importance of designing monitoring activities that are relevant and impactful. As a more technical complement to this chapter, techniques for the preparation of disaggregated data, including approaches to defining and constructing health indicators and measuring and categorizing dimensions of inequality, are covered in Chapter 17.

Reviewing background and contextual information

Background information about the context of monitoring and existing evidence should be consulted throughout the steps of inequality monitoring. Extensive knowledge about the population, setting and context is particularly important at the initial planning stages to ensure the proposed monitoring will be meaningful and impactful, and to avoid duplicating previous or ongoing efforts. Reviewing background and contextual information entails consulting with a wide range of stakeholders (see Chapter 4) and reviewing existing evidence from previous qualitative and quantitative analyses. Box 3.1 outlines various approaches to synthesizing evidence. See Chapter 24 for more about how

BOX 3.1. **Evidence synthesis approaches**

The following descriptions are adapted from *Evidence, policy, impact: WHO guide for evidence-informed decision-making (1)*:

- Evidence and gap maps are systematic evidence synthesis products that display the available evidence relevant to a specific research question. They are used to identify gaps that require filling with new evidence. They may support efforts to assemble collections of studies for review, and increase the discoverability and use of studies by decision-makers, research commissioners and researchers.
- Meta-analysis is a statistical method used to combine results from relevant studies. Having larger sample sizes increases the ability to provide reliable estimates.
- Modelling is the use of mathematical equations and existing data and research to simulate real-world scenarios and options.
- Qualitative synthesis is a method for integrating or comparing the findings from qualitative studies. It looks for themes or constructs that exist in individual qualitative studies.
- Rapid review is a type of systematic review in which components of the systematic review process are simplified, omitted or made more efficient to produce information in a shorter period of time, preferably with minimal impact on quality.
- Scoping review is an overview of the research evidence available without producing a summary answer to a discrete research question.
- Systematic review is a review of the evidence on a clearly formulated question that uses systematic and explicit methods to identify, select and critically appraise relevant primary research, and to extract and analyse data from the studies included in the review.

evidence can be integrated with the results of health inequality monitoring to inform further action.

Selecting a health topic for inequality monitoring

WHO offers an expansive definition of health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity *(2)*. Within this understanding of health, there are numerous health topics that constitute potential areas of inquiry for inequality monitoring. A given iteration of health inequality monitoring may, for example, address specific diseases such as HIV, tuberculosis or malaria, or it may pertain to a cross-cutting topic such as the health service delivery, health workforce or measures of well-being. Inequality monitoring may focus on a particular life stage, such as adult health or reproductive, maternal and child health, or it may align with an established set of priorities, such as the Sustainable Development Goals (SDGs) or the WHO General Programme of Work.

Annexes 1 and 2 highlight considerations for inequality monitoring in two topics: social determinants of health (SDH) and health expenditure. Monitoring inequalities in SDH is an important part of global efforts to emphasize tackling inequalities from the causes of the causes. Evidence about SDH, and how they are experienced within a population, can also help to inform the selection of relevant health indicators and dimensions of inequalities for monitoring. Monitoring inequalities in health expenditure is part of ensuring financial protection from catastrophic and impoverishing out-of-pocket health expenditure (in the case of private out-of-pocket health expenditure) and promoting equity, transparency, accountability and efficiency (in the case of public health expenditure).

SDH are the conditions in which people are born, grow, work, live and age, and people's access to power, money and resources *(3)*. SDH also refer to structural factors such as laws, policies and deeply entrenched practices that are the drivers of those conditions. See Chapter 9 for more on the importance of SDH in understanding and addressing health inequalities.

The selection of a health topic should take into consideration the population and circumstances in which monitoring is conducted. Monitoring might focus on health topics that have specific relevance to a particular population, context or geographical area. For example, Chapter 5 addresses inequality monitoring in lower- and higher-resourced settings, rural and remote settings, refugee and migrant populations, and emergency contexts. The health topic for a given inequality monitoring activity should be articulated by a guiding overarching objective or, depending on the application, a research question. Some monitoring activities may be focused on a single, narrowly defined topic, but other monitoring activities encompass a broader topic or multiple topics. The selected topic (or topics) for health inequality monitoring sets the scene for the selection of health indicators and dimensions of inequality, which are addressed in the subsequent sections of this chapter.

Health indicators

Health indicators provide metrics that can be used to monitor performance, measure results against targets, and assess accountability for a defined health topic. Health indicators may capture different aspects of health status, risk factors, service coverage and the health system *(4)*, as well as determinants of health. Some of the health indicators used to illustrate concepts across chapters of this book include:

- stunting prevalence in children aged under five years (%);
- hypertension among adults aged 30–79 years (%);
- people who have ever tested for HIV and received their test results (%);
- adolescent fertility rate (births per 1000 women aged 15–19 years).

Indicators selected for inequality monitoring should be aligned with the purpose of monitoring and its intended impact, as per the monitoring objective or research question. Indicators should reflect the needs, interests and preferences of stakeholders and knowledge users. Ideally, indicators should have a strong scientific basis and be aligned with what is considered appropriate to the monitoring population and relevant for policy and programme development.

Health indicators used as part of health inequality monitoring must be disaggregated according to a dimension of inequality.

A set of multiple, complementary indicators is often selected for inequality monitoring within a given health topic. Monitoring activities with a narrower focus may involve selecting a more concise set of indicators directly linked to the topic. For example, an exploration of inequalities in COVID-19 vaccination coverage may consider a limited number of indicators related to vaccine receipt or non-receipt and associated barriers and attitudes *(5)*. Monitoring with a broader perspective may encompass a more diverse range of indicators. An assessment aiming to capture inequalities related to COVID-19 more broadly might entail a set of indicators reflecting prevention and control efforts, exposures and outcomes, as well as indicators related to the health system more generally.

Often, consideration is given to ensure numerous indicators are selected that are distinct enough to represent diverse aspects of the topic. Selection of only one or two indicators within a topic can lead to perverse incentives – that is, too much attention and resources may be devoted to addressing a narrow aspect of the topic, without due consideration of the wider health or social context. In this case, actions to improve health and reduce inequality may hit the target but miss the goal.

WHO Monitoring, Evaluation and Review Framework

The WHO Monitoring, Evaluation and Review Framework organizes health indicators into four components: inputs and processes, outputs, outcomes and impacts *(6, 7)*. These components are described further in Box 3.2. Recognizing the larger aspiration of improving population health outcomes, the components present a continuum along which aspects of the health sector can be evaluated to identify successes and challenges (Figure 3.1).

BOX 3.2. Components of the WHO Monitoring, Evaluation and Review Framework

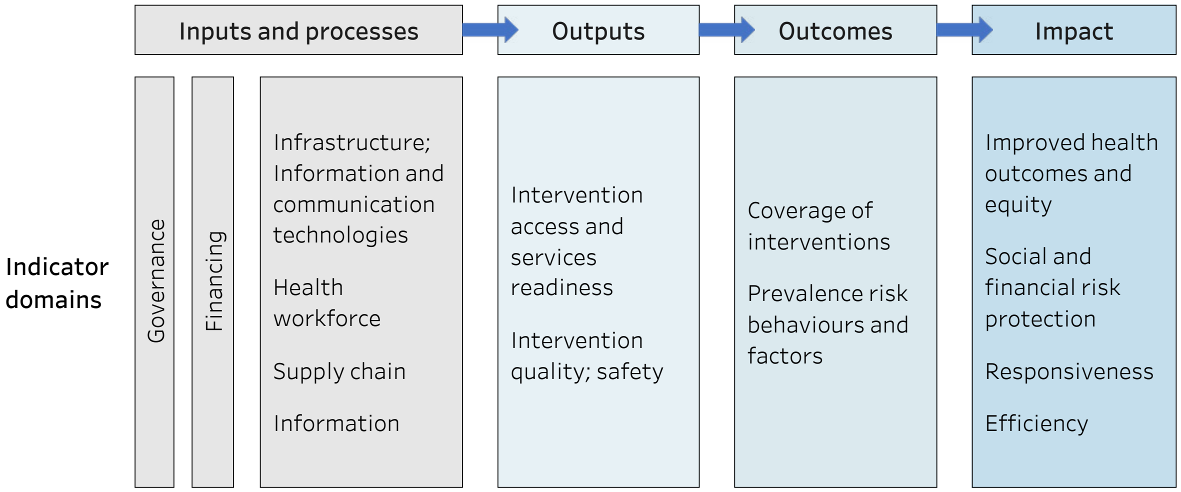
- Input and process indicators: input indicators measure human and financial resources, physical facilities, equipment and operational policies that enable programme activities to be implemented. This includes health financing, health workforce, health infrastructure, health information and communication technologies, and governance. Process indicators measure programme activities and outputs (direct products or deliverables of the activities). They include supply chain and information indicators. Together, measures of activities and outputs indicate whether the programme is being implemented as planned (e.g. health workforce training, constructing a health facility, process of registering births and deaths) *(4, 8)*.

- Output indicators: these measure the results of a process in terms of service access, availability, quality, safety and health security *(4, 8)*.

- Outcome indicators: these measure whether the programme is achieving the expected effects or changes in the short, intermediate and long term. Some programmes refer to the longest-term or most distal outcome indicators as impact indicators. This usually includes coverage of interventions, risk factors and behaviours *(4, 8)*.

- Impact indicators: these measure long-term outcomes that programmes are designed to affect, including decreases in mortality and morbidity *(4, 8)*.

FIGURE 3.1. WHO Monitoring, Evaluation and Review Framework



Source: derived from World Health Organization *(6)*.

Indicators of inputs and processes are broad, cutting across many parts of the health sector. Although inputs and processes can be scarcely correlated with health outcomes (e.g. because different populations face different burdens of disease), these condition an environment that will be conducive or inimical to health improvements, hence the importance of measuring them.

Output indicators tend to be more specific to a particular health topic and more responsive to changes in the health sector. Outputs, as well as inputs and processes, reflect the actions – and their immediate consequences – needed to achieve the desired improvement in outcome inequalities. These actions, however, act through complex pathways and do not always have a direct or intended effect on outcomes.

Outcome indicators, like output indicators, pertain to specific health topics. They capture aspects of programmes that may be strongly correlated with population health outcomes.

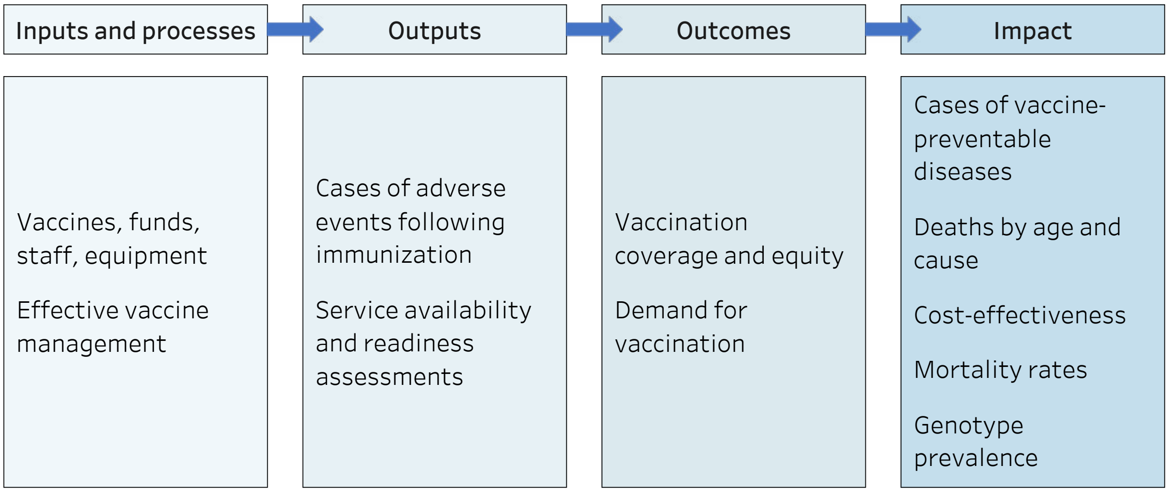
Impact indicators, which may be slower to respond to policy, programme and practice changes, are ultimately what matter, because they measure improvement in the health of a population.

Figure 3.2 shows an example set of indicators across the four components that could be used to monitor inequalities in immunization programmes. In some applications of health inequality monitoring, it may be useful to select health indicators across all four components to obtain a comprehensive understanding of the situation. Other applications of monitoring, however, may not entail the use of indicators across all components.

Tracer and composite indicators

When monitoring a broad health topic, the use of tracer or composite indicators may be applicable. A tracer indicator is chosen as an example to represent a health topic because the indicator and the topic are strongly associated. Tracer indicators are straightforward to understand and report, but they may not be representative of a broader topic, especially if special efforts are dedicated to a specific intervention or programme simply because it is being monitored (i.e. perverse incentives). Relatedly, proxy indicators are those that stand in for another indicator

FIGURE 3.2. **Example of a set of indicators applicable to monitoring inequalities in immunization**



Source: derived from World Health Organization *(9)*.

or topic that is difficult to measure or for which data are limited.

Composite indicators combine multiple indicators, sometimes across different health topics, into an index, generating an overall picture of the health topic. Composite indicators are useful to summarize information about a health topic and make comparisons between countries and over time, but they tend to be complex to report and understand. Additionally, problems with any one component of a complex indicator may introduce bias or render the index meaningless *(10)*. For more on constructing composite health indicators, see Chapter 17.

Box 3.3 provides examples of tracer, proxy and composite indicators for the topic of reproductive, maternal, newborn and child health.

Global indicator lists

Monitoring activities across different levels serve different purposes, which are reflected in the selection of health indicators. Global monitoring frameworks of recommended universal indicators are a good starting point for selecting indicators with relevance across settings. The indicators included in global monitoring frameworks reflect common metadata – that is, technical specifications for how the indicator is defined and calculated. Using an indicator with a standardized universal definition can facilitate benchmarking at later stages of monitoring, because other populations may have comparable data about the indicator. Box 3.4 contains examples of global health indicator lists.

In some cases, context-specific health indicators may be appropriate to reflect the unique circumstances of the monitored population. For example, universal health indicator definitions may be adapted for enhanced relevance within a local context, or new indicators may be developed to reflect a specific priority. For more information about defining and constructing indicators using universal and context-specific indicator definitions, see Chapter 17.

Dimensions of inequality

Dimensions of inequality, sometimes termed equity stratifiers, refer to the criteria upon which population

BOX 3.3. Examples of tracer, proxy and composite indicators

A frequently used tracer indicator of health service coverage in reproductive, maternal, newborn and child health is the coverage of births attended by skilled health personnel. Higher coverage of skilled birth attendance is understood to be associated with better reproductive, maternal, newborn and child health service coverage more generally. Chapters 19–21 on summary measures of health inequality feature this indicator in several examples.

An example of a proxy indicator used in childhood immunization is pentavalent vaccine coverage, which provides protection from five diseases and is typically administered to infants at six, 10 and 14 weeks of age. It is used as a proxy for access to routine immunization services, and it can be used to estimate the number of "zero-dose children" who have not received their first dose of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine *(11)*.

An example of a composite indicator relevant to reproductive, maternal, newborn and child health is the composite coverage index *(12)*. This is a weighted score reflecting the coverage of eight interventions along the continuum of care: demand for family planning satisfied (modern methods); antenatal care coverage (at least four visits); births attended by skilled health personnel; Bacillus Calmette–Guérin (BCG) immunization coverage among children aged one year; measles immunization coverage among children aged one year; immunization coverage with a third dose of the DTP vaccine among children aged one year; children aged under five years with diarrhoea receiving oral rehydration therapy and continued feeding; and children aged under five years with pneumonia symptoms taken to a health facility.

Another example of a composite indicator is the universal health coverage service coverage index *(13)*. This is made up of 14 indicators across a wide selection of essential health services in four areas: reproductive, maternal, newborn and child health; infectious diseases; noncommunicable diseases; and service capacity and access.

BOX 3.4. Examples of global health indicator lists

The following are examples of global lists of health indicators, spanning different topics:

- The WHO *Global reference list of 100 core health indicators* compiles universal indicators and corresponding definitions related to health status, risk factors, service coverage and health systems *(4)*. The indicators reflect current public health priorities for global monitoring. The initial list was published in 2015 and updated in 2018.

- The *Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development* contains over 230 unique indicators that correspond to the 17 goals and 169 targets; 28 indicators pertain to the health goal *(14)*. The Framework is accompanied by a list of desirable dimensions of inequality by which to disaggregate each indicator.

- The WHO *Operational framework for monitoring social determinants of health equity* specifies a menu of indicators for monitoring social determinants of health, spanning six domains: economic security and equality; education; physical environment; social and community context; health behaviours; and health care *(15)*. See Chapter 9 for more on the Operational Framework.

BOX 3.4. *continued*

- The WHO *Primary health care measurement framework and indicators* contains a menu of indicators to track and monitor progress in strengthening primary health care-oriented health systems as an accelerator towards universal health coverage and the SDGs *(16)*. Some indicators are specified for global monitoring. National and subnational policy-makers and planners can choose a subset of indicators from the menu based on consideration of respective country contexts.
- The WHO Mother and Newborn Information for Tracking Outcomes and Results Online Indicator Toolkit is a database of 167 core, aspirational and optional indicators related to maternal and newborn health *(17)*.
- The Indicator Registry is a central database of information for indicators used to track the HIV epidemic across global, regional and national levels *(18)*. It includes universal definitions and indicators endorsed by a wide range of multilateral agencies and international organizations, including the Global Fund to Fight AIDS, Tuberculosis and Malaria, the Joint United Nations Programme on HIV/AIDS, the United Nations Children's Fund, the United States President's Emergency Plan for AIDS Relief and WHO.

subgroups are categorized for health inequality monitoring. These subgroups serve as the basis of comparison for health inequality analysis. Some of the most used dimensions of inequality applicable across many health topics and populations include:

- demographic dimensions, such as age and sex;
- socioeconomic dimensions, such as economic status and education level;
- geographical dimensions, such as urban or rural place of residence and subnational region.

> Health inequalities are described according to the selected dimension of inequality, such as economic-related inequalities in health or inequalities in health by sex (noting that economic inequality and sex inequality are distinct concepts – see Chapter 1).

There are a multitude of other dimensions that may be applicable for health inequality analyses, depending on the context and data availability, including caste or tribe, disability status, ethnicity or race, languages spoken, migratory status, occupation, religion, and sexual orientation and gender identity. The PROGRESS-Plus framework summarizes dimensions of inequality that are commonly applied in inequality studies (Box 3.5).

> Data on health or determinants of health that are specific to population subgroups are termed disaggregated health data.

There are several factors to consider when selecting dimensions of inequality for a given health inequality monitoring activity. The most relevant dimensions are those that are likely to reflect unfair differences in health between subgroups that could be corrected by making structural changes to policies, programmes and institutional practices, or by shifting harmful social norms and relations. For example, for certain diseases, comparing health outcomes across age groups may be indicative of the natural progression of the disease rather than an unfair and remediable inequality. If, however, monitoring seeks to explore

BOX 3.5. PROGRESS-Plus framework

The acronym PROGRESS was first proposed in 2003 by Evans and Brown in an exploration of equity considerations related to road traffic crashes *(19)*. The acronym captures some of the most common dimensions of inequality applicable to health inequality monitoring: place of residence; race/ethnicity/culture/language; occupation; gender/sex;[1] religion; education; socioeconomic status; and social capital.

The acronym was subsequently expanded to PROGRESS-Plus to capture additional context-specific dimensions such as age, disability, immigration/citizenship status, insurance status and sexual orientation *(20)*.

[1] The PROGRESS acronym includes gender and sex together as a matter of convention. These are, however, distinct concepts with different implications for measuring and acting upon inequalities in health.

age-related discrimination in access to essential health services, age would constitute an appropriate dimension. Likewise, health differences identified on the basis of sex (sex-related inequalities in health) may reflect biological differences or may stem from the interaction between sex and gender (i.e. the socially constructed norms, roles, behaviours and relations among and between boys, gender diverse people, girls, men and women). See Box 3.6 for more on gender inequality and discrimination.

> Understanding how health indicators vary across population subgroups – that is, how they are equal or unequal – leads to questions such as: Why do differences exist? What are their root causes? Are they justified?

The selection of dimensions of inequality should consider whether it is relevant to the corresponding health topic and indicator. In some cases, certain

BOX 3.6. Gender inequality and discrimination

Gender inequalities and discrimination hinder progress to fulfil everyone's right to health *(21)*. Gender norms, roles and relations influence, and are influenced by, individual identity, interpersonal relationships, institutional structures and institutions. Harmful gender norms related to notions of masculinity or femininity in different cultures can negatively affect health and well-being. Women and girls are often disproportionately impacted by these, resulting in significant barriers to accessing health information and services throughout the world. Gender equality refers to equal capacities and opportunities to access and control all social, economic and political resources (e.g. health services, education, voting rights) and includes protection under the law to ensure such access. Gender equity refers to fairness and considers people's different needs to achieve gender equality. This may mean different treatment is needed to ensure equality of opportunity.

Addressing gender-based discrimination and harmful gender norms, along with other intersecting forms of discrimination related to ethnicity, socioeconomic status, disability, age, geographical location, sexual orientation and other factors, remains a critical aspect of enhancing health, access to care and health-care experiences of all people.

dimensions may not be applicable – for example, disaggregating data about the use of maternal health services by the sex of the individual or sex of the child is not relevant. Likewise, there are certain limitations when selecting dimensions of inequality for monitoring social determinants of health indicators (see Annex 1). Box 3.7 presents general considerations for selecting relevant dimensions of inequality that correspond to the four components of the Monitoring, Evaluation and Review Framework, highlighting how data availability is another key consideration.

Assessing how SDH are experienced by populations can help to inform the selection of relevant dimensions of inequality. The selection of dimensions of inequality should involve consultation with relevant stakeholders, such as knowledge users and affected communities, to understand and account for their interests and needs. Reviewing global initiatives and existing monitoring reports and recommendations can give a sense of relevant dimensions of inequality for a particular topic or population, and the potential for inequality monitoring to generate impact. See Box 3.8 for an example of monitoring age-related inequality in HIV, and how this can be aligned with priorities of relevant policies and programmes.

Recommended dimensions of inequality for global monitoring

Ideally, inequalities should be analysed and reported using all relevant dimensions of inequality for which data are available. PROGRESS-Plus offers a general framework of dimensions of inequality (see Box 3.5), but other guidance provides more concrete suggestions for different applications of inequality monitoring. For example, World Health Assembly Resolution 62.14 calls on Member States to “monitor and measure the health of national populations, with disaggregated data such as age, gender, ethnicity, race, caste, occupation,

BOX 3.7. Dimensions of inequality corresponding to the four components of the Monitoring, Evaluation and Review Framework

The following considerations are relevant when selecting dimensions of inequality across the four components of the Monitoring, Evaluation and Review Framework.

Input and process indicators related to health financing, governance and information are sometimes available only at the national level, in which case they would not be applicable when monitoring within-country health inequality. If indicators are available at the subnational level, geographical dimensions of inequality may be particularly relevant (e.g. health workforce indicators may be disaggregated by district).

Output indicators, such as indicators related to the availability, accessibility, and quality of health service, are often disaggregated by geography along with other setting-specific relevant dimensions (e.g. public- versus private-sector facilities).

Outcome indicators, such as health intervention coverage, and impact indicators, such as health status, can often be disaggregated by four or five common inequality dimensions (e.g. age, economic status, education level, place of residence or sex) plus relevant setting-specific inequality dimensions. The selection of inequality dimensions depends on the data source and data availability. When using data from household surveys, numerous inequality dimensions can be used. For administrative or facility data sources, the availability and accessibility of data about inequality dimensions may be more limited.

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BOX 3.8. Monitoring age-related inequality in HIV

Global HIV programmes often specify young people aged 15–24 years as a high-priority population. There are several initiatives and campaigns dedicated to advancing the interests of this group, demonstrating the importance of monitoring age-related inequalities and how age groupings for HIV have been previously categorized. The Millennium Development Goals included a focus on HIV in young people, with indicators to track the prevalence of HIV among people aged 15–24 years (indicator 6.1), and comprehensive correct knowledge of HIV among people of this age group (indicator 6.3) *(22)*. The WHO *State of inequality: HIV, tuberculosis and malaria* report included a section dedicated to young people aged 15–24 years, including further age disaggregation as people aged 15–19 years and 20–24 years, and disaggregation by sex, education level and place of residence *(23)*. The monitoring specifications for the SDG indicator 3.3.1 (related to new HIV infections) specifies data disaggregation by age, including groupings for 1–14 years, 15–24 years, 25–49 years, and 50 years and over *(24)*.

The intended impact of inequality monitoring is another key consideration when selecting dimensions of inequality. Monitoring age-related inequalities in HIV may be part of efforts to advocate for greater resource allocation for programmes targeting young people. In this case, highlighting the situation in young adults relative to other population groups might be particularly impactful. Alternatively, monitoring may be aiming to explore the burden of HIV during infancy and childhood, or to show variations in service access throughout adulthood.

education, income and employment where national law and context permits so that health inequities can be detected and the impact of policies on health equity measured" *(25)*. The United Nations General Assembly has stated the importance of considering cross-cutting dimensions of inequality for monitoring SDG indicators, including, "where relevant, income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics, in accordance with the Fundamental Principles of Official Statistics" *(26)*.

In addition to these global recommendations, other dimensions of inequality are important within certain contexts. Disaggregated data may be useful to expose how minority subgroups experience health in comparison with the larger population. For example, indigeneity is a relevant inequality dimension in many countries, including Australia (Box 3.9). Approaches to define, measure and categorize inequality dimensions may also be context-specific – and even within a single setting, there is often no standard agreement. For example, relevant categories for caste, ethnicity and race vary from country to country, and there are different perspectives on how these are defined and understood *(31)*. See Chapter 17 for more on the measurement and categorization of inequality dimensions, including indices that combine multiple dimensions of inequality.

Exploring intersectionality

Recognizing that people have multiple characteristics, experiences and situational factors, a single dimension of inequality may not always be sufficient to meaningfully capture inequality within a population. Intersectionality is a concept describing how interconnected dimensions of inequality (especially race/ethnicity, income/wealth and gender) interact to create different experiences of privilege, vulnerability or disadvantage *(32)*. For example, although health experiences may differ between urban and rural populations, there may also be inequalities in health between rich and poor subgroups in urban areas. Moreover, ethnic minority groups in poor urban areas may be particularly disadvantaged when it comes to health.

BOX 3.9. Indigeneity as a dimension of inequality in Australia

Indigeneity is a relevant dimension of inequality in Australia. Data disaggregated by indigenous status permit analysis of inequalities between Aboriginal and Torres Strait Island peoples versus non-Indigenous peoples. As of 2021, a minority of the total population of Australia, about 3.8%, were Aboriginal and Torres Strait Island peoples *(27)*. There are entrenched health inequalities between non-Indigenous Australians and Aboriginal and Torres Strait Island peoples, which are evident when data for these two groups are compared:

- A higher percentage of non-Indigenous children were born at a healthy birthweight than Aboriginal and Torres Strait Islander children, with a gap of 4.6 percentage points (94.2% versus 89.6%, respectively) *(28)*.
- A review of adolescent health and well-being reported that almost a third of Indigenous adolescents experienced psychological distress, which was twice the non-Indigenous rate, with marked inequalities also evident across other aspects of health *(29)*.

Recognizing the complex factors underlying these inequalities and the urgent need for collaborative, remedial actions, the Coalition of Aboriginal and Torres Strait Islander Peak Organisations and all the Australian governments endorsed the National Agreement on Closing the Gap in 2020 *(30)*.

In the context of health inequality monitoring, double or multiple disaggregation is a starting point for exploring intersectionality *(33)*. Double disaggregation involves applying two dimensions of inequality simultaneously, and multiple disaggregation applies more than two dimensions. Applying double or multiple disaggregation helps to account for experiences of compounding forms of inequality that, when combined, can generate increased risk. Box 3.10 demonstrates the application of double disaggregation to explore health inequalities in urban and rural areas by race/ethnicity and sex. For more on the preparation of data according to multiple dimensions of inequality, see Chapter 17. Chapter 25 addresses the use of multiple regression analysis to explore intersectionality.

Example: selecting topics, health indicators and dimensions of inequality

The WHO report *State of health inequality: Indonesia* was developed with the overall aims of quantifying the magnitude of health inequalities across health topics and dimensions of inequality, and identifying priority areas for action and their policy implications *(36)*. The process of preparing the report brought together a dedicated group of stakeholders across several institutions, who were involved in the selection of relevant health topics, health indicators and dimensions of inequality.

The report analysed inequality across 11 health topics: a public health development index and sub-indices; reproductive health; maternal, newborn and child health; childhood immunization; child malnutrition; child mortality; infectious diseases; environmental health; noncommunicable diseases, mental health and behavioural risk factors; disability and injury; and health facilities and personnel. National priorities and data availability played a role in the selection of the topics.

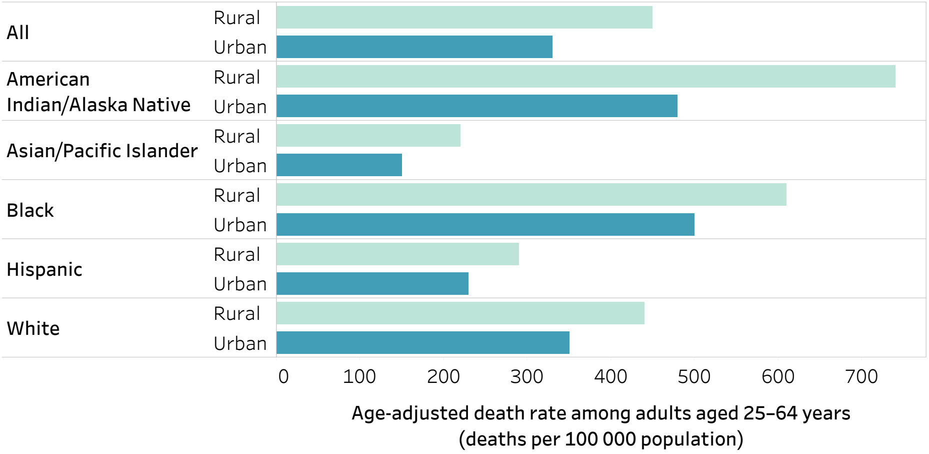
Across the topics, 53 relevant indicators were identified, considering data availability, relevance and importance to the health topic, and representation of diverse aspects of the

BOX 3.10. Examples of double disaggregation

The following examples demonstrate data disaggregated by two dimensions of inequality as a means to deepen explorations of place of residence inequalities.

Figure 3.3 shows age-adjusted death rates among adults in counties in the United States of America, which are classified as urban or rural. The data are further disaggregated by race/ethnicity *(34)*. The urban/rural disaggregated data demonstrate higher death rates in rural counties. Double disaggregation by race/ethnicity, however, shows that this gap existed for all subgroups, with the largest rural/urban gap among the American Indian/Alaska Native subgroup.

FIGURE 3.3. Age-adjusted death rates per 100 000 population among adults aged 25–64 years, by rurality of county of residence and race/ethnicity, United States of America



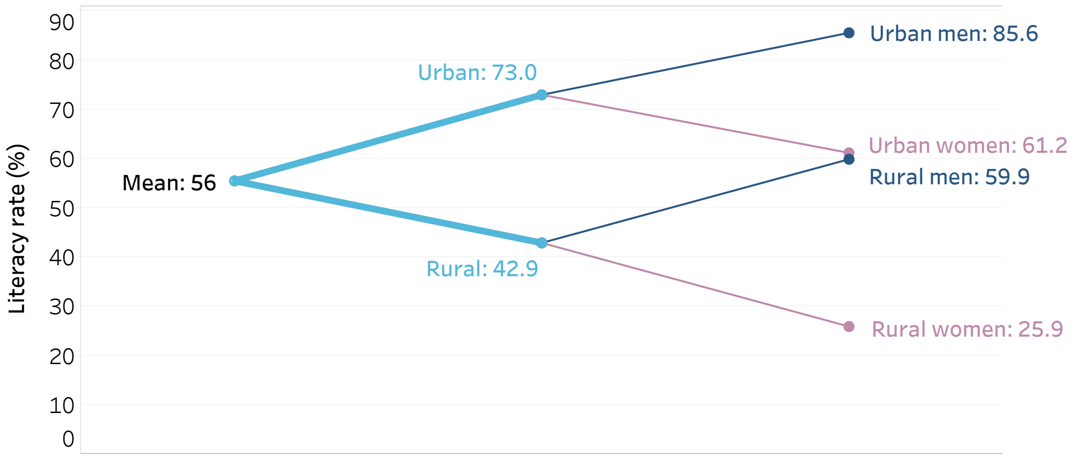
Race/ethnicity groupings, including the classifications and their names, were retained from the source.

Source: Probst, Eberth and Crouch *(34)*, with data from 2017.

Figure 3.4 provides data about literacy rates among people in urban and rural area in Liberia, additionally disaggregated by sex. Although literacy rates were higher in urban than rural areas overall – and higher among men than women within each area – double disaggregation demonstrated a gap of 59.7 percentage points between urban men and rural women. It was also apparent that urban women and rural men reported similar literacy rates. For more on health inequality monitoring considerations in rural and remote areas, see Chapter 5.

BOX 3.10. *continued*

FIGURE 3.4. Literacy rates, by place of residence and sex, Liberia



Literate describes people who attended secondary school or higher or can read a whole sentence or part of a sentence.
Source: United Nations System Chief Executives Board for Coordination *(35)*, with data from the 2007 Demographic and Health Surveys.

topic. For inclusion in the report, data about the health indicator had to be available nationally, with disaggregated data available by at least one relevant dimension of inequality. The relevance and importance of the indicator were determined through consultations with health topic experts. Consideration was given to the importance of the indicator in the context of global initiatives as well as their importance in the country context of Indonesia. As a result, some of the health indicators reflect global definitions (e.g. child malnutrition and child mortality indicators), and other indicator definitions were adapted or constructed specifically for the Indonesian context (e.g. the public health development index).

A variety of dimensions of inequality were featured in the report, including age, economic status, education, employment status, occupation, place of residence, sex and subnational region. The selection of dimensions of inequality was informed by data availability and the relevance to the health topic and indicator. For example, inequality related to subnational region was explored for all topics, as these data were widely available and applicable. Employment status of the household head was applied to a smaller subset of indicators, mainly related to child malnutrition.

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4

Health inequality monitoring: a shared responsibility

Overview

Health inequality monitoring is a shared responsibility, involving a range of stakeholders from global and regional levels to national, subnational, community and individual levels. Monitoring practices across these different spheres are complementary. Although they share many similarities in their approach and are united in the larger purpose of advancing health equity, they may reflect different purposes, with their own requirements, considerations and contributions. Global inequality monitoring offers a broad view of the situation, permitting cross-national comparisons and assessments of trends. As the scope of monitoring becomes more localized across regional, national and subnational levels, there are opportunities to explore context-specific factors and priorities more deeply.

Although specialized skills are often required to carry out the technical steps of health inequality monitoring (especially preparing and analysing data), wider engagement with a variety of stakeholder groups adds value across many other stages of health inequality monitoring:

- Policy-makers and implementers often have a strong role in initiating and overseeing inequality monitoring, including helping to establish the scope for monitoring, ensuring the availability of resources, and driving actions informed by the results of monitoring.

- Research and technical institutes are instrumental in developing and refining methodological approaches, supporting capacity-building for monitoring, and conducting analyses.

- Individuals from civil society and nongovernmental organizations, community members and people with lived experiences make diverse and important contributions, and may have a leadership role in defining the scope of what is to be monitored, collecting and analysing data, and pursuing the meaningful interpretation and application of findings. They also play a role in holding governments and other stakeholders accountable to promises and commitments and advocating for the needs of communities to decision-makers.

- Health professionals, including community health workers and public health professionals, have a role to play across the steps of inequality monitoring, because they bring important perspectives to agenda-setting activities, facilitate data collection activities, and collaborate on the development and deployment of actions to advance health equity.

Together, collaborations involving many stakeholders can help to identify and address inequalities in a manner that upholds accountability and is action-oriented.

This chapter explores the different levels at which health inequality monitoring is conducted and the roles and responsibilities of stakeholders working across these levels, underscoring the shared responsibility for health inequality monitoring. The objective of this chapter is to describe the purpose and contributions of health inequality monitoring across global, regional, national and subnational levels, highlighting the range of stakeholders involved in monitoring. It also addresses responsibilities related to health data governance, including data security considerations.

From global to local: purpose and contributions of inequality monitoring across various levels

At the global level, health inequality monitoring makes comparisons between multiple countries or regions. Such monitoring may be based on overall national or regional averages, but in the context of this book, between-country comparisons of the state of within-country inequality are of particular interest (see Chapter 2). Regional inequality monitoring adopts a narrower scope, comparing the state of inequality between countries within a world region. Global and regional levels may also play a role in identifying and addressing the needs of people who are stateless or mobile or who do not have legal rights in countries (see Chapter 5). At the national level, comparisons are derived from subgroups of national populations. Subnational monitoring focuses on inequalities within or between one or more provinces, states, districts, municipalities, communities or other subnational populations.

Global level

Global actors have an instrumental role in establishing mandates and support for health inequality monitoring activities through high-level political commitments and resource mobilization. When global in scope, inequality monitoring is often conducted to identify larger trends and patterns, track progress on global goals (such as the Sustainable Development Goals, SDGs), and inform high-level resource allocation (e.g. enabling targeted responses to global crises). These functions may be motivated by the priorities set out by global agencies, such as Gavi, the Vaccine Alliance, the Global Fund to Fight AIDS, Tuberculosis and Malaria, and United Nations agencies. It can also be instrumental for identifying priority settings of interest for further inequality monitoring (see Box 4.1). Benchmarking at the global level can promote a broader understanding of the state of inequality within a particular country and facilitate knowledge-sharing between settings.

Because inequality monitoring at the global level entails comparisons between countries or regions, it requires alignment in terms of how health indicators and dimensions of inequality are defined. Global monitoring standards, definitions and frameworks are particularly useful to ensure comparability across settings (see Chapter 3). Monitoring at the global level may rely on advanced techniques to consolidate

BOX 4.1. Assessing the global state of inequality in childhood immunization

The WHO report *State of inequality: childhood immunization* characterized within-country inequalities in 69 low- and middle-income countries with comparable data *(1)*. The findings of the report demonstrated large inequalities in national immunization coverage between countries, with many countries reporting high levels of within-country inequality by economic status and mother's education level. Based on this global analysis, 23 priority countries were identified for further analysis, featuring more detailed country-level disaggregated data across relevant dimensions of inequality *(1)*. A follow-up report *Explorations of inequality: childhood immunization* probed more deeply into the factors associated with childhood immunization across a subset of 10 priority countries *(2)*.

existing data, carry out targeted data collection (e.g. through multicountry household survey programmes – see Chapter 12), conduct modelling exercises, or apply advanced methods of inequality analysis. Depending on the target audience, reporting at the global level may involve high-level reports, technical publications, dissemination events, presentations and dashboards. For example, the WHO World Health Statistics report series is an annual compilation of health and health-related indicators across all countries, including inequality analyses for selected topics *(3)*. Global conferences and meetings can further enhance implementation and experience-sharing.

WHO plays a central role in directing and coordinating on international health work. It has an active programme dedicated to health inequality technical analysis and support, scientific collaboration and knowledge generation *(4)*. These activities are supported by numerous multilateral agencies, research institutions and development partners working across health and other sectors. For example, the WHO collaborating centre the International Center for Equity in Health, based at the Federal University of Pelotas in Brazil, undertakes activities related to providing technical assistance on health inequality monitoring for WHO Member States *(5)*.

Regional level

Although the general purposes and requirements of regional inequality monitoring are similar to those of global monitoring, regional monitoring has the scope to be more sensitive to regional needs and priorities. In this way, inequality monitoring at the regional level may be done against a backdrop of commonalities related to language, culture and geography. Inequality monitoring at this level can reflect specific health topics and forms of disadvantage that are relevant across countries of the region but not necessarily on a global scale. For example, migration, conflict, natural disasters and disease outbreaks may affect multiple countries, and coordinated data collection and analysis at the regional level may be required.

Regional supports for monitoring activities may be needed to bolster country capacity, especially when emergency or crisis situations hinder the availability of more localized resources for monitoring. Against a common regional backdrop, benchmarking at a regional level may be particularly useful for deriving lessons from the experiences of other countries and exploring the impact of national-level policies or conditions.

There are active health inequality monitoring initiatives across all six WHO regions. Collaborations specific to certain health topics may be instrumental for promoting and conducting health inequality monitoring within regions. Box 4.2 provides examples of regional-level health inequality monitoring initiatives.

National level

National-level inequality monitoring may be conducted as an extension of global and regional monitoring, or it may reflect separate priorities specific to a country. The purpose of inequality monitoring at the national level may be directly linked to accountability and action mechanisms present in government, the health sector, health programmes or development initiatives. When conducted regularly, national inequality monitoring serves an essential public health function. For example, it can provide evidence about the impact of national policies, programmes and practices (including budgets and resource allocations), which may help to inform subsequent changes to advance health equity. Ideally, regular health inequality monitoring should be integrated into national health information systems (see Chapter 6).

The specifications for national health inequality monitoring activities can be selected to closely reflect the national context *(10)*. National decision-makers and technical experts have a role in identifying health topics, indicators and population subgroups that are of national importance, aligning with global metrics where relevant. In terms of data collection, governments may commission regular or ad hoc surveys, studies or monitoring processes and have established routine health information systems (sometimes in partnership with donor agencies). National governments may make disaggregated data publicly available for wider use, and civil society organizations may compile data in population-based observatories or reviews. National agencies may carry

BOX 4.2. Examples of regional-level health inequality monitoring initiatives

The WHO European Region Health Equity Status Report Initiative promotes and supports policy action and commitment for health equity and well-being in the European Region *(6)*. Its aims include setting a baseline for monitoring health inequality within Member States and setting an agenda for scaling up and enabling action on health equity within countries. The initiative encompasses a WHO European health equity dataset, policy guidance and other supporting tools *(7)*.

As part of its efforts to monitor the health-related SDG 3, the Pan American Health Organization (PAHO) has developed an interactive dashboard tool for equity monitoring and analysis across the region *(8)*. The toolkit provides evidence about SDG 3 indicators across the region, enabling comparisons of between- and within-country inequality. For more on inequality monitoring and the SDGs, see the example later in this chapter.

The Every Woman Every Child initiative for the Latin America and Caribbean region has convened a health inequality monitoring focused coalition of United Nations agencies and key stakeholders, including the Inter-American Development Bank, the Joint United Nations Programme on HIV/AIDS, the Latin American and Caribbean Neonatal Alliance, the Latin American and Caribbean Regional Task Force for the Reduction of Maternal Mortality, PAHO, the United Nations Children's Fund, the United Nations Population Fund, the United States Agency for International Development, UN Women and the World Bank *(9)*. This coalition has created a data dashboard to monitor regionally prioritized indicators aligned with the global Survive, Thrive and Transform objectives, ensuring they have local relevance. Alongside this, a compendium of tools and resources has been created to support action on intermediary and structural determinants of health, with cascades of training on understanding and addressing inequalities, accessible to local stakeholders in their local languages.

out inequality analyses based on national priorities and needs, ensuring representation of population subgroups that may be left behind. Depending on the technical capacity available at the national level, analyses may be somewhat rudimentary or incorporate innovative analytical approaches. Box 4.3 contains examples of health inequality monitoring activities at the national level.

Subnational level

Subnational-level monitoring is characterized by the ability to closely reflect local priorities, contexts and knowledge systems. It can incorporate health concerns, environmental conditions or forms of disadvantage that are pertinent within a specific locality. It can be conducted within a single subnational area, such as a province or state, health district or community, with the purpose of generating a granular understanding of the local state of inequality. It may also be harmonized across multiple subnational areas, with the purpose of feeding into national-level monitoring. Due to the close proximity of subnational monitoring to on-the-ground service delivery and programme implementation, it has the

BOX 4.3. Examples of national-level health inequality monitoring activities

Indonesia undertook an extensive process involving a range of national stakeholders to build capacity for health inequality monitoring and institutionalize it as part of the country health information system *(11)*. A series of workshops, technical meetings and other activities in 2016–2017 resulted in the country's first national report on the state of health inequality *(12)* and numerous peer-reviewed manuscripts on health inequality in Indonesia *(13)*. Sustained political will across all levels of administration and leadership within the country, along with the participation and collaboration of stakeholders and concurrent development of technical tools, contributed to the success of this endeavour *(11)*. For more on the selection of topics, health indicators and dimensions of inequality for the national state of health inequality report, see Chapter 3.

In Malaysia, the Department of Statistics maintains a dashboard that catalogues, visualizes and analyses disaggregated data on health indicators, ensuring data are publicly available *(14)*. A report published by the non-profit-making organization Khazanah Research Institute in 2020 presents inequalities related to social factors (income and work) and their relationship with health outcomes *(15)*. This report adds to a growing body of literature on inequalities in health outcomes, which draws from national surveys and administrative data. Other analyses of health inequalities in Malaysia are conducted at the national and subnational levels, driven by emerging policy needs.

Canada endorsed the Rio Political Declaration on Social Determinants of Health in 2012, pledging to take action to promote health equity. Strengthening the capacity to monitor and report on health inequalities was recognized as a critical foundation for achieving meaningful progress towards this goal. The Pan-Canadian Health Inequalities Reporting Initiative supports Canada's pledges under the Rio Declaration. Based on a framework developed by WHO, the Initiative aims to strengthen the measurement, monitoring and reporting of health inequalities in Canada. It does this by improving access to data and developing resources to improve knowledge of health inequalities. Data tools and evidence products from the Initiative can be accessed by using the online interactive Health Inequalities Data Tool. This contains over 100 indicators of health status and health determinants, stratified by a range of population groups meaningful to health equity *(16)*.

The Office for National Statistics in the United Kingdom of Great Britain and Northern Ireland collects and publishes statistics and conducts the census in England and Wales every 10 years. Inequalities in health are monitored by measures of socioeconomic status *(17)*. For example, it has reported on life expectancy, mortality rates by cause, healthy life expectancy and disability-free life expectancy using slope index of inequality to demonstrate inequalities between deciles of small areas, classified by a national index of deprivation *(18, 19)*.

potential to be highly responsive to local communities in comparison with monitoring conducted at higher levels. To this end, health indicators and inequality dimensions that are defined nationally can be further adapted to reflect the local context and serve as an evidence base for action.

In health systems characterized by a high degree of decentralization (i.e. where a large extent of authority and power over public planning, management and decision-making is afforded to subnational rather than national levels), monitoring at the subnational level can provide evidence on local situations of inequality and inform strategies for targeting activities towards areas of greatest need. Subnational inequality monitoring and evaluation efforts can be a fruitful part of knowledge-sharing between localities. Insight into successes and challenges across one subnational area may impart lessons and inspire action in another area.

Communities and people with lived experiences, community health volunteers and frontline service delivery providers can define the scope of what is to be monitored and how it may be used (e.g. for local action or reporting to other levels), in partnership with civil society organizations. At the local level, monitoring of health services and facilities has occurred, with initiative taken by communities and civil society and, in some cases, by local self-government actors, focused on the needs of populations left behind. In these efforts, outcomes for populations left behind are interpreted in the light of existing norms, standards or guarantees, or in comparison with more advantaged regions or population subgroups (and sometimes tracked over time). Outcomes may be determined by communities, and the data may be collected and owned by communities and used to negotiate with local providers and government actors.

Box 4.4 provides examples of subnational-level health inequality monitoring activities.

BOX 4.4. Examples of subnational-level health inequality monitoring activities

The Canadian province of Québec has developed a strategy and set of indicators to monitor health inequalities at the provincial and health region levels. The system of *Surveillance des inégalités sociales de santé* presents inequality measures for various health indicators. These measures portray the current state of health inequalities and allow ongoing monitoring over time. Information is used to support the development of public health policies and programmes aimed at reducing health inequities *(20)*.

In the United Kingdom of Great Britain and Northern Ireland, the Department of Health and Social Care monitors inequalities in various health measures, including life expectancy, mortality rates, child health, behavioural risk factors and wider social determinants, at each local government administrative level *(21)*. The Health Inequalities Dashboard provides interactive information to monitor progress on reducing inequalities within regions and local authorities in England *(22)*.

Brazil has a longstanding tradition of compiling health and social indicators and monitoring health inequalities. The *Rede Interagencial de Informações para a Saúde* (Interagency Network for Health Information) congregates dozens of governmental, academic and nongovernmental organization stakeholders to select, estimate and publish a large collection of health-relevant estimates at the national and subnational levels. Drawing from a variety of data sources, the data feature indicators across demographic, socioeconomic, mortality, determinants, morbidity, health resources and intervention coverage topic areas. Tackling health inequities is a main priority. Indicators are presented at the national level and disaggregated by subnational region, state, municipality, and other relevant dimensions of inequality such as sex, age, schooling and occupation. A cross-cutting health equity committee is being established to find solutions to act on inequalities *(23)*.

Many societies have a history of community-based or community-led resource management practices, wherein small communities have a prominent role in leading or governing actions to promote health, well-being and other shared priorities *(24, 25)*. In some contexts, these practices continue to exist and evolve, while in other contexts, there are efforts to reclaim or introduce practices, including efforts to increase the voice of the people in matters related to health inequality monitoring (Box 4.5). For more information on community-led monitoring, see Annex 3.

How can health inequality monitoring be a shared responsibility?

When it is institutionalized, health inequality monitoring can add value to policy-making and implementation processes, while also enhancing accountability and participation in society more broadly. At each stage of the health inequality monitoring cycle, and across all levels of monitoring, there are opportunities for sharing roles and enhancing inclusion, accountability and linkages.

> Making health inequality monitoring a shared responsibility puts it on the agenda of a wider set of priorities, and enhances partnerships, collaboration and alignment in service of larger health and development goals. In this way, empowerment, equity and inclusion become not only the subject matter of health inequality monitoring but also part of its very process within and across countries.

To begin with, decision-makers, technical experts and agencies across all levels can carry out priority-setting and use evidence-based and consensus methods to determine what is to be monitored, with appropriate resource mobilization and leadership. Here, communities and civil society actors may

BOX 4.5. **Enhancing community voice for health inequality monitoring**

At all stages of the health inequality monitoring cycle, there is scope for increasing the voice of communities and people with lived experiences, which in turn enhances the rigour, relevance and impact of monitoring.

Political commitments and declarations can create an enabling environment for strengthened participation and community voice. For example, the Civil Society Engagement Mechanism for UHC2030 aims for universal health coverage policies to be inclusive and equitable by ensuring civil society has a voice in the UHC 2030 movement *(26)*. The *State of Commitment to Universal Health Coverage: Synthesis 2023* tracks progress in implementing agreed upon commitments for universal health coverage, drawing mixed-methods data from policy reviews, surveys, global indicator repositories, media sources and country consultations *(27)*. The Global Partnership for Social Accountability aims to expand opportunities for civil society to work with governments, presenting the possibility for deeper engagement around health equity issues and strengthening accountability and improving governance *(28)*.

Measures to uphold collaborative social accountability can increase the impact of participatory spaces and strengthen linkages across levels of the health system, enabling both government directives and grassroots advocacy. For example, in the state of Maharashtra in India, several social accountability tools were rolled out at the local, district and state levels of the health system, including community health service assessments, local meetings with clinic staff, public dialogues, health oversight committees, and autonomous monitoring committees active at multiple levels of the health system *(29)*.

help identify indicators that are meaningful to them – which may be at more local levels of monitoring – while multilateral agencies may furnish guidance on global-level indicators that could align national reform processes to global goals. If the private sector plays a role in these processes, requisite accountability and ethical considerations should be upheld. Based on inputs from a variety of stakeholders, governments may prioritize dimensions of inequality that are relevant at the global level, but also identify what is important in their country context (e.g. race/ethnicity or caste, particular socioeconomic groups or subnational regions), which may align to policy and programme targets for reform.

Governments then play a seminal role in setting up data structures and processes to examine national and subnational inequalities. In many cases, non-state actors in academic institutions, civil society institutions and communities continue to play a critical role in identifying indicators, furnishing data, supporting or enhancing analysis, and supporting knowledge translation.

At the global, regional, national and subnational levels, data-sharing is instrumental to expand the potential for monitoring and promote its impact. Lessons learnt from the COVID-19 pandemic revealed deficiencies in how data are published and used to drive action. Best practices to strengthen the dissemination of data include ensuring data are relevant and comparable over time and between settings; documenting what the data are measuring and the data collection processes; sharing the data frequently and promptly; publishing the data in a stable location; choosing a consistent and reusable data format; and allowing others to reuse the data *(30)*.

Across all levels of monitoring, stakeholders have a shared responsibility to ensure the rights and interests of individuals and communities are upheld. Health inequality monitoring activities should be beneficial and relevant – and not detrimental – to the health and well-being of individuals and communities. This includes adherence to ethical principles for the collection and use of data, including a focus on the common good, solidarity, accountability, trust, and balancing of individual rights with collective interests *(31)*. WHO has issued global guidelines specifically pertaining to ethical issues in public health surveillance, which are summarized in Annex 4 *(32)*.

Health data governance

There is increasing recognition that ownership of and control over data collection processes and the uses of data should lie with the people from whom the data were collected. Fostering community ownership of inequality monitoring may be especially important within communities that have experienced discrimination, marginalization or exclusion, and that may have a profound distrust of systems that reinforce health inequalities.

Data governance refers to a framework or mechanism that builds and maintains trust in data (and the institution producing and holding the data) by managing transparently the access, use and reuse (including matching and linking), quality and security of those data to maximize the net benefits. Data governance frameworks set out the standards, solutions and structures necessary to improve the coordination of the “data journey” from collection to sharing, storage, analysis and use *(33)*.

Elements included in a typical data governance framework include data management, quality, security and privacy, sharing and access, and reporting and analysis. These elements must be supported by a governance or management structure with clearly defined roles and responsibilities.

A comprehensive global set of health data governance principles has been developed to ensure individuals, groups and communities are protected against data-related harm and violations. The global Health Data Governance Principles, developed through collaborative efforts driven by civil society, seek to support the use of digital technologies and data for the public good *(34)*. The principles are clustered around three high-level objectives of protecting people, promoting health value and prioritizing equity. Recognizing the need for global guidance as regions and countries implement tailored health data governance policies and legislation, the principles are intended for use by governments, the private sector, international organizations, civil society and others *(34)*.

Likewise, WHO abides by the WHO Data Principles, which serve as a transparent framework of data governance for the organization (Box 4.6), and data governance is an integral part of the United Nations Secretary-General's Data Strategy *(36)*.

There are also national and subnational efforts to promote responsible and collaborative approaches to health data governance. For example, Box 4.7 highlights data governance principles and framework developed by Indigenous groups in Canada.

BOX 4.6. Health data governance at WHO

WHO developed a set of data principles through an internal consultation process involving staff from across headquarters and regional offices, and in consultation with external experts *(35)*. The five resulting principles are a commitment by WHO to:

- treat data as a public good;
- uphold Member States' trust in data;
- support Member States' data and health information systems capacity;
- be a responsible data manager and steward;
- strive to fill public health data gaps.

BOX 4.7. Health data governance: Indigenous groups in Canada

As part of Canada moving towards reconciliation with Indigenous Peoples, several community-specific data governance principles and frameworks have been developed *(37)*. They include the following:

- The First Nations Principles of Ownership, Control, Access and Possession assert that First Nations have control over data collection processes, and that they own and control how this information can be used. They are the standard approach to First Nations data governance and support data sovereignty *(38)*. Given the diversity within and across First Nations, expression of the principles may vary from one Nation to another, in line with different world views, traditional knowledge and data management protocols.

BOX 4.7. *continued*

- The Inuit Qaujimajatuqangit Framework, representing Indigenous Inuit knowledge, is based on four elements – working for the common good, respecting all living things, maintaining harmony and balance, and continually planning and preparing for the future *(39)*. This approach forms the foundation for wellness in Inuit communities, as does the valuing, preserving and promoting of traditional knowledge.

- The Manitoba Métis principles of Ownership, Control, Access and Stewardship describe how Métis health and wellness information should be collected, accessed and used. The information should be under the ownership and control of the Métis Nation *(40)*. The Métis National Council supports knowledge translation agreements with federal, provincial and territorial governments towards evidence-based interventions that benefit Métis health and well-being.

Data security considerations

As more health data around the globe are digitalized, data security is a growing consideration with regard to health data governance. Data security encompasses the protection of data privacy and confidentiality, while promoting its integrity and appropriate accessibility and utility. Increasingly, strict data protection and cybersecurity laws are put in place to ensure the processing of personal health data – including data used by the public health sector – adheres to core data protection principles *(41)*. The WHO Personal Data Protection Policy, for example, outlines the rules and principles relating to the processing of personal data by or within WHO *(42)*.

Safeguarding the confidentiality of monitoring information on health inequality – and on health in general – is crucial to gain and maintain public trust. Without public trust, many people may not participate in data collection, compromising the value of the efforts. Data custodians and government systems should ensure appropriate access of data coupled with adequate data protection protocols to maximize benefit and reduce harm to individuals and populations.

The Five Safes framework provides a structured approach to managing access to sensitive data and mitigating disclosure risk *(43)*. It covers the following five requirements:

- Safe people: only authorized individuals can access the data, such as people trained in confidentiality protocols and who have signed user agreements.

- Safe projects: data projects must be in the public interest, with a clear rationale for the data collection (i.e. which data are collected and why), the statistical purpose and the methodology.

- Safe data: data are de-identified in proportion to their use, with personal identifiers removed, as required. For example, source data may need to be identifiable for data validation and linkage under controlled conditions, but open-source data files must be completely anonymized. When data are shared, only the minimum necessary information should be reported.

- Safe settings: data can be accessed only in secure information technology and physical environments.

- Safe outputs: before public release, outputs undergo additional checks and measures (vetting rules) to avoid disclosure of identifiable information.

Due to the nature of disaggregated health data – where health information is presented for small population subgroups – there may be fewer data anonymity concerns than for individual-level data (noting that users may still need to access individual data to create aggregated estimates). Measures may still be required to avoid unintentional breaches of anonymity. Presenting racial or ethnic-specific data about disease rates by postal code, for example, may make it possible to trace individual identities. To uphold anonymity, data may need to be aggregated at a higher geographical level, such as by municipality. Another option is to aggregate small-area data according to a dimension of inequality – for example, by creating deciles of postal code areas based on degree of urbanization (see Chapter 17).

Example: inequality monitoring and the United Nations 2030 Agenda for Sustainable Development

The United Nations 2030 Agenda for Sustainable Development and its commitment to leave no one behind is a global accountability mechanism for identifying and addressing inequalities, including inequalities in health. Agreed upon at the United Nations Headquarters in 2015, the Agenda represents a global consensus on attaining 17 SDGs by the year 2030. Critically, linkages across global to local levels are important for global consensus processes and implementation at the local level, as well as national and subnational priority-setting and country-level contextualization.

Monitoring is central to tracking progressing towards achieving the 17 SDGs, which each specify corresponding targets and indicators, and an equity focus is evident throughout. SDG 10 specifically addresses inequality within and among countries, calling for “social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion, or economic or other status” *(44)*. SDG 17, on implementation and partnerships, includes a target on “support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts”. This specifically frames inequality monitoring as a shared responsibility involving exchange and capacity-strengthening initiatives within and across countries.

In support of SDG monitoring, a global indicator framework was agreed upon at the 48th session of the United Nations Statistical Commission in 2017, and subsequently adopted by the United Nations General Assembly *(45)*. The indicator development builds on a series of previous efforts, including the Commission on Sustainable Development, held since 1993, which was replaced by the United Nations High-level Political Forum on Sustainable Development in 2012 *(46)*. A major initiative of this Forum is its support of follow-up and review mechanisms, including encouraging Member States to “conduct regular and inclusive reviews of progress at the national and subnational levels, which are country-led and country-driven” *(47)*.

Voluntary national reviews are non-mandatory, state-led, multistakeholder initiatives that consolidate experiences and perspectives on progress against the 2030 Agenda with an emphasis on achievements, challenges and lessons learnt. The United Nations Economic and Social Council has directed the creation of various approaches, tools, trainings and resources for voluntary national review reporting, which creates a pathway between national review efforts and global appraisal of progress on the SDGs at High-level Political Forum meetings.

Localizing SDG initiatives, which are under way across many countries, are another example of monitoring efforts that span global, national and subnational levels *(48)*. Local self-government leaders are adapting and customizing global monitoring guidance to their local contexts while fulfilling obligations towards the global SDGs.

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5

Monitoring considerations across different contexts

Overview

Monitoring health inequalities is essential to identify and track the health experiences of population subgroups and to provide decision-makers with an evidence base to formulate equity-oriented policies, programmes and practices. This book elaborates on a general approach to monitoring health inequalities that is widely applicable, acknowledging that every iteration of monitoring, however, requires contextualization – that is, different contexts raise unique considerations for adapting and applying the approach. For example, how are the base populations for monitoring defined? Are there health topics, indicators and inequality dimensions that are of particular importance? What sources are likely to contain relevant data for inequality monitoring? What capacity exists for analysing data? What are relevant considerations for reporting key messages about health inequalities and using evidence to inform action?

The objective of this chapter is to discuss challenges and opportunities for health inequality monitoring in selected contexts. The contexts highlighted in this chapter include lower- and higher-resourced settings, rural and remote settings, refugee and migrant populations, and emergency contexts. Specifically, the chapter addresses pertinent considerations related to the scope of monitoring, data availability, technical capacity and knowledge translation (as applicable). The populations and contexts featured are intended to highlight a selection of the possible contexts for the application of health inequality monitoring approaches and are not intended to be comprehensive. Health inequality monitoring is warranted across many other diverse contexts to capture ongoing and evolving issues, such as climate change (see Annex 5) and urbanization (see Annex 6), which have cross-cutting implications for the contexts and populations discussed in the chapter.

Inequality monitoring in lower- and higher-resourced settings

This section addresses health inequality monitoring considerations across lower- and higher-resourced settings. These designations are meant to be approximate and descriptive of settings that share commonalities. Attributes of countries or other administrative areas may be variably reflected in descriptions of both lower- and higher-resourced settings.

The WHO *Health inequality monitoring workbook* contains exercises that guide the application of health inequality monitoring approaches across different contexts *(1)*.

Lower-resourced settings are areas where health needs tend to be high, alongside scarce resources, rudimentary or damaged health infrastructure, or weak governmental institutions. Population-wide access to basic and essential health services may be a pressing concern. These settings may include humanitarian emergencies or be facing protracted crises. They may be characterized by poverty, general lack of infrastructure, remote or mobile populations, emergencies of different natures, or other circumstances that compromise resource availability for high-quality health data collection and analysis.

Higher-resourced settings tend to have more developed infrastructure, including health data infrastructure and technology, and more stable governments and institutions. The capacity of people to collect, store, analyse and use data may be more advanced. With an abundance of data, health inequality monitoring approaches may be more specialized and technically advanced than in lower-resourced settings – and as a result, the results may be less comparable across settings.

Health information systems

In general, health information systems are less functional in lower-resourced settings than in higher-resourced settings. Weaker governance structures, standardization practices and coordination mechanisms in lower-resourced settings often mean that certain data sources are incomplete or of variable quality. For example, arduous requirements for collecting, reporting and managing data on a large number of indicators may be beyond the capacity of data systems and health workers, resulting in poor adherence to protocols and low-quality data.

Lower-resourced settings commonly rely on international donor agencies to support data collection efforts or data source development. Although country ownership and leadership has been a priority in some settings (Box 5.1), in the absence of strong policy and legal environments, the interests and priorities of external funding organizations – such as the private sector or international nongovernmental organizations – may weigh heavily into which data are collected, from whom, and at what frequency. Data governance

BOX 5.1. Ethiopia's One Plan, One Budget, One Report

Ethiopia's One Plan, One Budget, One Report is part of a health-sector goal to promote government leadership in improving harmonization and alignment across all levels of the health sector, reduce transaction costs of delivering services, and enhance coordination across stakeholders, including donor agencies *(2)*. An overarching priority is for all stakeholder activities and budgets to be reflected in one strategic plan, which is implemented according to an agreed set of indicators and reporting formats:

- One Plan refers to the health sector having one countrywide, shared, agreed strategic plan. The plan is developed through extensive consultation between the Government, donors and other stakeholders. All plans at regional, zonal, district and facility levels are to be subsets of the plan. Programmes and donors may have their own detailed plans, but they should be consistent with the priorities and activities of the public sector.

BOX 5.1. *continued*

- One Budget ideally means all funding for health activities, including from the Government, donors, nongovernmental organizations and others, is pooled and routed through Government channels. (At the subnational level, a less ideal realization of One Budget entails that all funds for health activities are reflected in one plan and one documented budget but disbursed through separate channels.) Every cost centre at the federal, regional, zonal, district and facility levels will know about all financial and non-financial resources allocated and spent in the health sector across all levels. This facilitates more comprehensive planning, avoids duplication of efforts, reduces wastage, and increases programme effectiveness.

- One Report means using one monitoring system and one monitoring calendar. A set of indicators has been identified to monitor progress in achieving the health-sector strategy. Reports should be based on these indicators without duplicating the channels of reporting.

A roadmap for accelerating progress towards the implementation of One Plan, One Budget, One Report was developed in 2012 through a participatory approach, enhancing stakeholder buy-in and embodying the premise of the approach, working together *(3)*.

concerns, such as those related to data-sharing, data ownership and digital interoperability, may arise. See Chapter 4 for more on health data governance.

Higher-resourced settings have stronger health information systems. They tend to have more comprehensive health data about the population due to better infrastructure, implementation of stronger standards, and greater availability of resources for data collection. Strong coordination across well-established sources of health and population data may provide opportunities for linking data, presenting numerous possibilities for monitoring across diverse dimensions of inequality. With more advanced digitization and expanding passive data collection (e.g. through mobile applications), higher-resourced settings may face data overload, requiring advances in technology and data management practices to process large amounts of data. Issues related to the digital divide, privacy and security may compromise the quality of data derived from digital sources (see Chapter 16).

Data sources

Household surveys are conducted across all settings, and they are often the primary source of health inequality data in lower-resourced settings. In such settings, household surveys tend to be funded wholly or in part by international donor agencies, whose interests may be limited to a specific disease or programme area and may not be aligned with local priorities. According to a 2020 WHO global report on health data systems and capacity, only 6% of surveys in low- and lower-middle-income countries were funded solely by the national government. Upper-middle-income countries received less support from international donor agencies but also had limited ability to fund their own survey programmes *(4)*. Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) are major international household health surveys supported by the United States Agency for International Development and the United Nations Children's Fund, respectively, and conducted primarily in low- and middle-income countries *(5, 6)*. Chapter 12 contains more information about household surveys and their use as a data source for health inequality monitoring.

> In 2020, two-thirds of high-income countries had well-developed and sustainable capacity for conducting population-level surveys, but only half of middle- and low-income countries had this capacity *(4)*.

Civil registration and vital statistics (CRVS) systems collect data about vital events, namely births, deaths and causes of death (see Chapter 12). They require accurate and continuous registration of events and associated details, in adherence with established legal frameworks and standards and supported by strong centralized and decentralized administration *(7)*. CRVS systems can serve as a source of vital statistics for health inequality monitoring in higher-resourced settings, but lower-resourced settings often have poorly functioning CRVS systems, with only partial coverage. In 2020, fewer than one in 10 low-income countries achieved complete registration of births (defined as over 90% of births registered); by comparison, a third of lower-middle-income countries, two-thirds of upper-middle-income countries, and almost all high-income countries had complete registration. Regarding death registration, most low-income countries reported no data or had completeness below 50%, but over 90% of high-income countries had complete registration *(4)*.

Census data are available across most countries and can provide information about population demographic, socioeconomic and geographic characteristics (see Chapter 12). The quality of census data and the ability to derive disaggregated population projections, however, vary *(4)*. Census data in lower-resourced settings may be old or fail to meet minimum standards. This contributes to issues stemming from a lack of reliable denominator data for health inequality monitoring – that is, data that provide information about the size of the base population for health inequality monitoring. Higher-resourced settings, however, are increasingly applying sophisticated and efficient methodologies to conduct censuses, allowing for more frequent censuses with greater potential for linking data across sources.

Technical capacity

Technical capacity for health inequality monitoring encompasses the skills, knowledge and expertise required to carry out monitoring activities (which include, broadly, determining the scope of monitoring, obtaining data, analysing and interpreting data, reporting results and translating knowledge into action – see Chapter 2). Capacity-strengthening efforts for health inequality monitoring are often focused on lower-resourced settings, where institutional support and political will for inequality monitoring may be weak or lacking, and there may be less access to technology and other infrastructure limitations. Lower-resourced settings may have more sporadic review cycles and less transparent mechanisms for effecting changes based on the results of monitoring. In some cases, weak national institutions may result in an increased reliance on regional or global institutes to support technical capacity-strengthening.

Inequality monitoring in rural and remote settings

Populations in rural and remote areas make important economic, social and cultural contributions to countries, but they experience various forms of disadvantage. Characterized by dispersed populations and weaker health systems, rural and remote areas around the globe face shortages of well-trained, skilled and motivated health workers *(8)*. Populations in these settings experience a unique set of social and environmental determinants of health, including high rates of extreme and multidimensional poverty *(9, 10)*. Climate change, natural disasters, droughts, fires and conflicts may disproportionally affect these populations. The United Nations General Assembly resolution Eradicating Rural Poverty to Implement the 2030 Agenda for Sustainable Development brought attention to the urgent need to accelerate rural poverty eradication and strengthen health service provision in rural areas *(11)*. It also underscored the global nature of the issue, acknowledging that rural poverty exists in countries across all stages of development, although the extent of disadvantage may be different from country to country.

As many countries experience rapid rates of urbanization, health and development attention has shifted towards urban areas and away from rural areas *(12)*. A governmental commitment to balanced urban/rural territorial development is absent in many contexts. As a result, there may be a declining economic incentive to invest in rural health systems. There is, however, a strong rationale for investing in rural health systems, especially in consideration of broader, intersectoral factors and the cost of neglecting such investments. For example, disinvestment in rural populations can create conditions ripe for discontent, conflict and insecurity.

Scope of monitoring

Monitoring inequalities by urban/rural place of residence is a common practice, although unique considerations and limitations arise when further distilling rural settings and defining parameters for monitoring that are relevant within these settings. One pertinent issue pertains to how rural and remote areas are defined and classified. This is key for establishing the base population for monitoring and for categorizing rurality as a dimension of inequality. A second issue when exploring inequalities in rural and remote settings relates to the selection of relevant health indicators and dimensions of inequalities.

Defining rurality

There are various ways to define rural areas and capture the extent of remoteness within them (i.e. the degree of rurality). Defining rural areas too broadly can mask inequalities within these areas, while defining them too narrowly may fail to fully capture the population experiencing spatial disadvantage. For example, of the 103 countries that use a minimum population size threshold to define rural and urban areas, 84 use a threshold of 5000 or fewer inhabitants to define rural areas *(13)*. In some cases, this threshold of 5000 inhabitants represents too broad a grouping to capture the diverse health experiences of people living in smaller settlements.

Detailed classifications of remoteness can provide a breakdown of how disadvantage may be experienced as a gradient within rural contexts. Ideally, the definition of rurality for a particular monitoring application should allow for the results of monitoring to inform effective and efficient policy responses in rural areas to advance equity.

A rudimentary approach to urban/rural classification might consider the capital city of a country as urban and the rest of the country as rural. This approach, however, poses major limitations in many settings, especially if the capital city is not the main urban centre or if there are multiple large cities in the country. Further, binary urban/rural categories do not differentiate between remote rural areas and rural areas close to a city. Other approaches to defining rurality might consider population size and density, administrative designations, sectoral employment and economic activities, proximity to services and infrastructure (sometimes captured by satellite imagery), land use or other factors. The applicability of these different approaches varies across countries. Box 5.2 describes an example in New Zealand.

Although global-level monitoring may rely on country-level specifications, the Degree of Urbanisation methodology, endorsed by the United Nations Statistical Commission in 2020, provides a common set of thresholds that can be applied across countries. Covering all territories within countries, it specifies the three classes of cities, towns and semi-dense areas, and rural areas. Within rural areas, further classification can be applied to divide local units into villages, dispersed rural areas, and mostly uninhabited areas, which are determined based on population thresholds and clustering *(17)*.

Health indicators and dimensions of inequality

Because a major challenge in rural contexts relates to the physical accessibility of health services, health indicators with a spatial component are of special importance. These include indicators related to health workforce density and distribution, health facility density and distribution, geographical access to essential medicines and health services, and household expenditure on health. To date, the exploration of inequalities in rural areas has focused largely on reproductive, maternal, newborn and child health topics. Further efforts are needed to better understand inequalities across a wider range of indicators and topics.

> AccessMod (version 5) is a tool that facilitates analyses to support universal health coverage "by modelling physical accessibility to health care", with particular relevance to rural and remote settings. The tool contains accessibility analysis, geographic coverage analysis, referral analysis, zonal statistics and scaling up analysis *(18)*.

Poverty and its worst manifestations are overwhelmingly rural. In many settings, however, a lack of available data limits the extent to which economic-related inequalities in health within rural and remote populations can be unpacked. Approaches to measuring economic status may need to be adapted to reflect indirect aspects (e.g. assets, housing and access to services) that are relevant in rural and remote settings.

Within rural areas, intersecting forms of disadvantage relate to age, indigenous status, migration status, occupation and sex (see Chapter 3). These constitute important and overlapping

BOX 5.2. Developing a relevant classification of rurality in New Zealand

New Zealand has undertaken efforts to develop meaningful urban/rural classifications for the analysis of health data and exploration of rural health inequalities in the country *(14)*. Although anecdotal experiences surrounding health and determinants of health point to important differences between rural and urban areas, generic classification schemes have traditionally underestimated inequality between these settings. One contributing factor is that classification approaches may inappropriately designate urban fringe areas as rural, while medium-sized isolated communities are considered urban. An alternative approach to defining rurality in New Zealand is focused on integrating factors relevant for measuring inequalities in health such as proximity in terms of travel time to larger urban areas. The Geographic Classification for Health is a "fit for health purpose" rural/urban classification for analysis of health data at the national and local levels *(15)*. The Rural Health Strategy 2023 for New Zealand relies on this refined approach to measuring rurality *(16)*.

dimensions of inequality in many contexts, which may also have implications for remedial action. For example, inequality monitoring might expose how intersecting sources of disadvantage compound in rural agricultural workers, informing entry points for health programming and social protection policies.

Data availability and quality

A lack of adequate data (and particularly disaggregated data) in rural and remote areas is a critical limitation for inequality monitoring. Data collection through CRVS systems, censuses, health facility-based records and registries may have low coverage and quality constraints. Household surveys that include data collection in rural areas may help to fill data gaps because they tend to gather a range of information about relevant dimensions of inequality. Data collection in remote rural areas with low population density is resource-intensive, however, and resulting small sample sizes may limit inequality analysis capabilities.

Data quality is also a key consideration in rural and remote settings. Issues related to training and capacity, information technology, communication and task prioritization may contribute to incomplete or unreliable data collection and lead to underreporting or biased reporting. Quality issues may also emerge during data preparation and analysis. For example, data about rural health-system performance indicators may be excluded from reporting due to small sample sizes, or they may be aggregated across regions (which may have distinct characteristics). The periodic collection of quantitative data may not be sufficient to understand the variations in health indicators across rural and remote settings, which may be highly variable over time.

Generating demand for data in rural areas is key to addressing data scarcity. A strategic entry point lies in securing government and donor commitments to promoting health and well-being in rural areas, for example, through balanced territorial growth initiatives. Commitments linked to monitoring activities create a mandate for data collection and health information system strengthening in rural areas and promote regular reporting on rural health inequalities. They can also bolster political will for monitoring and follow-up action, public support and engagement.

There is an increasing use of technologies to facilitate data collection in rural and remote settings, such as mobile and web-based surveys or geospatial data collected through satellite imagery (see Chapter 16). There are, however, limitations in these approaches, such as the introduction of bias due to differences in the access and use of digital technologies (the “digital divide”) *(19)*.

Knowledge translation

Inequality monitoring in rural settings can have direct implications for policies and programmes, especially if it is integrated into ongoing monitoring and evaluation cycles *(20)*. Moreover, inequality monitoring that aligns with rural and remote administrative boundaries contains clear entry points for targeted, intersectoral interventions *(21)*. Subpopulations experiencing disadvantage are easy to identify and locate, and health information specific to a geographical setting can be considered alongside information across diverse sectors. Too often, however, inequality monitoring in rural areas is limited to situation analyses with insufficient follow-through in terms of designing and deploying equity-oriented interventions that address differentiated population needs. In general, capacity for generating action in rural and remote settings from inequality evidence is often lacking. There are several success stories, however, where evidence from inequality monitoring has been used to inform action (Box 5.3).

BOX 5.3. Addressing rural inequalities: country examples

Over the past decades, Thailand has successfully worked to narrow gaps in health service provision in rural and remote areas, using inequality monitoring to inform and refine health workforce interventions *(22, 23)*. The country has adopted integrated, multipronged strategies to address the inequitable distribution of human resources for health between urban and rural areas. These have focused on:

- prioritizing medical education admission for students from rural areas;
- locating health profession schools outside the capital city;
- providing health profession training and preparation specifically to practise in rural settings;
- financial incentives to attract health professionals to work in rural areas;
- personal and professional support interventions, including improved health facility infrastructure, logistics support, housing and transportation;
- opportunities for career advancement and enhancement of professional networks;
- social recognition and job perquisites to sustain motivation.

India faces shortages of human resource for health, especially in rural and remote settings *(24)*. The predominantly rural state of Chhattisgarh, for example, has quantified the vacancy of health professionals across divisions and districts within the state, reporting more severe challenges and shortages in rural and remote areas. Additionally, there are inequalities in health and access to health services across population groups defined by geography, socioeconomic status, gender, class and social group *(23)*. Policy interventions to strengthen human resources for health include educational interventions, regulatory interventions, financial incentives, and personal and professional support systems. Notably, a three-year medical diploma course was established, focused on service in rural and remote areas. The initiation of the Chhattisgarh Rural Medical Corps incentivizes health professionals to work in difficult and less accessible areas, including rural, remote and conflict-affected settings *(25)*. The scheme was given sustained funding over a period of time and placed emphasis on financial incentives, gradually expanding rural residency incentives while ensuring health system functioning improved in rural areas *(26)*.

Despite rapid industrialization and economic growth during the 1960s and 1970s, rural areas in the Islamic Republic of Iran remained underdeveloped. The rural population was characterized by poor health status, with many areas lacking basic health-care infrastructure *(27)*. In response, the country initiated a rural development strategy, focusing on providing primary health care *(28)*. The programme aimed to address the immediate health-care needs of rural populations by creating a network of rural health centres and health houses *(28)*. These health houses, staffed by trained community health workers (*Behvarz*), became the backbone of the country's rural health-care system. The responsibilities of *Behvarz* include a wide range of preventive and basic health-care services, such as providing maternal and child health care, family planning, immunization, noncommunicable disease control, supporting health education, environmental health activities, and annual population censuses *(27, 28)*. By addressing basic health-care needs and promoting healthy lifestyles, the *Behvarz* programme has contributed to a reduction in the burden of disease and an increase in life expectancy among rural populations *(29)*. The success of the programme in reaching remote rural areas has been attributed to its decentralized structure and the extensive network of health houses *(30)*. As of 2022, the programme covered about 85% of the Iranian rural population through more than 17 000 health houses spread across villages and settlements *(31)*.

Inequality monitoring among refugee and migrant populations

One in eight individuals globally is a migrant or forcibly displaced person, meaning over 1 billion people are on the move worldwide. Refugees and migrants comprise diverse groups of people with complex and varied health experiences. The term "refugee" is defined in the 1951 Refugee Convention and the 1967 Convention and Protocol Relating to the Status of Refugees as "any person outside their country of origin who needs international protection because they fear persecution or a serious threat to their life, physical integrity or freedom in their country of origin as a result of persecution, armed conflict, violence or serious public disorder" *(32)*. There is no formal legal definition of a migrant, but a widely used definition is "a person who moves from one place to another, whether across or within international boundaries" *(33)*, acknowledging there are a variety of further specifications that could be made (Box 5.4). Drivers for migration and displacement include climate change, collective expulsion, human rights violations, natural or human disasters, armed conflict, situations of generalized violence, family reunification, freedom of movement, and labour and economic factors.

Refugee and migrant populations face many of the same health and health-related challenges as host populations, but they may encounter additional barriers and risks due to their migratory status and circumstance (e.g. linked to substandard living and working conditions). Migration and displacement are considered key determinants of health and

BOX 5.4. Descriptions of migrants

Recognizing the diversity within the general classification of migrants, the International Organization for Migration (IOM), the United Nations High Commissioner for Refugees (UNHCR) and WHO have developed specific descriptions for migrants in different situations *(34)*.

An international migrant is any person who changes their country of usual residence. In 2020, there were an estimated 281 million international migrants *(35)*.

Internal migrants are migrants who stay within their country of origin. In 2005, there were an estimated 763 million internal migrants, although this number may be much higher due to the informal nature of much of this movement *(36)*.

Internally displaced people are those who have been "forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters, and who have not crossed an internationally recognized state border" *(33)*. As of 2023, there were a total of 75.9 million internally displaced people in 116 countries and territories *(37)*.

Asylum-seekers are people who seek international protection. In countries where asylum is judged on a case-by-case basis using specific eligibility criteria, asylum-seekers are people whose claim has not been finally decided on by the country in which they have submitted it. Not every asylum-seeker will ultimately be recognized as a refugee, but every recognized refugee is initially an asylum-seeker. As of end of 2023, there were 6.9 million asylum-seekers globally *(38)*.

Other designations, which have various uses, cases and contextual specifications, include international migrant workers, migrants in irregular situations, stateless people, environmental migrants, and documented and undocumented migrants.

are often associated with worse health and well-being outcomes compared with those in non-migrant host populations. Migratory status and the ensuing conditions may be compounded by other social determinants of health, such as education, income, housing and access to services, as well as linguistic, cultural, legal and other health-system barriers *(34)*. Racism, discrimination and xenophobia may exacerbate disadvantages experienced by refugees and migrants *(39)*. In some circumstances, refugees and migrants lack access to essential health services or have low levels of health literacy, hindering health-care seeking, access and treatment adherence.

> Xenophobia refers to "attitudes, prejudices and behaviour that reject, exclude and often vilify persons, based on the perception that they are outsiders or foreigners to the community, society or national identity" *(39)*.

Data availability

In general, data disaggregated by migratory status are lacking from major global health datasets, including official Sustainable Development Goal data. The absence of these data hinders the ability to make comparisons of refugee and migrant populations against host populations within and across countries. The 2022 *World report on the health of refugees and migrants* underscored a need for "higher-quality and standardized, disaggregated data and definitions around health and migration" *(34)*, which was further highlighted in the subsequent WHO *Global research agenda on health, migration and displacement* (Box 5.5) *(40)*.

Another major challenge stems from the unclear definitions of migratory status. Much of the data that exist about refugee and migrant populations are not harmonized, limiting the extent to which data can be compared across countries and over time. The lack of standardized migrant classifications conceals important differences and varied health experiences and risks within refugee and migrant populations. Individuals within these populations encompass a broad spectrum of circumstances and experiences, with shifting and evolving health needs and risks. Definitional ambiguity hinders the ability to compare between different subgroups of refugees and migrants, and to benchmark other forms of inequality analyses. In particular, there is a lack of data about hard-to-reach irregular migrants, refugees residing outside of camps, people who have been trafficked, deportees and stateless individuals.

Refugee and migrant populations, inherently transient and mobile, present challenges for data collection. Data may be collected at different phases of migration journeys, by different institutions and

BOX 5.5. WHO *Global research agenda on health, migration and displacement*

The 2023 WHO *Global research agenda on health, migration and displacement* identified data collection and knowledge exchange as a key implementation challenge to strengthening research on the topic globally *(40)*. It noted the following limitations and challenges and also highlighted possible actions to address these: limited availability, granularity, quality and comparability of data sources; challenges with accessing migration related data; navigating legal and ethical considerations; lack of trust and sustainable partnerships with migrant communities to collect good-quality data; language and cultural barriers to data collection; time and cost of collecting data; and achieving a balance between qualitative, quantitative and mixed-methods data collection and research.

for different purposes. Considerations for collecting data from these populations include ensuring language accessibility, cultural sensitivity and awareness, equitable reach of people on the move, and addressing concerns such as lack of trust, fear of mistreatment or discrimination. Refugees and migrants have the right to detailed explanations of the purposes and use of data collection, in languages that they understand, to obtain informed consent *(34)*. Data collection agencies must ethically ensure adequate data protections, including upholding privacy, confidentiality, safeguarding of health data from immigrant enforcement, and the appropriate use of data.

Data sharing and linking in refugee and migrant populations require coordination among multiple stakeholders nationally and globally. Entities such as IOM, UNHCR and WHO, together with other United Nations agencies and other national and international organizations, work collaboratively to promote the health, well-being and safety of refugees and migrants *(41)*. Fragmentation of data and information systems at the national level needs to be addressed – but incompatible software systems and data protection regulations limit the extent to which data may be shared between agencies.

For example, structures do not typically exist to link migrant health assessment upon entry to a country with the public health system of the country of origin. This poses challenges to understanding the health status and needs of people on the move, and to the continuity of treatment and care across borders.

Data sources

Acknowledging the complexities described above, a substantial challenge across all data sources lies in introducing or expanding the collection of data about migration indicators in existing data sources.

The WHO European Region has published technical guidance for integrating migration health data into national health information systems and for creating a basis for harmonization of data reporting across Member States in the Region *(42)*.

Household surveys remain a common and relevant source for population-based data and monitoring of global goals and targets. WHO works with countries to help improve their health information systems, but it is imperative to look at information systems for health in a holistic manner and to invest in population-based data-collection instruments and approaches. Household survey programmes, including multicountry initiatives such as DHS and MICS, collect some relevant but limited information related to migration *(43)*. For example, DHS includes questions related to rural-to-urban migration and international migration, such as length of stay or date of entry, citizenship and country of birth – although countries can opt out of migration questions. The World Bank Living Standards Measurement Study includes a migration module with questions about place of birth, most recent place of residence, reasons for moving, number of times moved, and specified types of migration (including inter-district, rural-to-urban and international migration) *(44)*. Nevertheless, the use of data disaggregated by migration variables may be limited if these populations are not adequately accounted for in the survey sampling frame (see Chapter 12).

If they are functional, censuses and CRVS systems may include information such as a person's length of stay or date of entry into a country, citizenship and country of birth, allowing for some characterization of migration flows and potential use in inequality monitoring (see Chapter 12). The United Nations

Expert Group on Migration Statistics has proposed additional questions for censuses and household surveys to improve the quality and comparability of migration data *(45)*.

In general, institution-based data sources, including medical records, have limited utility for monitoring in refugee and migrant populations, unless information about migration status is routinely recorded and accessible in a format that can be linked with health data to yield disaggregated estimates. Some disease control surveillance programmes, such as HIV, tuberculosis and malaria, collect migration data as part of their efforts.

Recognizing the need for continued efforts to address the health needs of refugees and migrants, the WHO 2019–2023 *Promoting the health of refugees and migrants: global action plan* (subsequently extended to 2030) highlights the importance of strengthening health monitoring and health information systems *(41)*. This includes collaborating with countries to develop disaggregated data on the health of refugees and migrants and supporting the development of approaches for data collection. A commitment to "collect and utilize disaggregated data as a basis for evidence-based policies" is also evident in the first objective of the Global Compact for Safe, Orderly and Regular Migration, a comprehensive framework for managing international migration *(46)*.

Promoting the health of refugees and migrants: experiences from around the world is a WHO compendium of 49 country examples the illustrates how countries are advancing health monitoring and information systems to promote the health of refugees and migrants *(47)*. Box 5.6 describes an example of an initiative in Peru.

Expanding the depth and scope of inequality monitoring

Due to the lack of disaggregated data on refugee and migrant populations, health inequality monitoring has focused on comparisons between refugee and migrant versus non-migrant (host) populations. Although there are cases where refugees and migrants are found to be healthier than host populations, limited available evidence is often generalized to give a notion of a healthy migrant effect (which may be misleading). Analyses of health inequalities within refugee and migrant populations have been more limited and fragmented, but they are crucial for understanding how disadvantages are experienced within these populations. Box 5.7 overviews the availability of disaggregated migration data in the WHO Health Inequality Data Repository *(48)*.

Collecting data about nationality is a good step towards inequality monitoring for health of refugees and migrants, but data sources also need to include

BOX 5.6. Strengthening health monitoring and health information systems to promote the health of refugees and migrants in Peru

In response to the increasing migrant populations within Peru, the Ministry of Health established the Functional Health Unit of Migrant and Border Populations in 2020 *(47)*. Recognizing that the majority of migrants may not access health services, the unit focuses on promoting the integration of migrants into the health system. Its mandate includes proposing public policy strategies and monitoring their implementation and impact. The introduction of nationality variables in health records has enabled closer monitoring of the health-care needs of migrants.

BOX 5.7. Migration data featured in the WHO Health Inequality Data Repository

The WHO Health Inequality Data Repository includes disaggregated data pertaining to migration *(48)*. As of 2024, the Data Repository contained indicators disaggregated by migratory status in European countries, sourced from Eurostat. These indicators are related to health status, health behaviours and risk factors, health care and health determinants.

Disaggregated data within refugee and migrant populations are also available. This includes Eurostat data from European countries, disaggregated by age, sex and type of migrant. Globally, data from 197 countries, sourced from the United Nations Statistical Department International Migrant Stock 2020 *(35)* and the UNHCR Refugee Data Finder *(38)*, pertain to the number of international migrants and refugees per 1000 population, disaggregated by age, place of residence and sex.

information about variables such as time of arrival in the country, country of citizenship and nationality of parents. The expanded collection of data disaggregated by gender or sex can help elucidate gender influences on migration experiences *(49)*. Targeted explorations of inequality are warranted to address specific circumstances. For example, monitoring occupational accidents, injuries and deaths is relevant for migrant worker populations who often work in jobs that are "dirty, dangerous and demanding" *(34)*.

Inequality monitoring should also attend to the various factors that influence the physical and mental health of refugees and migrants throughout the phases of migration, which have implications for the types of relevant health indicators *(43)*. Notably, pre-migration events and trauma, especially common in forced migration and displacement flows, can have significant impact on mental health and well-being. Conditions during transit, arrival and integration phases vary, with potential exposure to communicable diseases. Barriers or delays in accessing timely testing, diagnostic or treatment services could further exacerbate negative health outcomes. Unique factors during the return phase, where applicable, further affect health outcomes. For example, refugees and migrants are particularly vulnerable to the effects of antimicrobial resistance throughout various phases of migration and displacement, due to factors such as exposure to infections, limited access to diagnostics and therapeutics, and inappropriate use of antibiotics *(50)*.

Developing a global health indicator framework tailored to refugee and migrant health would enhance inequality monitoring efforts, ensuring comprehensive tracking of their diverse health needs and challenges, and informing tailored health policies and interventions in origin, transit and host countries.

Inequality monitoring in emergency contexts

WHO defines an emergency as a "situation impacting the lives and well-being of many people or a significant percentage of a population and requiring substantial multisectoral assistance" *(51)*. Emergencies are diverse. They may be acute or protracted and have a rapid or slow onset. They may be complex, with more than one cause, and have significant public health, social, economic and political impacts that span a single country, or they may be regional or global in scope. Multiple emergencies can occur concurrently and may be the result of, or exacerbated by, pre-existing inequalities. Globally, the number of emergencies with public health impacts is anticipated to continue to rise alongside increases in risk factors such as biological hazards (prompting epidemics and pandemics), humanitarian crises (such as armed conflicts and civil unrest), extreme weather events and natural disasters *(52)*.

The risks, vulnerabilities and impacts of health emergencies fall disproportionally on population groups with longstanding experiences of disadvantage. For example, women and girls are at heightened risk of experiencing sexual violence in conflict situations *(53)*. Children, older people, people living with disabilities, people living with HIV, people from ethnic or religious minorities, internally displaced people and people living in poverty may be more vulnerable to health risks during emergencies. There may be cases where people from certain population subgroups face discrimination or deliberate exclusion on the basis of religion, ethnicity, political affiliation or place of residence. This underscores the importance of equity-oriented health emergency preparedness, response and resilience efforts. Indeed, proposals that emerged as a result of the COVID-19 pandemic to strengthen global efforts emphasized equity as a principle and a goal *(54)*.

The International Health Regulations provide a legal framework that defines countries' rights and obligations in handling public health events and emergencies that have the potential to cross borders *(55)*. One of the requirements for countries is to establish, strengthen and maintain core capacities for surveillance and response. Relatedly, the notion of "accountability to affected populations", a key part of a people-centred approach to emergency responses, recognizes the unique situations of population subgroups of different ages, genders, disability status, mental health status and other factors. WHO country offices are accountable for "systematically including accountability to affected populations in all needs assessments and monitoring, review and evaluation processes" *(56)*.

The management of public health information in emergency contexts requires a high level of coordination to avoid duplication, inefficiency, and poor-quality or contradictory information. To this end, the Standards for Public Health Information Services of the Global Health Cluster provide guidance, templates and best practices for integration of all available public health information to support evidence-based operational decision-making *(57)*.

Scope of monitoring

In emergency contexts, monitoring is required to assess the health status of – and health threats to – affected populations; assess the availability of health resources and services; identify potential barriers to health care; and determine health-system performance *(58)*. The nature of public health emergencies varies greatly, and the timing, frequency and general scope of monitoring should have the ability to rapidly surge and adapt to the scale of the emergency. Disease outbreaks may be global or regional in nature, requiring coordinated mechanisms for harmonizing and sharing information, and continuous updates and surveillance in accordance with the spread of the hazard. For example, the frequency of collecting and reporting data about COVID-19 cases and deaths changed over the course of the pandemic (Box 5.8). Protracted humanitarian crises may require ongoing monitoring over longer periods.

For environmental disasters with a rapid onset, such as floods or earthquakes, monitoring takes place after the initial event. Monitoring may include the use of needs assessment tools such as the Multi-cluster/sector Initial Rapid Assessment (MIRA), the Multi-sector Needs Assessment (MSNA) and public health situation analysis (Box 5.9).

BOX 5.8. Frequency of reporting WHO COVID-19 surveillance data

Initially WHO published daily updated numbers of reported cases and deaths, but in August 2023 it moved to weekly reporting *(59)*. Age- and sex-disaggregated data about COVID-19 case rates, death rates and case fatality ratios were available weekly from January 2020 in the WHO COVID-19 Detailed Surveillance Data Dashboard *(60)*. In some countries, such as those affected by conflict, case identification was reported to be low due to detection and testing strategy limitations (as noted in a caveat in the Dashboard).

BOX 5.9. Needs assessment tools

MIRA is a joint needs assessment tool that can be used in sudden-onset emergencies to identify needs, affected areas and affected subpopulations *(61)*.

MSNA is a more detailed versions of MIRA used to identify subpopulations experiencing disadvantage *(62)*. MSNA is led by the United Nations Office for the Coordination of Humanitarian Affairs, usually with support from the REACH initiative *(63)*.

A public health situation analysis draws on secondary data to identify the current health status and all potential health threats that the population may face, the functioning of the health system, barriers for access and utilisation, and the humanitarian health response. It identifies the major areas for health action to respond to and recover from the crisis. It is relevant for preparedness and response-planning *(59)*.

Health indicators and dimensions of inequality

Disaggregated data in emergency contexts are vital to determine who is at greatest risk or in need of health care. Integrated as part of larger barrier assessment analyses, disaggregated data can also assist in identifying and anticipating health system capacity needs. Core health indicators for humanitarian contexts are laid out in the Standards for Public Health Information Services *(57)*, with guidance for disaggregation where relevant *(64)*. Indicators span several health topics and may be applicable in some situations but not others. Examples of these indicators include:

- proportional mortality (Box 5.10);
- average population per functioning health facility, disaggregated by health facility type and administrative unit (permitting assessment of inequality in geographical accessibility and availability of health facilities by administrative unit);
- percentage of children who have received measles vaccination (disaggregated by age and sex, and by displaced versus host population);
- number of community health workers per 500 people in rural and hard-to-reach locations.

BOX 5.10. Population mortality estimation in emergency contexts

Population mortality indicators have important uses in emergency contexts, including informing emergency responses, estimating the magnitude and severity of humanitarian crises, and supporting human rights and internal law advocacy *(65)*. These data are often inadequate, incomplete and of low quality, however, especially in unstable and conflict-affected regions. For example, monitoring proportional mortality (i.e. deaths due to a given cause) by age group can help to assess the appropriateness of a health service package deployed during a crisis and inform subsequent adaptations. Monitoring death rates due to intentional trauma in disadvantaged population subgroups can help to build cases for alleged crimes against humanity or other violations of international law. In some situations, excess mortality and other health impacts attributable to a crisis may require long-term monitoring over decades or even generations.

> The WHO *Handbook for conducting assessments of barriers to effective coverage with health services* applies a mixed-methods research approach to identify and understand the supply- and demand-size barriers experienced by potential users and non-users of health services. Across each of its eight modules, the Handbook includes guidance for its adaptation to humanitarian contexts *(66)*.

Data collection in emergency contexts typically focuses on specific affected areas or populations. Disaggregation of health indicators by geographic variables such as subnational regions, neighbourhoods or catchment areas for health facilities can have direct implications for targeted operational responses. In addition, many health indicators should be disaggregated by age group, people living with HIV or other condition, or sex. This information is important to establish the impact of the crisis, plan the scale of the response, inform resource allocations, and target responses towards priority subgroups or areas. For example, WHO guidance states that data about people in need – calculations that seek to determine how many people require assistance to meet their basic health needs – should be disaggregated by age, disability status, displacement status (i.e. refugee, internally displaced person or returnee), sex and subnational region *(67)*.

Data sources

Population surveys often provide a frontline method of collecting key data in real time to guide programmatic decisions *(68)*. They may also be used retrospectively, to assess the health impact of an emergency. Population surveys can be deployed quickly and be tailored to the immediate data requirements of a given situation, potentially capturing diverse dimensions of inequality alongside health information. Reliable lists of people or households are rarely available in emergency situations because there are often large population movements. Survey sampling design may rely on approximations – for example, drawing from IOM and UNHCR data sources – and there may be bias in how respondents are selected. For more information about population surveys, see Chapter 12.

Systems of public health surveillance – defined as the continuous, systematic collection, analysis and interpretation of health-related data *(69)* – are important data sources in emergency contexts. Disease surveillance data can help to identify impending outbreaks. The WHO Early Warning, Alert and Response System (EWARS) is designed to improve disease outbreak detection in emergency settings, such as in countries in conflict or following a natural disaster *(70)*. More generally, surveillance systems can enable monitoring and evaluation of the impact of interventions and can contribute to priority-setting and planning activities for public health policy and strategies *(69)*. For example, demographic surveillance, which may include weekly or monthly updates from community health workers, can provide information about population size and mortality. Facility-based surveillance may collect information relevant to cases of sexual or gender-based violence or mental health symptoms *(68)*. A limitation of using surveillance data is that they require population or population subgroup estimates as denominators, which may be challenging to obtain in emergency contexts (Box 5.11). For more information about surveillance systems, see Chapter 14.

For acute emergencies, qualitative reports gathered through rapid field assessments are a key source of information and may be used to identify priority populations initially *(68)*. There are also several rapid assessment questionnaires and protocols that can be used to gather quantitative information from key informants and non-representative samples, although the robustness of these assessments, and their usefulness to guide humanitarian responses, may be limited.

One approach to strengthening data availability and quality regarding availability of essential health resources and services during emergencies is the WHO Health Resources and Services Availability Monitoring System (HeRAMS). HeRAMS aims to ensure that information on essential health resources and services is readily available to decision-makers at the country, regional and global levels. The approach, which supports the standardization and continuous collection, analysis and dissemination of information, is rapidly deployable and scalable in emergency contexts and fragile states. As of 2023, HeRAMS supports 30 projects across 27 countries and includes a geospatial modelling service that allows the precise identification, location and quantification of populations lacking access to essential health services *(72, 73)*.

Reporting inequality data

Frequent and centralized reporting of disaggregated data about health emergencies can help to guide the ongoing development and targeting of responses, including prioritization and optimization of resource allocation. Reporting channels include databases, repositories, situation updates, news bulletins or other publications. WHO maintains emergency situation reports for ongoing health emergencies, including outbreaks and humanitarian crises *(74)*. For example, beginning in October 2023, WHO released periodic emergency situation reports on the health impacts of the humanitarian crisis in the occupied Palestinian territory, including east Jerusalem, with disaggregated data for certain indicators *(75)*. *Disease outbreak news* reports provide information on

BOX 5.11. Population denominator estimation in emergency contexts

One data challenge in emergency contexts relates to estimating population sizes – that is, denominators for the whole population and population subgroups, such as age and sex groupings *(71)*. There are numerous reasons why it can be difficult to estimate population denominators, including weak pre-crisis health information systems; hindered physical access to affected populations; overreporting of population sizes to maximize possible access to resources; lack of expertise and resources to apply rigorous methods for population estimation; and crises spanning administrative boundaries. Additionally, fluctuations in the population size and composition (e.g. by age and sex) may occur due to displacement. Geospatial data and technologies and health-tracking applications (see Chapter 16) are of emerging importance for gathering information in emergency contexts.

confirmed or acute public health events or potential events of concern *(76)*. The *Weekly epidemiological record* publishes epidemiological information on cases and outbreaks of diseases *(77)*.

There may, however, be sensitivities associated with publishing data collected in conjunction with a public health emergency. The practice is often highly political, and governments may not want to acknowledge inequalities or draw attention to certain realities. For example, government ministries may be reluctant to release information that could prompt scrutiny about their preparation and response.

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PART 2

Generating impact

6

Embedding inequality monitoring within health information systems

Overview

Health information systems integrate data collection, processing, analysis, reporting, and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services *(1)*. Health information systems include data from the health sector and other relevant sectors to support management and decision-making processes across health systems *(2, 3)*. The main components of a health information system include health information system resources, indicators and related targets, data sources, data management, information products, and dissemination and use *(3)*.

Integrating health inequality monitoring considerations across a country's health information systems contributes to mainstreaming health equity in the health sector. For example, health-sector policies and plans should include equity-based targets and indicators, including those related to determinants of health. Health equity indicators can be estimated through the regular collection of disaggregated data that are timely, relevant and of high quality. Inequality analyses and reporting should be strategically timed to ensure the resulting evidence can be used as part of decision-making processes. Ideally, this equity orientation should be evident across all health programmes and initiatives, rather than serving as a parallel programme. In this way, health information systems can be leveraged to generate and link inequality data to action on health equity.

Often, however, health information systems are not optimally oriented towards generating and acting on evidence about health inequalities. They may lack the necessary funding, technical capacity, political will and public support to generate inequality data and act on the recommendations that arise from the monitoring results. In some cases, health inequality monitoring may not be conducted on a frequent basis, resulting in insufficient or untimely evidence. Societal factors external to health information systems may sway attention and resources towards maintaining the status quo (see Chapter 10).

Efforts to integrate and mainstream health inequality monitoring as part of health information systems may entail improving the quality, scope and reach of data-collection efforts. Expanded or more rigorous analysis of existing data and systems may be required, including information about health outcomes, determinants of health and health systems factors. Integrating health inequality monitoring may entail more effective strategies to communicate results of existing analyses and underlying disaggregated data to the appropriate audiences. Establishing political support for these activities is vital to ensure health inequality monitoring is adequately resourced and sustainable.

The objective of this chapter is to demonstrate how health information systems can be oriented to promote and enable routine inequality monitoring in the health sector. Much of the chapter focuses on national health information systems, but the concepts have wider applicability to other contexts. Examples are provided to demonstrate how inequality monitoring has been – or can be – embedded into the activities of global health initiatives. After identifying strategic entry points for introducing or strengthening key health inequality monitoring activities through health information systems, the chapter provides an example of inequality monitoring in immunization programmes.

Strategic entry points for promoting inequality monitoring

To enhance its impact, health inequality monitoring can be strategically integrated across the components of a health information system. This may be supported through legislative, regulatory and planning frameworks that embed health equity as a priority, commit resources for inequality monitoring, and create accountability for inequality monitoring activities. This conveys political will for characterizing and addressing situations of inequity and provides a rationale for ensuring inequality monitoring activities are adequately resourced in terms of personnel, finances and other logistics support.

The collection of high-quality, meaningfully disaggregated data ensures the availability of information about population subgroups. Investments in capacity-strengthening for inequality analysis techniques enhance the ability to assess and interpret data accurately and derive reliable conclusions. Regular reporting through annual reports, programme or policy review cycles, meetings or conventions can serve as powerful platforms to share the results of monitoring with particular audiences. Such information products, and their dissemination, can enable the use of evidence for decision-making processes.

Across these components, coordination is required to ensure inequality monitoring is aligned with relevant decision-making processes, and adequate budget allocations and other resources are dedicated to follow through with action and advocacy.

Establish inequality targets and indicators

A first strategic entry point for promoting regular health inequality monitoring lies in establishing inequality targets and indicators. Globally, equity is a key tenet of human rights treaties, and the advancement of equity is evident in major health and development initiatives (Box 6.1). High-level planning exercises, whether across national health sectors or in specific health programmes, frequently specify equity as a foundational principle. This provides a basis for developing equity targets and indicators. Their inclusion as part of monitoring frameworks creates accountability for health inequality monitoring, while also defining the parameters of what is monitored (i.e. which indicators and how they are defined) and when monitoring is to be done (i.e. ensuring timeliness of analysis and reporting). Inequality monitoring should encompass both health and determinants of health indicators, as appropriate. Consideration should be given to ensure the set of indicators reflects diverse aspects of the topic beyond health outcomes (see Chapter 3).

BOX 6.1. Major global health initiatives emphasize the reduction of health inequalities in plans and strategies

Equity has been integrated into the strategic plans and activities of high-level health programmes such as Gavi, the Vaccine Alliance, the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund), and the Joint United Nations Programme on HIV/AIDS (UNAIDS).

Gavi, the Vaccine Alliance foregrounded equity in its phase 5 institutional strategy (2021–2025), placing particular emphasis on increasing equity in immunization delivery as a core component of its health systems strengthening support *(4)*. The corresponding target aims to reduce the number of children who do not receive any routine vaccinations by 25% by 2025, and by 50% by 2030. To facilitate monitoring, Gavi has set up Zero-dose Learning Hubs in four priority countries, with the aim to marshal evidence on intervention approaches to reduce gaps and inequalities in immunization coverage, focusing on unimmunized and under-immunized children and missed communities *(5)*. For more information, see the example of embedding inequality monitoring in immunization programmes at the end of this chapter.

The Global Fund is focused on a world free of HIV, tuberculosis (TB) and malaria. Its 2023–2028 strategy, Fighting Pandemics and Building a Healthier and More Equitable World, has a specific objective calling for maximization of health equity, gender equality and human rights *(6)*. The Global Fund promotes country ownership, commitment and capacity of monitoring and evaluating equity-oriented programmes through initiatives such as Breaking Down Barriers, which carries out analyses of inequalities countries challenged by disproportionate burdens of HIV, TB and malaria. The analyses are specifically intended to expand programming and reduce human rights and gender-related barriers to services. In addition, the Global Fund has introduced new health equity key performance indicators, which track whether health inequalities are reducing within the country programmes it supports.

The UNAIDS Global Aids Strategy 2021–2026. End Inequalities. End AIDS positioned the reduction of inequalities as the key to ending HIV as a public health threat globally *(7)*. Acknowledging that inequalities exist between and within countries, and that overall averages mask areas of continued concern, the Global AIDS Strategy applies an inequalities lens to identify, reduce and eliminate inequalities that are barriers to people living with or affected by HIV.

> Equity targets are measurable goals aimed at reducing inequalities by a specified amount, within a specified timeframe. Monitoring frameworks with equity targets include indicators that capture the reduction of inequality or, in some cases, improvements among disadvantaged subgroups.

The inclusion of equity targets and indicators is not yet a standard part of health planning processes in all countries. Nearly all national health policies in the Region of the Americas, for example, specified health equity as a goal, but in more than half of countries this did not translate into the inclusion of inequality reduction targets (Box 6.2). Although the United Nations 2030 Agenda for Sustainable Development underscores a strong commitment to equity and leaving no one behind, the health-related targets and indicators are focused on global and national averages rather than the explicit reduction of inequality *(9)*. A methodology has been proposed for setting national health inequality reduction targets aligned with the health-related Sustainable Development Goal (SDG) *(10)*.

BOX 6.2. Equity in national health plans in the Region of the Americas

A region-wide analysis of national health-sector policies, strategies and plans in the Region of the Americas assessed the degree to which countries incorporated equity into their national health plans *(8)*. In nearly all of the 32 countries in the study, the national health plan stated that health equity was part of the overarching mission or vision, and countries most specified a goal of providing universal health coverage. Fewer countries, however, addressed multisectoral actions, accountability measures, or capacity to respond to health inequities.

With regard to disaggregated data, monitoring and accountability, about 60% of countries included baseline data on health inequalities in the national health plan, and around 40% included time-bound targets on reducing absolute or relative health inequalities in health service access or health outcomes. Only a few countries included health equity targets in their national development strategies.

Political will and data availability are important prerequisites for delivering on plans to address health equity. There is also a need for increased technical support and peer learning. Overall, the study concluded that the diversity across national plans – which each contained strengths and gaps – could serve as an opportunity for learning and sharing of best practices across countries.

Orient health information systems to collect disaggregated data

Another entry point for promoting inequality monitoring lies in the expanded collection of disaggregated health data across diverse data sources. Disaggregated health data reveal underlying inequality patterns that are not evident from overall averages and are the most basic data requirement for the inequality analyses described in Part 4. Many health information systems collect data that can be disaggregated by age or sex, but disaggregation by other factors, such as economic status, education or place of residence, tends to be less available. Box 6.3 describes a scoping exercise used for the WHO

BOX 6.3. Scoping exercise for the Heath Inequality Data Repository

In 2023, WHO undertook a systematic scoping exercise to identify sources of publicly available disaggregated data on health and health determinants *(11)*. The results of this exercise were featured in the 2023 update of the WHO Health Inequality Data Repository *(12)*. The exercise entailed a search of databases maintained by WHO, the United Nations and its specialized agencies, and other prominent international health, development and research organizations. The main criteria for inclusion were country-level data, disaggregated by one or more dimensions of inequality and updated within the past five years.

The search yielded data from 16 sources, including over 2000 indicators and 22 dimensions of inequality. The most common dimension of inequality was sex (87% of indicators), followed by age (23%) and place of residence (22%). There was limited availability of data disaggregated by socioeconomic-related dimensions of inequality such as education (15% of indicators), economic status (14%), subnational region (12%) or disability (2%).

Disaggregated data were available for around half of the eligible SDG indicators (52 of 97 indicators), but less than half of the indicators for the health-related goal (SDG 3) were disaggregated (11 of 26 indicators).

Health Inequality Data Repository. Countries should be strategic in planning how to collect relevant data most effectively through routine systems, surveys or special studies to understand health inequalities within the population. See Part 3 for more on data sources, including their strengths and limitations for health inequality monitoring.

Build and sustain capacity for inequality analysis

A range of technical skills are required to conduct inequality analyses, including assessing data availability and suitability, preparing disaggregating data, calculating and interpreting summary measures of inequality, and developing key messages. These topics are addressed in Parts 3 and 4. Building, strengthening and sustaining capacity for inequality analysis as part of a health information system is an active process that requires country commitment. Incorporating capacity-building for health inequality analysis into health information systems constitutes another entry point for embedding health inequality monitoring.

To this end, the *WHO Inequality Monitoring and Analysis Strategy 2022–27* includes a goal dedicated to strengthening capacity for health inequality monitoring at the country, regional and global levels *(13)*. WHO has developed a number of tools to support capacity-building in countries and other global partners *(14)*. Dedicated capacity-building activities in the South-East Asia Region, for example, have included workshops and the development of analytical frameworks and tools *(15)*.

Establish regular inequality reporting

Another entry point for promoting health inequality monitoring lies in establishing reporting requirements for inequality data and evidence. This includes ensuring available disaggregated data are routinely included in national statistical reporting (e.g. in dashboards, statistical reports or policy briefs). Some countries publish regular health inequality reports to share experiences and progress in advancing health equity. Canada, for example, established the cross-institute Pan-Canadian Health Inequalities Reporting Initiative to support regular health inequality reporting and guide health equity-informed policy and action. The Initiative has developed several key products since its inception in 2012 – including the online interactive Health Inequalities Data Tool *(16)* and key reports *(17, 18)* – to present in-depth data about some of the most pressing health inequalities across Canadian populations. The WHO SCORE assessment provided insight into how countries reported disaggregated data obtained from various data sources (Box 6.4).

Reporting practices should ensure the evidence generated from health inequality monitoring is reported in a timely manner that aligns with key policy- and decision-making periods. For example, health-sector reviews may be conducted annually or at other specified times (e.g. midterm or end of a health programme) and may be a prime opportunity for the development and uptake of evidence-informed recommendations.

Link data to action

Identifying health inequalities and building an evidence base to characterize the magnitude and trends of inequality are important functions of health information systems, but further efforts are required to foster a culture of data use. Data and evidence should be applied to inform and drive actions, including actions on underlying determinants of health, where warranted (see Chapter 9). Health information systems can support the use of data for action by linking analyses of health situations and trends to data on health inputs, including expenditure *(3)*.

A culture of evidence-based decision-making can be supported through institutional mechanisms and incentives. For example, data about health

BOX 6.4. WHO SCORE assessment

The WHO *SCORE for health data technical package: global report on health data systems and capacity, 2020* provided a global assessment (based on 133 countries) of the availability and reporting of disaggregated data from various data sources *(19)*. Overall, only half of country health statistics reports included disaggregation.

Population surveys conducted between 2013 and 2018 tended to be the sources with the most disaggregated data, especially in low- and middle-income countries. A total of 91% of surveys across all countries contained data disaggregated by sex and 83% contained data disaggregated by age – but less than 75% collected data by education, rural/urban place of residence or subnational region, and only 58% collected data disaggregated by economic status. Countries were more likely to publish analytical reports containing data disaggregated by sex (56% of countries) than by socioeconomic status (38%).

Disaggregation across other data sources was more limited. In half of countries, census data included disaggregated population projections. Routine facility data about the delivery of services and treatment outcomes specific to health programmes were more often disaggregated by subnational region than by age or sex, with variation by indicator. For example, more than 80% of countries collected age- and sex-disaggregated data about antiretroviral therapy coverage, but less than 30% collected this information with regard to severe mental health disorders. About 55% of countries reported data about health workforce density and distribution disaggregated by subnational region.

inequalities should be a core part of managing health system planning and delivery. The production and analysis of data can be linked to resource allocation (including financial and human resources) and the development of indicator-driven planning. Data may be useful to indicate underperforming programme activities that require more resources, but a programme that is performing well may still require continuous resource inputs and ongoing monitoring to ensure it continues to benefit all. For more on equity-oriented policy-making, see Chapter 8.

Data users may comprise diverse audiences within and outside the health sector, each with specialized needs and requirements. Programme planners and managers require information that is more detailed than the broader type of evidence and key messages used for strategic decision-making by policy-makers. See Chapter 7 for more on communicating about health inequalities and Chapter 24 for more on evidence-informed decision-making.

Frequency and timing of health inequality monitoring

The frequency and timing of health inequality monitoring will be informed, in part, by the availability of new data. Depending on the data source, data may be updated with different frequency. For example, routine data from the health system may be collected on a rolling basis and made available on a weekly, monthly or annual schedule. Many recurring household health surveys collect data every three to five years, while censuses are often scheduled to occur every 10 years. Other sources may collect data on a sporadic or one-off basis.

Another consideration for the timing of health inequality monitoring pertains to the rationale for repeated inequality monitoring in a given context – that is, the time by which inequalities can be reasonably expected to change. For example, monitoring during a pandemic, where new data are rapidly available and the situation is rapidly changing, may need to be done on a frequent basis. Evidence about inequalities may inform changes, with immediate effect on the population's health. On the other hand, monitoring inequalities in chronic health conditions, where the situation is slower to respond to changes, may need to be done on a less frequent basis. In some cases, health inequality monitoring can be aligned advantageously with policy cycles to maximize the impact of monitoring (see Chapter 8).

The frequency of inequality monitoring may also be contingent on the opportunity for meaningful engagement with relevant stakeholders, including communities and groups. For example, community-led monitoring efforts require the active involvement of community members and stakeholders, aiming to align monitoring activities and outputs with their needs and priorities. On these terms, inequality monitoring fosters a shared sense of ownership and accountability (see Annex 3).

Example: embedding inequality monitoring in immunization programmes

The importance of addressing inequalities in immunization is emphasized in global immunization initiatives, including the United Nations SDGs *(9)*, the WHO Immunization Agenda 2030 *(20)*, Gavi strategies *(21)*, and the Equity Reference Group for Immunization *(22)*. The evidence generated from inequality monitoring provides important inputs to guide the planning and implementation of immunization activities globally, regionally, nationally and subnationally. Immunization programmes have made strides in integrating health inequality monitoring considerations as part of data collection, evaluation, reporting and planning activities.

Dedicated and collaborative efforts to advance the collection and analysis of data pertaining to immunization have led to deeper and more precise understandings of inequalities in immunization *(23, 24)*. These efforts are driven in part by the monitoring obligations set out in the objectives, targets and indicators identified by global initiatives. For example, the Immunization Agenda 2030 calls for enhanced partnerships and people-centred approaches with local communities and representatives of disadvantaged groups, allowing for deeper understandings of local barriers and the changes needed in data and information systems *(20)*. It also includes an objective specific to the use of data to map and track subnational inequality in unvaccinated children.

As another example, WHO has developed guidance on the use of behavioural and social driver tools to understand factors affecting the uptake of vaccines by different populations *(25)*. Tracking data on the behavioural and social drivers of immunization offers insights that can help to close coverage gaps and advance equity.

Capacity-building support for health inequality monitoring activities is evident in initiatives such as the Zero-dose Learning Hubs established by Gavi *(26)*. (In this context, "zero-dose" describes children who have not received their first dose of the diphtheria, tetanus toxoid and pertussis vaccine.) The Learning Hubs serve as a global resource "to increase access to key measures, tools, and evidence; improve evidence generation aligned with the Identify–Reach–Monitor–Measure–Advocate framework; and improve synthesis, dissemination, sharing, and ultimately use to improve immunization equity" *(27)*. The mandate of the Learning Hubs includes providing collaborative capacity-strengthening, technical assistance and mentorship to identify and resolve challenges.

The results of inequality monitoring in immunization should be considered at multiple strategic points to maximize potential for impact. They should be considered during programme reviews and planning.

Expanded Programme on Immunization (EPI) reviews (also referred to as a National Immunization Programme reviews) are comprehensive assessments of the strengths and weaknesses of an immunization programme at the national, subnational and service-delivery levels *(28)*. A desk review occurs early in the EPI review process and includes inequality monitoring to help identify field sites to be visited and equity issues to be addressed.

Strategies such as reducing missed opportunities for vaccination *(29)* and tailoring immunization programmes *(30)* can use the findings of inequality monitoring to help identify underlying causes of inequities. Any proposed equity-oriented immunization interventions should be included in national immunization strategies to improve the likelihood of the activities being budgeted, planned and implemented. Thus, considerations of the results of inequality monitoring, particularly for EPI reviews, should be conducted before the immunization programme strategic planning cycle.

Gavi places a heavy emphasis on targeting and tailoring its support to the people most in need, namely, zero-dose and under-vaccinated children and missed communities. Inequality monitoring and analyses can prove foundational to informing Gavi applications and review processes.

For countries eligible for support from Gavi, another opportunity to integrate equity considerations into programmes and plans are Gavi application and review processes *(31)*. In support of applications for Gavi support for health systems strengthening, countries undertake a full portfolio planning process, with support from partners to detail goals, objectives, activities and requests for financing, including how immunization targets will be reached *(32)*. More recently, countries may apply to Gavi for dedicated Equity Accelerator Funding to support efforts to reach zero-dose children and missed communities *(33)*. The full portfolio planning and Equity Accelerator Funding applications require a situational analysis that includes equity-focused analyses, including geographic distributions, key populations (e.g. conflict-affected and nomadic populations), and gender barriers to immunization *(34)*. Joint appraisals are annual in-country multistakeholder reviews of the implementation progress, performance and results across Gavi support to the country. Although not as comprehensive as holistic EPI reviews, joint appraisals offer a key opportunity to review successes and challenges, agree on programmatic priorities for the coming period, and in some cases revisit and potentially reprogramme Gavi support to communities and populations most in need.

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7

Communicating about health inequalities

Overview

Conveying messages and recommendations about health inequalities is part of an evidence-based approach to advancing health equity. In general, the content of reporting outputs should be based on an accurate interpretation and thorough understanding of the underlying evidence and its implications (see Chapters 18, 22 and 24). Communications should be aligned with the overarching purpose of health inequality monitoring, tailored to the intended audience (i.e. considering their prior knowledge, skills, needs, priorities and interests), and delivered through an appropriate channel – effectively addressing the questions of why, what, how, when and to whom reporting is required.

Designing effective, integrated and coordinated communications requires a strategic approach. The WHO *Strategic Communications Framework for effective communications* identifies six principles for effective communications, which are relevant to activities across all audiences, including individuals, communities, health-care providers, WHO staff, international organizations and policy-makers. The principles include accessibility, actionability, credibility, relevance, timeliness and understandability *(1)*.

Reporting on health inequalities should be sensitive to the underlying context, and all people should be addressed inclusively and respectfully *(2)*. Reporting should not contribute to or perpetuate stigma or discrimination against certain populations, or lead to further marginalization or other negative consequences, especially among people who are experiencing disadvantage. Meaningful consultation and engagement with affected populations throughout inequality monitoring, including communication activities, can help to attenuate this.

Although communications may take the form of written reports, there are many other compelling ways of communicating information about health inequalities. Increasingly, reporting outputs combine a variety of multimedia elements and interactive components. When possible, members of the intended audience should be involved in the development, including pilot testing, of the reporting outputs.

The objective of this chapter is to facilitate a deeper understanding of strategies to effectively convey key messaging about health inequalities to different audiences. The chapter highlights purpose-driven reporting and reviews considerations for communication with different intended audiences, covering different types of reporting output that may be suited to specific audiences. The chapter offers strategies for navigating challenges that arise when information is scarce, or when inequality evidence is conflicting or confusing, and the content of reporting is anticipated to be unpopular or contentious with the intended audience.

This chapter complements other chapters that address technical considerations for reporting, including the presentation of inequality data (Chapter 23) and the use of health inequality analyses in evidence-informed decision-making (Chapter 24).

Purpose-driven reporting

The overarching purpose of health inequality monitoring is to promote health equity and improve the health of all people. Through regular health inequality monitoring, inequalities between population subgroups can be identified and tracked over time, which helps to inform the development of equity-oriented responses. Reporting should align with this broader vision, with the general purpose of creating knowledge and awareness. The purpose of reporting may also be oriented towards advocacy, sharing information, calls for further research, or programme or policy changes.

A description of the reporting purpose addresses why reporting is being done. Aims, goals and objectives further clarify what reporting is setting out to achieve and how it will do so. Having a clearly defined purpose of reporting can help identify an appropriate audience that is positioned to advance the aim, goals and objectives of reporting. For a given inequality analysis, multiple, complementary reporting outputs may be prepared. Clear goals and objectives for each reporting output should be identified to ensure the output fulfils its purpose and is impactful (Box 7.1).

BOX 7.1. Examples of aims, goals and objectives corresponding to different health inequality reporting purposes

The following four examples demonstrate different sets of aims, goals and objectives that may be identified as part of health inequality reporting:

- Example 1: the stated purpose of reporting may be to present an overview of the state of inequality in a country over the past decade, with the aim of integrating equity into goals and targets of a forthcoming national health strategy. The goal of reporting may be to show the potential impact of reducing inequalities. An objective may be to calculate and report summary measures of health inequality that show impact, demonstrating how accelerated improvements among disadvantaged population subgroups would benefit the overall situation.

- Example 2: the purpose of reporting may be to provide an in-depth picture of the current state of inequality in the health of population subgroups experiencing disadvantage, aiming to increase awareness about population subgroups that have been underserved by the health system and to redirect resources and programme activities to reach them. A goal of reporting may be to present evidence to inform resource reallocation. A corresponding objective could be to present disaggregated data about health outcomes, funding levels and programme activities.

BOX 7.1. *continued*

- Example 3: reporting could be undertaken with the purpose of highlighting where further research and analysis are required. The aim of this reporting may be to produce evidence to better understand the root causes of health inequalities. It may include the goal of identifying existing gaps in data and evidence that need to be addressed. A corresponding objective could be to systematically assess and report data availability for a particular health inequality analysis.
- Example 4: the purpose of reporting may be to compile the latest available global data and evidence about the current state of health inequality in a topic. The aim may be to cultivate a broad understanding of the state of inequality, with the goal of presenting high-level evidence derived from inequality analyses using data from multicountry household health surveys. To this end, the objectives may include presenting the latest state of inequality, tracking changes over time, and discussing the general implications of the findings for policies, programmes and practices.

Aims reflect the ideals of reporting or the desired result in a general sense. Aims direct the construction of goals and objectives.

Goals state what is to be done – that is, a specific desired outcome or result.

Objectives define actions to achieve goals.

Communicating with diverse audiences

Alongside the reporting purpose, consideration of the target audience for reporting is warranted to determine who is best positioned to support the intended outcome of reporting. Ideally, the identified audience has an interest in the topic area and can help achieve the goals and objectives of reporting. In some cases, the audience may be very intentional. For example, reporting may be done to a specific department within the ministry of health or to members of a certain policy advisory group. In other cases, the audience may encompass diverse groups of people across multiple sectors, such as policy-makers, community leaders, affected populations, civil society actors, researchers, scientists and other knowledge users. As a continuation of Box 7.1, considerations for identifying target audiences for each of the four examples are presented in Box 7.2.

It is important to be familiar with the interests, needs and preferences of the target audience to ensure reporting is relevant and accessible. It is also important to consider the prior knowledge of the audience about the health topic, population, setting, inequalities, and approaches for measuring inequalities (Box 7.3). For example, it would likely be appropriate to include detailed technical content in reports designed for researchers and scientists. Policy-makers or programme managers, on the other hand, tend to value more succinct summaries of results, accompanied by clear and timely recommendations. For general audiences, such as affected populations or community leaders, plain language should be used, focusing on new and relatable insights into the topic area.

Having close familiarity with the target audience means relevant information can be included in a way that is accessible to the audience and, where applicable, motivates the audience to take desired actions. To the extent possible, members of the target audience should be involved in the

BOX 7.2. Examples of target audiences corresponding to different health inequality reporting purposes

Building on the examples presented in Box 7.1, different target audiences may be positioned to support the specified aims, goals and objectives for reporting:

- Example 1: the aim is to integrate equity into the goals and targets of a forthcoming national health strategy. A relevant target audience would be national policy-makers and others involved in the development of the health strategy.
- Example 2: reporting is focused on informing resource allocation and programme activities to reach populations underserved by the health system. Programme managers would be an appropriate target audience, because their role as managers means they have influence on decisions about resource allocation and programme activities.
- Example 3: reporting highlights where further research and analysis are required to better understand the causes of inequality. This reporting would be appropriately directed to academic audiences such as researchers and people who oversee research funding decisions. These audiences are positioned to act on addressing the identified research gaps.
- Example 4: the reporting output presents the current global state of inequality. Because of its broad purpose, this output could serve as useful background for diverse audiences, including policy-makers, civil society actors, scientists and the general public. Other accompanying reporting outputs may be developed for more specific audiences, such as policy briefs for policy-makers or research papers for academic audiences.

BOX 7.3. Learning about target audiences

Acquiring an in-depth understanding of the audience may seek answers to questions such as:

- Are there prevailing biases or misconceptions that should be addressed?
- How do audience members tend to access information?
- What is the technical ability of the audience?
- What type of language (technical or plain) is preferred, and at what level?
- What is the level of digital literacy?
- What are the relevant political, cultural and social influences that affect how audiences interpret and act upon knowledge?
- What are the processes that guide how information is used and shared?

This list is not exhaustive, but it underscores the insights that will enable more impactful reporting.

development of reporting outputs, including piloting reporting approaches. Existing examples of high-quality and impactful reporting outputs can be consulted to derive lessons and best practices.

Reporting outputs

There are many types of reporting outputs, which can be tailored to reach different audiences with different types of information. For example, peer-reviewed journal articles and technical reports require more detailed methods and results because they are intended for audiences with more technical expertise. Other forms of reporting, such as policy briefs and nontechnical reports, tend to include a greater focus on the application and use of the findings and may be particularly impactful with audiences such as policy-makers, civil society actors and health advocates.

Multiple reporting outputs may be prepared and used to complement each other. The use of multiple reporting outputs can help to reach broader audiences and cater to members of the target audiences with different preferences in how they access information – for example, some people may prefer to read information, but others may prefer to listen to audio tracks. The use of multiple reporting outputs can help to reinforce key messages and make different types of supporting information accessible.

See Chapter 23 for an overview of the general components of health inequality reporting, including examples and best practices.

Written reports

Written reports are a common reporting output that can be tailored for a variety of audiences and reporting purposes. Reports may be highly technical, containing a high level of detail about the results and the underlying analysis approach. For example, the WHO State of Inequality and Explorations of Inequality Reports are technical reports written for specialized audiences familiar with the topics or analysis approaches *(3)*. The WHO World Health Statistics reports are global annual statistical reports that provide updated information on selected health topics, with disaggregated data where available *(4)*. Academic publications such as peer-reviewed journal articles are another form of written highly technical report with a prescribed reporting structure (Box 7.4).

In some cases, reports may be less technical. For example, reports geared towards general audiences or policy-makers may present analysis findings more generally, emphasizing their practical implications. Policy briefs are written reports that contain focused information about a specific issue. They are prepared to be accessible to nonspecialized audiences that may not have extensive knowledge of the issue. They usually include some contextual information and relevant evidence, but the key features of policy briefs are options and recommendations for follow-up actions and policies. Policy briefs are typically short and, depending on the context, may follow a specific template.

> Readability assessments, available online or through word-processing software, can provide an initial sense of the accessibility of the language and style of writing to the intended audience.

Written reports often combine narrative text with tables, graphs and maps. Additional elements such as photographs, personal anecdotes, reference lists and technical appendices can also be integrated, as appropriate. Many institutions have established systems for distributing and archiving written reports, either digitally or in print form.

BOX 7.4. Academic publications

Academic publications such as journal articles are written primarily for researchers or people with advanced technical knowledge. They are appropriate outputs for reporting technical details about a specific analysis, with a detailed description of the underlying methodology. The organization of an academic publication often includes four clearly demarcated sections:

- The introduction contains relevant background information, explains why the study was undertaken, and states the research question or objective.
- The methods describe how the study was conducted, including details about the population, data sources, health indicator and inequality dimension variables, analysis methods and interpretation. The level of detail should be sufficient such that the analysis approach could be replicated.
- The results present the findings of the analysis and answer the research question.
- The discussion explores the implications of the results and how they fit with the current state of knowledge, and future research directions.

Academic publications that go through a peer-review process have a high level of credibility within the scientific community. There are well-established systems for archiving, cataloguing and searching academic publications.

Interactive displays

Interactive displays present findings digitally, engaging viewers as active participants in determining the information that is presented. Data repositories, platforms and tools designed around large datasets may enable tailored exploration of the data. For example, the WHO Health Equity Assessment Toolkit allows users to select a health topic and customize views according to settings, data sources, dates, indicators, inequality dimensions, and various graph and table types *(5)*. These display types tend to be appropriate for audiences with more advanced technical knowledge (see Chapter 23).

Interactive displays may also be designed for more general audiences. Displays can be integrated into websites and other digital content to highlight key messages, appealing to a wider audience. The use of a visual summary, for example, engages users by presenting information in a predominately pictorial format with interactive components. Visual summaries have been prepared alongside the *State of inequality: HIV, tuberculosis and malaria* report *(6)* and the WHO World Health Statistics reports *(4)*.

Presentations

Presentations such as webinars, interviews and conferences can be an engaging way to provide a human connection to reporting. Presentations are most effective when the results are conveyed through clear key messages. They can be particularly impactful when reporting is advocacy-oriented (i.e. asking for a follow-up response or action from the audience). Depending on the format, presentations may include interactive elements such as audience polls or question-and-answer sessions. Recording and disseminating presentations can increase the reach of these outputs.

WHO regularly hosts webinars on occasions such as the launch of inequality monitoring resources and journal special issues. As examples, see the recordings of the webinar for the launch of the step-by-step manual for inequality monitoring in sexual, reproductive, maternal, newborn, child and adolescent health *(7)*, and the webinar for the launch of the 2023 special issue of Vaccines on inequality in immunization *(8)*. These webinars feature remarks by senior members of the WHO leadership team, reflections from technical experts internal and external to WHO, testimonials from members of the target audience, and question-and-answer sessions.

News media

Traditional media content (e.g. articles, commentaries, opinion pieces, and radio and television broadcasts) and social media content (e.g. posts shared through networking platforms) are other approaches to reporting. Videos, factsheets and question-and-answer documents, which may accompany news media, can be effective ways to provide information about inequality to the general public. The ability to track public engagement with content and to interact with the public (e.g. through comment sections and message boards) can help to gauge public interest and tailor information and messaging to the intended audience.

> Commentaries and opinion pieces may be written by people directly involved in carrying out monitoring activities (e.g. researchers, analysts, policy-makers or other subject matter experts) to express an opinion, backed by evidence.

Depending on the outlet, traditional and social media content can achieve wide coverage among general audiences, bringing attention to the most important messages. Traditional and social media tend to be appropriate for reporting a limited number of key messages and may direct audiences towards other reporting outputs for further details. For example, WHO and the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) used several forms of news media as part of disseminating the findings from the *State of inequality: HIV, tuberculosis and malaria* report (Box 7.5).

Delivering key messages

As described in Chapter 24, the results of inequality analyses, together with other forms of evidence, should inform the development of key messages and recommendations communicated as part of health inequality reporting. When delivering key messages to different audiences, however, challenges may arise when navigating information gaps, conflicting or confusing messaging, and unpopular messaging. Across these scenarios, communication efforts benefit from pilot testing reporting outputs and key messages with members of the intended audience to ensure the messaging is presented clearly and in an effective format. If feasible, working with communication experts may be warranted if the messaging is particularly challenging.

BOX 7.5. Use of news media to disseminate inequality messages about HIV, tuberculosis and malaria

On the publication of the *State of inequality: HIV, tuberculosis and malaria* report *(9)*, WHO and the Global Fund put out a joint news release to announce the publication and spotlight high-level messages from the report *(10)*. The release was picked up and covered by news media from around the world.

As part of a social media plan, social media assets were created and disseminated through WHO social media accounts on multiple platforms. This included a video clip, which was reposted on the report webpage *(11)*.

The authors of the report published a commentary in a prominent general medical journal to underscore the key findings of the report *(12)*.

Communicating about information gaps

In some cases, key messages about health inequalities may be derived from information that is incomplete, outdated or of poor quality. For example, a lack of disaggregated data for relevant health indicators and inequality dimensions may leave gaps in the analysis. In some contexts, such as acute emergencies, there may be a high level of uncertainty associated with the accuracy of the data because the situation is evolving and changing, with variable data availability and quality (see Chapter 5).

Aspects of risk communication and community engagement strategies, which are integral to health emergency readiness and response activities, may be relevant when faced with information gaps. A central tenant in such responses is to proactively communicate what is known, what is not known, and what is being done to get more information. The use of regular communication with the public recognizes that people have the right to be informed and community engagement can strengthen involvement in responses *(13)*.

In terms of health inequality monitoring, findings and key messages should not be overstated. Instead, reporting should be upfront about any underlying limitations related to the data and their interpretation. Uncertainty in the messaging should be highlighted by presenting qualitative explanations for general audiences and including statistical measures of uncertainty for audiences with higher data literacy. Accompanying messaging may highlight the need for improved or expanded data collection or strengthened capacity for inequality monitoring. For more on strategies for navigating data scarcity as part of sourcing data for health inequality analyses, see Chapter 15.

Making sense of conflicting or confusing messaging

Conflicting or confusing messaging may be a concern when the direction of inequality is unexpected (i.e. a subgroup that is traditionally disadvantaged outperforms more advantaged subgroups); when key messages do not align with what is happening in other populations or settings; or when there are outliers in the results. Such cases may arise due to variable data quality – in which case, it may be advisable to reassess the data source and analysis to find an explanation.

It might be the case, however, that the messages derived from the data accurately reflect complexities of the situation in the affected population. Delivering key messages that are conflicting or confusing requires attention to ensure adequate context is provided. This includes consulting other qualitative and quantitative evidence and seeking expert opinions to understand factors that may contribute to the observed situation.

For example, global data have shown that the burden of tuberculosis (TB) was higher in men than women *(14)*. It is important, however, to consider the fuller context, recognizing that women face gender-related barriers to TB diagnosis and care and experience greater stigma and discrimination. Women may also lack decision-making power over health and care-seeking decisions *(15)*.

Delivering unpopular messaging

The messaging derived from health inequality monitoring may be unpopular or sensitive with some audiences. For example, messaging may draw attention to the shortcomings of governments, the systemic exclusion or lack of recognition of certain populations, or issues such as misinformation, discrimination or corruption.

Delivering unpopular messaging requires a thoughtful and strategic approach that balances evidence with an understanding of and respect for the perspectives and values of all stakeholders, including the populations represented in the monitoring results and the intended audience for reporting. The main results of inequality analyses should be reviewed with diverse stakeholder groups (including affected populations) to ensure that conclusions and recommendations are relevant and sensitive to gender and culture, and that they do not perpetuate stigma and discrimination against groups experiencing disadvantage. Messaging should aim to balance reporting on deficits and strengths. Reporting approaches that emphasize deficits over strengths should be avoided because this may stigmatize groups in vulnerable situations, reinforce power imbalances, erode trust and credibility with communities, and shift the focus away from the structural factors that underlie inequalities.

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8

Equity-oriented policy-making

Overview

Equity-oriented health policies honour the right to health (and related rights) of all people by creating and sustaining conditions for all people to achieve their highest attainable standard of health. Policy measures, whether within or beyond the purview of the health system, should be informed by evidence. The use of evidence to inform policy-making, however, requires that the data are provided in the right format, to the right person, at the right time.

Equity-oriented policy-making is the bedrock of the global development agenda, reflected in the mandate of WHO – which states that "governments have a responsibility for the health of their peoples which can be fulfilled only by the provision of adequate health and social measures" *(1)* – and the imperative of "leaving no one behind" in the United Nations 2030 Agenda for Sustainable Development *(2)*. Health equity is a policy directive around which there is global consensus and commitment, and obligation on the part of national and subnational authorities.

This chapter focuses on policy-making environments, where advancing action to reduce health inequities requires prioritization, allocation of resources, and design of policies or interventions, often in resource-scarce areas. Various forms of evidence, including inequality analyses, can help to inform these actions (see Chapter 24), taking into account other contextual economic, political, moral and practical considerations. The goal of Health for All is aligned with equity-oriented policy – and both the process and the outcome of equity-oriented policy-making must be transparent and accountable and result from robust ethical consideration.

The objective of this chapter is to introduce considerations, contexts and approaches for equity-oriented policy-making. After outlining general considerations for policy-making, the chapter describes primary health care and universal health coverage as guiding principles for equity-oriented policy-making, highlighting the concept of progressive universalism, in which populations experiencing disadvantage are prioritized on the pathway to achieving the goal of universalism. The chapter introduces the priority public health conditions analysis framework and its application as a holistic approach underpinning policy-making processes.

General considerations for policy-making

Setting a policy agenda for health equity raises several issues *(3)*. In prioritizing policy actions, consideration is required regarding which inequalities constitute inequitable differences and are potentially subject to remediable actions; which subgroups warrant more attention or resources (e.g. due to disproportionate need or historical injustices); and how resources should be invested to balance improvements in overall population health with targeted approaches that focus on priority subgroups *(4)*. Policy-makers may inevitably face competing demands and interests and will need to negotiate the extent to which policies and subsequent investments address equity concerns *(5, 6)*.

To promote effective and impactful engagement in the policy process, it is important to align with national planning and policy cycles, including budget planning to secure financial resources for policy directives (see Chapter 4). National policy cycles are country-specific. Some countries have longer, overarching national health policies spanning multiple years, with other longer-range policies addressing specific health topics or priority populations. Countries may have scheduled annual reviews and updates, with different arrangements for working with international partners *(7)*.

Health inequities reflect social and political circumstances that systematically disadvantage certain subgroups. Health system policies can help to reduce inequalities, but equity-oriented interventions operating outside the health sector entirely can also have important impacts *(8)*. Policy action at several levels, including actions on proximal, intermediate and distal determinants of health, are vital to address the drivers of inequality. The importance of multisectoral actions aimed at social determinants of health (see Chapter 9) and efforts to improve societal-level injustices (see Chapter 10) are widely acknowledged – although in practice, policies and interventions often focus on individual-level behaviours, which may limit their effectiveness in the long term *(9)*.

Policy environments for advancing Health for All

Equity-oriented health policies are instantiated in the Health for All goal, which builds a moral case for health equity. Health for All – whereby all people have good health for a fulfilling life in a peaceful, prosperous and sustainable world – has remained a guiding vision for public health initiatives and policies around the globe since the late 1970s (Box 8.1). Health for All is emphasized in the WHO Fourteenth General Programme of Work for 2025–2028, which reaffirms WHO commitment to health equity and the common goal of promoting, providing and protecting health *(14)*.

Health for All conveys the WHO holistic understanding of health, which extends beyond the absence of disease and infirmity to broader aspects of physical, mental and social well-being that enable a fulfilling life. It captures the central importance of the surrounding environments, alluding to the diverse conditions that together are a prerequisite for population-level health. Aspiring towards Health for All upholds values of universality, community participation and social justice, respecting the significance of each person and their fundamental human right to health *(15)*.

Under the vision of Health for All, individuals and communities live in environments that enable, protect and maintain health – and, when needed, have access to high-quality health services so they can take care of their own health and that of their families. Skilled health workers provide good-quality, person-centred care, and policy-makers

BOX 8.1. Health for All

In 1977, the 30th World Health Assembly resolved that "the main social target of governments and WHO in the coming decades should be the attainment by all citizens of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life" *(10)*.

In 1978, Health for All was adopted as a goal at the International Conference on Primary Health Care in Alma-Ata (now Almaty, Kazakhstan). The Declaration of Alma-Ata was a commitment among health leaders to advance primary health care and uphold values of social justice, health equity and the social determinants of health *(11)*. It positioned health at the centre of development policy, shifting the onus of governments from providing health services towards being accountable for the health of their populations *(12)*. The Declaration called attention to inequalities, stating that "the existing gross inequality in the health status of the people particularly between developed and developing countries as well as within countries is politically, socially and economically unacceptable and is, therefore, of common concern to all countries" *(11)*.

In commemoration of the 40-year anniversary of the Alma-Ata Declaration, the Astana Declaration, endorsed at the 2018 Global Conference on Primary Health Care in Astana, Kazakhstan, renewed a commitment to achieve Health for All, involving major investments in primary health care to improve health outcomes *(13)*.

are committed to investing in a full range of good-quality health services that are accessible to people, when and where they are needed. The pursuit of Health for All entails coordinated action across multiple sectors. A primary health-care approach for achieving universal health coverage is the means through which Health for All can be realized *(15)*.

Primary health care

Primary health care is a whole-of-society approach to health that aims to maximize the level and equitable distribution of health and well-being. It focuses on people's needs and preferences as early as possible along the continuum from health promotion and disease prevention to treatment, rehabilitation and palliative care. Primary health care encompasses three mutually dependent components: primary care and essential public health functions at the core of all integrated health services; multisectoral policy and action; and individual empowerment and community engagement *(15)*. It upholds a holistic and proactive approach to health and well-being and can serve as a basis for health system strengthening.

Primary health care-oriented health policies and plans can enhance equity through context-specific strategies that focus on reaching groups that experience disadvantage and stand to benefit from policies to increase health service access and financial protection *(16)*. This has been achieved through means such as:

- prioritizing public funding and explicit coverage of essential health services for groups experiencing disadvantage;
- allocating defined communities to specific health teams that can provide care holistically through the process of empanelment;
- developing decentralized multidisciplinary teams that include community health workers and managers;
- making care more approachable and acceptable through community-led approaches;
- using technologies to bring care to underserved areas.

The 2020 WHO *Operational framework for primary health care* proposed a set of 14 strategic and operations levers, with corresponding actions and interventions for national, subnational and community stakeholders to advance equity-oriented primary health care policies *(17)*. The monitoring and evaluation lever recognizes the importance of using data and information to support the continuous processes of prioritization, decision-making and planning that are inherent to strengthening primary health care. To this end, countries require comprehensive, coherent and integrated approaches to monitoring and evaluation that encompass a broad set of health indicators and inequality dimensions. In 2022, WHO released a primary health-care measurement framework. This included a menu of indicators for policy-makers and leaders to track and monitor progress in strengthening primary health care-oriented health systems as a key proponent of accelerating universal health coverage and the Sustainable Development Goals (SDGs). The guidance recommends that monitoring includes data disaggregated by diverse dimensions of inequality relevant to the indicator and context *(18)*.

Universal health coverage

Achieving universal health coverage – which is the aim of SDG target 3.8 – means that all people have access to the full range of good-quality health services they need, when and where they need them, without financial hardship. This covers the full continuum of essential health services, from health promotion to prevention, treatment, rehabilitation and palliative care across the life course *(19)*. Health inequality monitoring and equity-oriented target-setting can support the realization of universal health coverage *(20)*.

Policies can support universal health coverage by ensuring health services are used relative to need; are efficiently delivered and accessed; are of good quality; and are offered in an environment of transparency and accountability. The expansion of universal health coverage requires policy action on three fronts: expanding the number and extent of services that are covered; expanding coverage to people who are not covered; and protecting people from the financial consequences of paying out of pocket when they seek health services. Given this complexity, universal health coverage cannot be attained all at once and by using a singular approach or strategy – rather, it requires progressive universalism.

Progressive universalism

The concept of progressive universalism is central to promoting equity throughout the process of advancing universal health coverage *(21)*. As health services are expanded as part of universal health coverage, fair progressive universalism approaches require that services be allocated according to need, such that people with greater needs receive more services *(22)*. In this way, the advancement of universal health coverage intentionally provides services to population subgroups experiencing disadvantage first, rather than providing services to everyone and assuming it reaches those in greatest need (sometimes called a “trickle-down approach”).

> Progressive universalism is an approach to reaching universal health coverage that ensures disadvantaged populations realize equal or greater gains until the goal of universalism is eventually approached *(23)*.

A general strategy for countries seeking fair progressive realization of universal health coverage requires:

- categorizing health services into priority classes, using criteria related to cost-effectiveness, prioritizing people who are worse off, and financial risk protection;

- expanding coverage for high-priority services to everyone, including financial protection and sustainable financing mechanisms;
- ensuring groups experiencing disadvantage are not left behind *(21)*.

Progressive universalism requires the approach of advancing service coverage in an incremental fashion. An aspirational essential set of services can be defined, and then a core set of services within this can first be provided to all people. Once the budget and system resources allow, the scope of services can be increased over time *(24)*. Progressive universalism also requires that healthy and wealthy members of society cross-subsidize people who experience ill-health, vulnerability, poverty or other forms of disadvantage, through the exercise of social solidarity *(22)*. Although there may be competing considerations when pursuing the fair, progressive realization of universal health coverage, certain trade-offs have been identified as inequitable and therefore unacceptable (Box 8.2).

Equity-oriented policies are central to the realization of universal health coverage through progressive universalism. There are, however, some challenges. Disadvantaged populations may be difficult to identify and reach through programming, underscoring the need to establish strong health inequality monitoring systems alongside effective equity-oriented service delivery platforms. There may be challenges with regard to health system capacity in priority communities. Dedicated efforts may be required to achieve effective coverage, defined as "the proportion of people in need of services who receive services of sufficient quality to obtain potential health gains" *(25)*. For more on the assessing effective coverage and the Tanahashi framework, see Box 8.3.

BOX 8.2. Unacceptable trade-offs for the fair progressive realization of universal health coverage

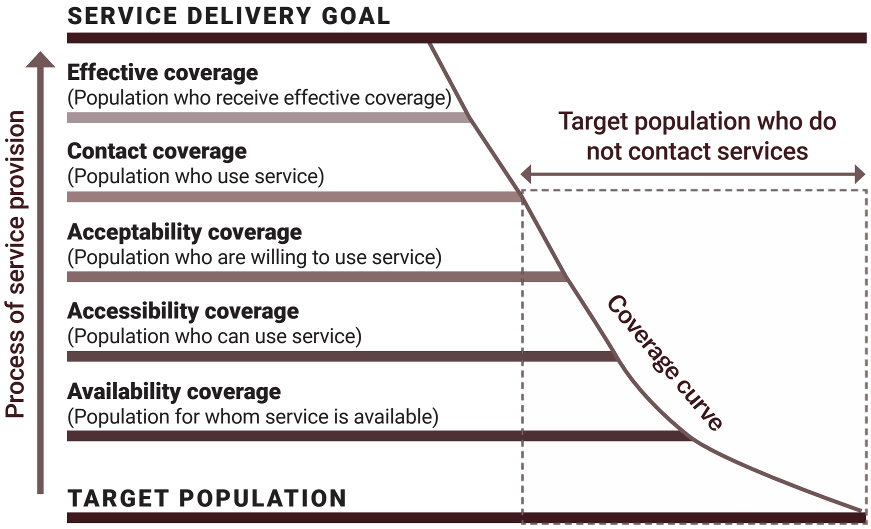
The following compromises are considered unacceptable when pursing the fair progressive realization of universal health coverage:

- It is unacceptable to expand coverage for low- or medium-priority services before achieving near-universal coverage for high-priority services. This includes reducing out-of-pocket payments for low- or medium-priority services before eliminating out-of-pocket payments for high-priority services.
- It is unacceptable to prioritize very costly services whose coverage will provide substantial financial protection when the health benefits are very small compared with alternative, less costly services.
- It is unacceptable to expand coverage for more-advantaged groups before doing so for less-advantaged groups, when the costs and benefits are similar. This includes expanding coverage for people with already high coverage before groups with lower coverage.
- It is unacceptable to give priority to people with the ability to pay and to not include informal workers and poor people, even if such an approach would be easier.
- It is unacceptable to shift from out-of-pocket payments towards mandatory prepayments in a way that makes the financing system less progressive *(21)*.

BOX 8.3. Tanahashi framework for assessing service coverage

The Tanahashi framework can be used to identify, map and monitor gaps and barriers along a coverage continuum. The framework illustrates coverage of a given service or group of services (e.g. a benefits package) as a cascade (Figure 8.1). The cascade begins with availability coverage, representing what services are being provided, where and by whom. Following this, it captures the extent to which such services are within reasonable reach (accessibility coverage). Even if services are available and accessible, users may not be willing or able to use these services because they are not affordable or culturally appropriate (acceptability coverage). Next on the cascade is contact coverage, representing the extent to which services are being used – although this may not mean that the services are effective. Effective coverage is the extent to which services are safe, of good quality, efficient, and found to be satisfactory by users *(26)*.

FIGURE 8.1. Tanahashi framework of coverage



Source: derived from WHO *Handbook for conducting assessments of barriers to effective coverage with health services (27)*, based on Tanahashi *(26)*.

Using data disaggregated by relevant inequality dimensions, the Tanahashi framework can be used as a basis to explore inequalities in levels of attainment of service coverage, leading to deeper understanding of the different barriers to effective coverage and entry points for equity-oriented policy responses. According to a 2023 review, applications of the Tanahashi framework across different settings and health topics frequently reveal a large drop in effective coverage across the processes of service provision *(28)*.

BOX 8.3. *continued*

The Tanahashi framework was used as part of a barriers assessment activity in the Republic of Moldova in 2011. The assessment found that many gaps in health service coverage remained. Furthermore, there was a lack of routine monitoring of effective coverage and scant information about populations that are excluded or experiencing disadvantage. The report made several recommendations for policy and research to address gaps across each level of the cascade *(29)*.

The WHO *Handbook for conducting assessments of barriers to effective coverage with health services* elaborates more on methods for exploring barriers and facilitating factors to effective coverage within each of the coverage domains of the Tanahashi framework. It contains additional examples of how the framework has been used to inform policy and programming *(27)*.

Priority public health conditions analysis framework

Designing policies to tackle health inequities requires a deep understanding of how inequities are generated, which can then inform supportive policy environments to address and mitigate them. The priority public health conditions analysis framework provides a practical and holistic approach for analysing, intervening and measuring health equity and its determinants across five levels of analysis, spanning:

- structure of society, encompassing socio-economic contexts, relations and positions;
- differential environmental exposures through social and physical environments;
- differential vulnerability resulting from population characteristics;
- differential health outcomes across individuals;
- differential consequences of poor health.

At each level, analyses are aimed at establishing entry points for interventions and understanding potential side-effects, sources of resistance to change, and lessons learnt from previous experiences *(30)*. The components of the framework reflect the social origins of health inequities proposed by Diderichsen and colleagues *(31)* and applied in the work of the Commission on Social Determinants of Health Priority Public Health Knowledge Network *(30)*. The framework aligns with the political commitments expressed in the 2011 Rio Political Declaration on Social Determinants of Health (Box 8.4). For more on social determinants of health, see Chapter 9.

The priority public health conditions analysis framework has been widely applied. For example, it was used to understand the disproportionate impacts of COVID-19 across ethnic minority groups and Indigenous Peoples. The analysis elucidated key drivers of the greater risk of severe outcomes from COVID-19 among ethnic minority groups and Indigenous Peoples, and the differential vulnerability, exposure, and consequences experienced by ethnic minority groups and Indigenous Peoples. Opportunities for interventions to address racism, racial discrimination and intersecting drivers of inequity in service coverage were identified *(33)*.

BOX 8.4. Rio Political Declaration on Social Determinants of Health

The 2011 Rio Political Declaration on Social Determinants of Health expresses global political commitments to "achieve social and health equity through action on social determinants of health and well-being by a comprehensive intersectoral approach" *(32)*. The declaration identified five key action areas for advancing health equity: adopting better governance for health and development; promoting participation in policy-making and implementation; further reorienting the health sector towards reducing health inequities; strengthening global governance and collaboration; and monitoring progress and increasing accountability.

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9

Social determinants of health: from monitoring to multisectoral action

Overview

Although health inequalities can be driven by health system performance deficiencies, they are also impacted by broader conditions outside the medical and health sector that influence health outcomes. Social determinants of health (SDH) refer to the conditions in which people are born, grow, work, live, and age, and people's access to power, money and resources *(1)*. SDH encompass factors important for health in daily life such as income security and social protection, education, employment and job insecurity, good working conditions, food security, good-quality physical environment (including housing and basic amenities), early childhood development, social inclusion and nondiscrimination, security (the absence of violence), and access to affordable health services of good quality *(1)*.

SDH have a powerful influence on health and are major drivers of health inequalities. SDH frameworks can help to distil evidence on the wide range of factors important for sustaining healthy living and working conditions and on the core causal mechanisms through which health inequalities emerge. Moreover, understanding how population groups variably experience SDH, and the mechanisms behind them, is an essential part of responses to improve health and reduce health inequity.

Interventions and policies addressing SDH, such as early education programmes and social protection, can have positive effects on health and the reduction of health inequalities. Due to the cross-cutting nature of SDH, taking action to address them is strengthened through collaborations across health and non-health sectors. Approaches such as Health in All Policies (HiAP) – "an approach to public policies across sectors that systematically takes into account the health implications of decisions, seeks synergies, and avoids harmful health impacts in order to improve population health and health equity" *(2)* – are crucial to embed SDH and health interests in policies across sectors.

As the area of SDH is vast and other guides exist describing the context for action and the monitoring of SDH for advancing health equity *(3, 4)*, the objectives of this chapter are to recognize the importance of SDH in understanding and addressing health inequalities, to initiate discussion about actions on SDH, and to propose strategies for building and sustaining multisectoral partnerships. Following an overview of the political commitments to addressing SDH on the global health stage, this chapter discusses the application of inequality monitoring approaches to assess inequalities in SDH. It provides examples of how SDH data have been used to address health inequalities as part of multisectoral collaborations and an integrated HiAP approach. This chapter refers to a selection of resources for further exploration of these topics.

Political commitments

Over the past half-century, although many countries have witnessed remarkable health gains, unacceptable gaps still persist in health within and across countries. Decades of research show the powerful influence of SDH on population health and health inequities, as recorded in the final 2008 report of the WHO Commission on the Social Determinants of Health. This report called on WHO and all governments to lead global action on SDH in accordance with three overarching recommendations: improve daily living conditions; tackle the inequitable distribution of power, money and resources; and measure and understand the problem and assess the impact of action *(5)*. The third of these recommendations set a global mandate for health monitoring in service of addressing health equity and the SDH by calling for a global health equity surveillance framework that included monitoring of health equity and social determinants (Box 9.1).

Following this recognition of the importance of addressing SDH, intensified efforts were made to advance political will for multisectoral approaches and governance under the banner of HiAP and technical work on monitoring SDH. A number of high-level commitments to address SDH were made, including the 2010 Adelaide Statement on Health in All Policies *(6)* and the 2011 Rio Political Declaration on the Social Determinants of Health *(7)*. The Declaration of Oslo on Social Determinants of Health put SDH on the agenda of the World Medical Association and its national representative groups *(8)*. Over the period of 2013–2017, parallel efforts on HiAP led to WHO regional position statements *(9)*, the new definition of HiAP and the Helsinki Statement on HiAP *(2)*, and technical resources describing how to take action through a global training programme on HiAP *(10)*.

BOX 9.1. WHO Commission on the Social Determinants of Health recommendations regarding monitoring

The Commission recommended three specific actions on monitoring:

- Ensure routine monitoring systems for health equity and social determinants are in place locally, nationally and internationally.
- Invest in generating and sharing new evidence on how social determinants influence population health and health equity, and on the effectiveness of measures to reduce health inequities through action on social determinants.
- Provide information about social determinants to policy actors, stakeholders and practitioners, and invest in raising public awareness *(5)*.

> Through the Rio Political Declaration, countries expressed a commitment to "achieve social and health equity through action on the social determinants of health and well-being by a comprehensive intersectoral approach", including a pledge to establish and strengthen monitoring systems that provide disaggregated data for assessing health inequalities *(7)*.

WHO Member States have reinvigorated the call for a unified political commitment to address SDH. In 2021, at the 74th WHO World Health Assembly, Member States requested WHO to develop an operational framework for the measurement and assessment of SDH and health inequities, how they are addressed from a cross-sectoral perspective, and their impact on health outcomes *(11)*.

Monitoring social determinants of health

Monitoring SDH involves "systematically collecting, analysing and reporting data on SDH and action indicators across multiple sectors" *(3)*. When performed through an equity lens, evidence about SDH contributes to a broader understanding of population health and provides insight into the factors and actions that drive health inequalities, which can be used to inform evidence-based policy-making.

Monitoring SDH is critical to achieve health equity, for a number of reasons *(3)*. Assessments of SDH data can reveal sources of injustices in SDH and related policies and interventions. Monitoring SDH and related actions can help to show what conditions and actions promote or detract from health and drive or reduce health gaps. It can lend understanding to whether interventions, policies and investments are addressing and improving SDH. Integrating SDH in health inequality monitoring provides a way for countries to measure and track progress towards health equity over time. In this way, monitoring SDH can strengthen accountability and transparency. Box 9.2 lists further reading on the evidence about SDH monitoring.

Following the general approach described in Chapter 2, the steps for monitoring health inequalities can be applied to quantify differences

BOX 9.2. Further reading on evidence about SDH monitoring

Biermann O, Mwoka M, Ettman CK, Abdalla SM, Shawky S, Ambuko J, et al. Data, social determinants, and better decision-making for health: the 3-D commission. J Urban Health. 2021;98(Suppl. 1):4–14. doi:10.1007/s11524-021-00556-9.

De Paz C, Valentine NB, Hosseinpoor AR, Koller TS, Gerecke M. Intersectoral factors influencing equity-oriented progress towards universal health coverage: results from a scoping review of literature. Geneva: World Health Organization; 2017 (https://iris.who.int/handle/10665/255607, accessed 4 September 2024).

Donkin A, Goldblatt P, Allen J, Nathanson V, Marmot M. Global action on the social determinants of health. BMJ Global Health. 2018;3(Suppl. 1):e000603. doi:10.1136/bmjgh-2017-000603corr1.

Pega F, Valentine NB, Rasanathan K, Hosseinpoor AR, Torgersen TP, Ramanathan V, et al. The need to monitor actions on the social determinants of health. Bull World Health Organ. 2017;95(11):784–7. doi:10.2471/BLT.16.184622.

BOX 9.2. *continued*

Valentine NB, Koller TS, Hosseinpoor AR. Monitoring health determinants with an equity focus: a key role in addressing social determinants, universal health coverage, and advancing the 2030 sustainable development agenda. Glob Health Action. 2016;9:34247. doi:10.3402/gha.v9.34247.

Working Group for Monitoring Action on the Social Determinants of Health. Towards a global monitoring system for implementing the Rio Political Declaration on Social Determinants of Health: developing a core set of indicators for government action on the social determinants of health to improve health equity. Int J Equity Health. 2018;17(1):136. doi:10.1186/s12939-018-0836-7.

in SDH indicators between subgroups constructed on the basis of economic status, education level, place of residence, sex, subnational region or other dimensions of inequality (see Annex 1 for more on monitoring inequalities in SDH). Familiarity with SDH within a population – including how SDH are differentially experienced by population subgroups – can inform the selection of relevant health indicators and dimensions of inequalities for monitoring. SDH evidence can be presented alongside the results of other health inequality analyses to set the scene for reporting, and when developing key messages and recommendations.

Monitoring SDH with an equity focus is concerned with indicators describing actions to improve the distribution of power, resources and environments for populations, and indicators that describe the conditions of daily life.

As an extension of health inequality monitoring, ecological analyses can be conducted to assess correlations between SDH and health indicators. These techniques, covered in Chapter 25, can reveal high-level associations between SDH variables and health indicators, measured at the population level. Assessing the relationships between SDH and health indicators can help to better understand factors explaining population health. Although such assessments of association cannot confirm causation, the results of these analyses can serve as a starting point for conducting further studies.

Systems for monitoring SDH have been in place at the global, regional, national and local levels from the 1990s onwards, but they have tended to have limited impact, particularly at the national level. Few countries systematically monitor SDH and actions to improve health equity or use the data generated to develop policies aimed at closing health gaps. Although data pertaining to many of the indicators for SDH conditions and policies have been collected, it is rare that they are explicitly linked to health information systems or accountability systems for health equity.

In 2024, WHO published the *Operational framework for monitoring social determinants of health equity* (Box 9.3). The Framework provides countries with critical guidance on monitoring SDH and health inequality and on actions to address them. The Framework addresses the use of monitoring systems to generate and support policy action across sectors to improve health equity *(3)*.

Alongside the Framework, the WHO *World report on social determinants of health equity (12)* and guidance on multisectoral collaboration in *Working together for equity and healthier populations (13)*

BOX 9.3. WHO *Operational framework for monitoring social determinants of health equity*

The WHO *Operational framework for monitoring social determinants of health equity* helps to support data-driven decision-making for policy-makers and practitioners to improve the health of all populations. It serves as an important tool towards creating fairer societies and healthier lives *(3)*.

The Framework consists of two main components. The first component is a globally applicable and harmonized menu of indicators for monitoring across six SDH domains: economic security and equality; education; physical environment; social and community context; health behaviours; and health care. For each domain, there are multiple subdomains representing more specific SDH and related actions. Within each subdomain, indicators are identified along with corresponding dimensions of inequality. For example, for the domain of economic security and equality, poverty is a subdomain and a corresponding indicator is the percentage of the population living below the national poverty level. The menu includes indicators for determinants and related actions such as policies and interventions.

The second component provides guidance on actions for monitoring SDH equity, incorporating relevant lessons learnt from countries. Building on existing WHO tools for health inequality monitoring, it addresses the process for technical monitoring of SDH and related actions at the national and subnational levels, the use of data to inform policy for health equity at the national and subnational levels, and the harmonization of monitoring at the regional and global levels.

present a way forward for countries to renew action and to build multisectoral policy collaboration mechanisms and capacities.

Acting on the social determinants of health

SDH converge and accumulate over the life course in complex ways, reflecting the unequal distribution of power and resources among population subgroups. The development of explicit action plans and strategies to address SDH are complex and multisectoral in nature – and their implementation has been slow and uneven across countries, despite growing political attention and mounting evidence. There are a number of reasons for this. The expansive nature of SDH as a concept and the high level of complexity involved in understanding and addressing SDH often make it challenging for governments to take coordinated action. There are challenges in terms of high-level political will and accountability because SDH cover different, often siloed government ministries and interest groups in society at large *(14)*. Because many of the health effects related to SDH accumulate over the life course, the impact of remedial actions may not be evident in the short term – which may disincentivize or deprioritize such actions.

Encouragingly, however, many countries are increasingly taking explicit actions to act on SDH, including implementing HiAP approaches. At the global level, country-level actions are supported by the Alliance for Health Policy and Systems Research – a partnership hosted by WHO whose mandate includes supporting the generation and use of research to address SDH and reduce health inequities *(15)*. In response to the heightened demand for evidence on SDH and their relationship to health, the health and social protection academic community has developed research initiatives to explore policies addressing multiple SDH across domains related to food, climate change and social protection (Box 9.4).

BOX 9.4. Social protection measures

Financial security is highly impactful on health outcomes, care-seeking, and the consequences of illness in people's lives. One area of public policy that addresses financial security across the life course is social protection measures. These measures refer to nationally defined systems of policies and programmes that provide equitable access to all people and protect them throughout their lives against poverty and risks to their livelihoods and well-being *(16)*.

Social protection measures exist in different forms across many countries. These measures can include cash or in-kind benefits (e.g. related to parental leave, disability, work injury benefits or pensions), contributory or noncontributory schemes (e.g. insurance), and programmes to enhance human capital, productive assets or access to jobs (e.g. skills development programmes) *(17)*. The United Nations Collaboration on Social Protection recognizes the importance of social protection policies for achieving the Sustainable Development Goals, including those impacting multiple SDH *(18, 19)*.

Universal social protection measures can prevent and reduce poverty, enhance social inclusion, and protect the dignity of people facing discrimination or disadvantage. While contributing to economic growth, these measures can also foster development by enhancing nutrition access, increasing participation in school and stemming exploitative (child) labour practices. Further, they can offer recourse to people experiencing the negative effects of pandemics, natural disasters and economic constraint.

The impacts of social protection measures can be tracked through health inequality monitoring. Inequality monitoring can yield important insights into where social protection efforts are having a beneficial impact and where targeting may be required. This requires a structured process of identifying relevant indicators and dimensions of inequality and monitoring them over time *(20)*. For example, one important indicator of social protection included in the United Nations 2030 Agenda for Sustainable Development and the WHO Fourteenth General Programme of Work for 2025–2028 measures the proportion of population covered by at least one social protection benefit *(21, 22)*.

Examples of specific effort to address SDH more comprehensively can be found in several countries. In China, the Health China 2030 plan was developed by more than 20 governmental departments, which put forth a vision for an expanded health industry that would become a pillar of the national economy. Aiming to achieve health equity by 2030, a key component of the plan is the promotion of a healthy lifestyle and physical fitness, including a focus on disease prevention *(23)*.

In Zambia, the Ministry of Health has a department dedicated to health promotion and SDH. It is mandated to fulfil functions such as collaborating with stakeholders on addressing environmental and social hazards to health; developing and implementing workplace wellness policies; and developing and implementing strategies to transform social structures for health and socioeconomic well-being *(24)*.

In Thailand, actions on SDH – under the umbrella of an HiAP approach – have included the creation of enabling policy environments to promote healthy diets and nutrition, realized, for example, through the implementation of school feeding policies and programmes *(25)*.

WHO efforts to harmonize guidance for action, networking and amplifying actions to address SDH with a specific focus on advancing health equity across multiple countries are under way (Box 9.5).

BOX 9.5. WHO Special Initiative for Action on Social Determinants of Health for Advancing Health Equity

Launched in 2021, the WHO Special initiative for Action on Social Determinants of Health for Advancing Health Equity has the goal of demonstrating the "effectiveness of strategies, policies, models and practices through improving the social determinants of health for at least 20 million disadvantaged people in at least 12 countries by 2028" *(26)*. The eight-year initiative comprises a broad range of collaborators from WHO, development agencies, academic institutions and national governments *(27)*.

With an initial focus on nine pathfinder countries and territories across three WHO regions (Chile, Colombia, Costa Rica, El Salvador and Peru in the Region of the Americas; Morocco and the occupied Palestinian territory, including east Jerusalem, in the Eastern Mediterranean Region; and the Lao People's Democratic Republic and the Philippines in the Western Pacific Region) *(28)*, the initiative is rooted in a theory of change development process. Barrier mapping resulted in identification of gaps in understanding, integration, under-prioritization of structural determinants, underrepresentation of communities, and few forums and incentives for policy shifts. The initiative set about expanding knowledge and narratives for scale-up of existing actions (which in some cases have navigated or directly tackled barriers). Emphasis in pathfinder countries will be on addressing structural determinants. Across countries, emphasis is proposed on networking across academic, worker, decision-maker and community change agents. Initial themes of the initiative are employment precarity, income and food security, housing and social services.

Partnerships: the role of multisectoral collaboration

Inequalities in health and SDH are complex challenges for governments. Deliberately addressing these inequalities requires coordinated action across sectors to ensure policies and institutions positively reinforce each other *(13)*. Multisectoral action – a term used interchangeably with the concept of intersectoral action – is the involvement of several sectors in developing and implementing public policies intended to improve health, equity, well-being and other policy outcomes *(13)*. Multisectoral actions require some form of collaboration across sectors such as agriculture, education, environment, health, social welfare, and trade and industry. Indeed, engagement with multisectoral committees or secretariats is integral to the advancement of multisectoral action (Table 9.1). Such structures provide opportunities for SDH monitoring systems and data to be linked more strongly to actions.

TABLE 9.1. **Multisectoral governance structures and mechanisms**

Level of government	**Cabinet committees and secretariats**
Parliament	Parliamentary committees
Public sector or civil service	Interdepartmental committees and units Mega-ministries and mergers Cross-sector working and technical groups
Management of funding arrangements	Joint budgeting Delegated financing
Engagement with nongovernmental entities	Communities and civil society Nongovernmental organizations Private sector

Source: adapted from the WHO *Health in All Policies: training manual (10)*.

Working across multiple sectors towards a shared interest, collaborative actions are imperative to help reduce health inequities and achieve health goals and targets. This may be orchestrated through comprehensive HiAP approaches, whereby health actors have a proactive role in engaging with non-health sectors to influence policies, while seeking co-benefits for other public policy goals such as social protection, to advance population health and health equity.

Health in All Policies approaches

The foundations of the HiAP approach date back to the 1978 Alma-Ata Declaration and the 1986 Ottawa Charter for Health Promotion, although the approach was first articulated as a global-level strategy or approach for action on health determinants as part of the 2014 Helsinki Statement on Health in All Policies *(2)*. HiAP approaches are defined by the following unique features: emphasis on formal governance structures and mechanisms poised to address emerging problems, even where information may be incomplete; explicit partnerships between health and other sectors; emphasis on co-benefits for health and development, and attention to conflicts of interest; investment in relationships of trust, with the expectation of a longer time horizon for impact; and focus on upstream social determinants that relate to inequities in power, money and resources *(13)*.

> HiAP approaches are relevant to the advancement of health equity when they adopt an equity focus, ensuring actions are oriented towards the reduction of inequalities alongside population-level improvements.

A new model of HiAP, which emphasizes the importance of collaboration ("seeking synergies"), is premised on four pillars:

- Pillar 1: governance and accountability, establishing the mandate and legitimacy for HiAP actions and collaborative mechanisms for cross-government efforts.
- Pillar 2: leadership at all levels, advocating for HiAP and other collaborative approaches, promoting a culture of collaboration and establishing a network of champions across sectors.
- Pillar 3: ways of working and work methods, using a co-production or co-design approach and building relationships of trust.
- Pillar 4: resources, financing and capabilities, ensuring adequate budgetary allocations, role clarity, and other capabilities necessary to address upstream determinants *(13)*.

Box 9.6 demonstrates how these four pillars are evident in operations of the California HiAP Task Force in the United States of America, which convenes over 25 state government departments and agencies to advance health equity.

Whole-of-government and whole-of-society approaches are part of implementing HiAP *(13)*. A whole-of-government approach describes collaborations across various ministries or agencies at the national, provincial or local levels (Pillar 2). Whole-of-society approaches cast this net broader, focusing on the inclusion of stakeholders from outside government. Such stakeholders may include academia and universities, communities, civil society, nongovernmental organizations, and the private sector (which includes a diverse range of economic or commercial enterprises that involve processes or products that may promote or harm health). Once established, such collaborations have the potential to complement and augment the impact and sustainability of siloed hierarchical approaches to promoting health, and indeed, to complement health-care systems.

There are promising examples of HiAP at local community levels *(30)*. In comparison with national and subnational governments, authorities working within more decentralized contexts operate in closer proximity to the community and are therefore better positioned to engage with their needs and respond

BOX 9.6. Applying the principles of Health in All Policies in California

The following demonstrate how the four pillars of the HiAP model are featured in the multisectoral and multistakeholder mechanisms and operations of the California HiAP Task Force of the California Strategic Growth Council *(29)*:

- Governance and accountability: the Task Force was established in 2010 through a Governor's Executive Order (S-04-10), affirmed by the legislature in 2012, and subsequently affirmed through a budget act in 2019 that formally committed Government-funded staff positions for continued work. Funding requirements and public accountability mechanisms ensure priorities are driven by public input and ensure a whole-of-government approach, which is novel in the United States. Reporting through a cabinet-level council is critical for ensuring leadership support and public transparency.

- Leadership at all levels: a blend of Government and nongovernment leadership has been critical for success. Within the Government, executive leaders lend political support to health and racial equity issues. Subject matter experts bring experience and solutions-oriented approaches as members of the Task Force. Outside the Government, advocacy groups, community members and nongovernmental organizations shape priorities, guide solutions, demand transparency and hold the Government accountable.

- Ways of working and work methods: the Task Force is built on trust, collaboration, co-benefits and co-design. This has been particularly important due to the lack of legislated mandates for participating organizations and limited funding for this work. Every participating entity must benefit to remain involved. This way of working includes involvement of civil society. As the Task Force affirms its focus on racial equity, it is taking steps to further centre the voices of affected communities.

- Resources, financing and capabilities: the facilitation staff of the HiAP Task Force come from three different organizations – the cabinet-level Strategic Growth Council, the non-profit-making Public Health Institute, and the California Department of Public Health. Each of these organizations has a different role in the partnership based on strengths and positionality. The Strategic Growth Council leverages the connection with the Governor's Office for executive-level support. The Public Health Institute connects with outside advocate groups and community-based organizations for grassroots support. The Public Health Institute and the California Department of Public Health both bring public health expertise. The California Department of Public Health connects the Task Force with local health jurisdictions. Building the case for Government-funded HiAP positions has been essential for the staffing of this initiative and a key programmatic outcome of normalizing the concept of a whole-of-government approach to health and racial equity.

to challenges and opportunities. Box 9.7 lists further reading with more examples of case studies and research on HiAP.

Monitoring inequalities in SDH is critical in both shaping and evaluating the impact of HiAP. Determining which sectors should be involved in such an initiative could be identified on the basis of analysis of the dimensions of inequality associated with health outcomes, and of the correlation and further in-depth analysis of the links between population health and SDH conditions. For example, health inequalities related to economic status are often identified, which may prompt engagement with economic institutions, structures and policies to align commercial interests in support of population-level well-being and social prosperity *(31)*. Tracking SDH indicators related to economic conditions and policies for income security provides further understanding of the current situation. Assessment of trends in health inequality and trends in SDH over time can provide an indication of how inequalities may have changed alongside the rollout of HiAP initiatives.

BOX 9.7. Further reading on HiAP

Global status report on Health in All Policies. Adelaide: Government of South Australia and Global Network for Health in All Policies; 2019 (https://actionsdg.ctb.ku.edu/wp-content/uploads/2019/10/HiAP-Global-Status-Report-final-single-pages.pdf, accessed 18 September 2024).

Health in All Policies: experiences from local health departments. Washington, DC: National Association of County and City Health Officials; 2017 (https://www.naccho.org/uploads/downloadable-resources/NACCHO-HiAP-Report_Experiences-from-Local-Health-Departments-Feb-2017.pdf, accessed 18 September 2024).

Scheele CE, Little I, Diderichsen F. Governing health equity in Scandinavian municipalities: the inter-sectorial challenge. Scand J Public Health. 2018;46(1):57–67. doi:10.1177/1403494816685538.

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12. World report on social determinants of health equity. Geneva: World Health Organization (https://www.who.int/initiatives/action-on-the-social-determinants-of-health-for-advancing-equity/world-report-on-social-determinants-of-health-equity, accessed 19 June 2024).

13. Working together for equity and healthier populations: sustainable multisectoral collaboration based on Health in All Policies approaches. Geneva: World Health Organization; 2023 (https://iris.who.int/handle/10665/372714, accessed 23 September 2024).
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31. Occhipinti JA, Skinner A, Doraiswamy PM, Saxena S, Eyre HA, Hynes W, et al. The influence of economic policies on social environments and mental health. Bull World Health Organ. 2024;102:323–329. doi:10.2471/BLT.23.290286.

10

Health inequality monitoring on the path to a just society

Overview

Rectifying health inequities is a matter of human rights and social justice and a cornerstone of global development agendas. Yet, across global to local levels, social structures, institutions and cultural norms contribute to shaping the environments that create and perpetuate injustices. Recognizing that "social injustice is killing people on a grand scale", the WHO Commission on Social Determinants of Health brought attention to the societal conditions and upstream forces that impede progress to achieve a more just world *(1)*. A justice-oriented approach to global health necessitates moving beyond health outcomes to address unfair aspects of society within and beyond health-care systems *(1)*. Critically, it also means upholding and respecting human rights.

Injustices influence the health of individuals and populations in different ways, directly and indirectly, and may have different implications across different stages of the life course and with varying levels of exposure. For example, people from racialized and ethnic minorities in the United States of America report poorer health status and access to recommended health care *(2)*. Experiencing social injustice at critical periods, such as early childhood, can have a strong bearing on later life health and recommended health care *(3)*.

Disadvantage and risk can accumulate over time. For example, people with adverse childhood circumstances are more likely to have greater exposure to risk behaviour, to engage in risk behaviours, and to experience compromised health *(4)*. Disadvantage may exhibit transgenerational transmission, with prolonged effects of stress on the physiology of the body and declines in physical health attributable to chronic exposure to social and economic disadvantage or discrimination perpetuated by unequal societal norms and structures. Such effects have been evident in groups such as racialized and ethnic minorities and First Nations or Indigenous Peoples *(3, 5, 6)*.

The path towards a just society requires acknowledgement and accountability to understand and address the structural roots of inequities, including recalcitrant social injustices linked to discrimination, colonialism and corruption. Recognizing the pervasiveness and complexity of such forces – and the importance of moving forward on this path – this chapter aims to demonstrate how health inequality monitoring can play a role in the advancement of societal equity and justice.

At the core of justice are the concepts of human rights, freedoms and entitlements that belong to all human beings *(7)*. States have a legal obligation to counter and redress violations of human rights, including those that may have their roots in history and may continue to cause and perpetuate societal injustice. After introducing foundational concepts related to human rights, this chapter focuses on three selected themes – discrimination, colonialism and corruption – with brief descriptions showing how these themes intersect with health inequalities and examples indicating the role monitoring could play in driving and tracking their redressal. The themes and examples featured in this chapter are intended to be illustrative and serve as a starting point for further exploration; they are not meant to be comprehensive in scope or depth.

Human rights: a foundation for health equity

Human rights are moral aspirations based on the inherent dignity and equality of the human person. They are codified through international and regional human rights treaties (conventions), international customary law and national laws. Characteristics of human rights include that they are universal and inalienable, indivisible and interdependent, equal and nondiscriminatory. All humans have the right to the highest attainable standard of health – both physical and mental – to which all countries have a legal obligation (Box 10.1).

More specifically, states have the obligation to respect, protect and fulfil the right to health *(11, 12)*. States should respect the right to health, meaning they should refrain from directly or indirectly interfering with the right to health. For example, states should not restrict access to health-care services, censor or misrepresent health information, or impose discriminatory practices that affect the care-seeking of any group. The obligation to protect requires that proactive efforts be made to prevent third parties from interfering with the right to health. This includes ensuring privatization does not threaten the availability or financial accessibility of services. In fulfilling the right to health, states should set up appropriate measures – legislative, administrative, promotional or other – to ensure well-being, tackle causes of ill health, and ensure health facilities, goods and services are available, accessible, acceptable and of good quality, without any discrimination.

BOX 10.1. Human rights obligations for health and health equity

A human rights-based approach specifically aims to realize human rights, including the right to health. The Universal Declaration of Human Rights was adopted by the United Nations in 1948, enshrining the basic freedom and equality in dignity and rights of all humans *(8)*. All WHO Member States have ratified at least one international human rights treaty that includes the right to health.

The WHO Constitution states that "the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition" *(9)*. To realize this right, states must ensure access to health services that are available, accessible, acceptable and of good quality. States must also remove obstacles to some of the underlying determinants of health, such as safe and potable water, sanitation, food, housing, health-related information and education, and information about health problems affecting a person's community *(10)*.

Some of the most critical human rights principles that matter for health are nondiscrimination and equality. This means ensuring multiple reasons for exclusion are addressed and that information, services and resources are not intentionally or unintentionally denied to any population subgroups *(13)*. Another principle is participation, such that health service users, communities and civil society play a role in planning, deciding, monitoring and budgeting for health across levels of the health and other systems. The concept of a dignified life encompasses the principles of self-determination and freedom to live a life that "one has reason to value" *(14)*. Grounded in the respect for human dignity and the right to health, the capability to be healthy emphasizes the moral entitlement and equitable capability to live a normal length of lifespan and achieve a cluster of capabilities and functionings *(15)*.

Accountability is another key human rights principle. Regulatory institutions and instruments are part of ensuring accountability to human rights obligations. Health inequality monitoring approaches discussed throughout this book can be used to monitor the realization of human rights. WHO has prioritized lists of indicators for monitoring human rights in certain programmes and topics and has provided guidance on how monitoring can be applied as part of a human rights analysis. For example, in the area of reproductive health, the WHO report *Ensuring human rights within contraceptive programmes: a human rights analysis of existing quantitative indicators* provides a methodology for identifying indicators that can be used in a rights analysis of contraceptive programmes, highlighting 12 prioritized indicators *(16)*.

Inequality monitoring may explore how health-related human rights (outcome indicators) are realized across population subgroups. Such approaches may complement human rights monitoring across other domains, including structural indicators, which provide information on whether a state has ratified international human rights treaties, and process indicators, which measure the realization of the obligations that flow from ratifying these treaties (e.g. whether populations experiencing disadvantage are covered by health programmes) *(17)*. In many countries, national human rights institutions and civil society organizations have played significant roles in identifying violations of health-related rights, including forms of discrimination that require redress and advocating for rights-based approaches. Box 10.2 lists further reading on human rights and health.

BOX 10.2. Further reading on human rights and health

Beyrer C, Kamarulzaman A, Isbell M, Amon J, Baral S, Bassett MT, et al. Under threat: the International AIDS Society–Lancet Commission on Health and Human Rights 2024;403(10434):1374–1418. doi:10.1016/S0140-6736(24)00302-7.

Braveman P. Social conditions, health equity, and human rights. Health Hum Rights. 2010;12(2):31–48.

Gruskin S, Grodin M, Tarantola D, Annas G, editors. Health and human rights in a changing world. New York: Routledge; 2013.

Montel L, Ssenyonga N, Coleman MP, Allemani C. How should implementation of the human right to health be assessed? A scoping review of the public health literature from 2000 to 2021. Int J Equity Health. 2022;21(1):139. doi:10.1186/s12939-022-01742-0.

Human rights. Geneva: World Health Organization (https://www.who.int/health-topics/human-rights#tab=tab_1, accessed 19 June 2024).

Part of contextualizing the results of health inequality analyses and determining how to act upon them should consider how relevant human rights are protected, promoted, enforced or violated.

Discrimination

Routinely described as a social or psychosocial determinant of health *(18)*, discrimination is defined as "any unfair treatment or arbitrary distinction based on a person's race, sex, religion, nationality, ethnic origin, sexual orientation, disability, age, language, social origin or other status" *(19)*. It may occur as an isolated event impacting a single person or group of people who share a similar circumstance, or it may be manifest through harassment or misuse of power. Discrimination is a human rights violation. Stigma, a broader term, refers to the negative attitudes, beliefs or behaviours about or towards a group of people because of their situation in life *(20)*. Discrimination can result from internalized stigma or due to interpersonal, systemic or structural barriers *(2)*.

Discrimination can affect health in diverse ways. Discriminatory laws and policies can have negative impacts on health-care access for certain populations. Systemic and structural discrimination have implications on social determinants of health, including education, employment and housing. Systemic issues within health systems, such as inequitable distribution of resources, can result in poorer health-care access and health outcomes for populations experiencing disadvantage. Biased or discriminatory health-care provider attitudes and practices can affect access and quality of care. The experience of discrimination at one health facility or in one facet of life may affect care-seeking and risk behaviours related to health throughout the life course. In 2017, the United Nations issued the *Joint statement on ending discrimination in health care settings*, recognizing discrimination as a major barrier to achieving the United Nations 2030 Sustainable Development Agenda *(21)*.

Health inequality monitoring may help quantify and track cases of discrimination by incorporating indicators that overtly measure discrimination, such as accepting or discriminatory attitudes. It can be used to assess whether there are inequalities based on the prohibited grounds of discrimination, such as age, ethnicity or sex. Additionally, analyses may be conducted to measure compounded vulnerability and advantage to get a sense of how dimensions may act cumulatively (see Chapter 25). Box 10.3 lists further reading on discrimination and health.

BOX 10.3. Further reading on discrimination and health

Declaration on Racism, Discrimination, Xenophobia and Related Intolerance against Migrants and Trafficked Persons. Tehran: Asia-Pacific NGO Meeting for the World Conference Against Racism, Racial Discrimination, Xenophobia and Related Intolerance; 2001 (https://www.hurights.or.jp/wcar/E/tehran/migration.htm,accessed 19 June 2024).

Braveman PA, Arkin E, Proctor D, Kauh T, Holm N. Systemic and structural racism: definitions, examples, health damages, and approaches to dismantling. Health Affairs. 2022;41(2):171–178. doi:10.1377/hlthaff.2021.01394.

Frontier dialogue consultations on addressing structural racial and ethnicity-based discrimination: key action areas for COVID-19 recovery plans. Geneva: World Health Organization; 2021 (https://www.who.int/publications/m/item/frontier-dialogue-consultations-on-addressing-structural-racial-and-ethnicity-based-discrimination, accessed 19 June 2024).

BOX 10.3. *continued*

Joint United Nations statement on ending discrimination in health care settings. Geneva: World Health Organization; 2017 (https://iris.who.int/handle/10665/259622, accessed 23 September 2024).

Gender and health. Geneva: World Health Organization (https://www.who.int/health-topics/gender, accessed 19 June 2024).

Improving LGBTIQ+ health and well-being with consideration for SOGIESC. Geneva: World Health Organization (https://www.who.int/activities/improving-lgbtqi-health-and-well--being-with-consideration-for-sogiesc , accessed 19 June 2024).

Tackling structural racism and ethnicity-based discrimination in health. Geneva: World Health Organization (https://www.who.int/activities/tackling-structural-racism-and-ethnicity-based-discrimination-in-health, accessed 19 June 2024).

Example: HIV-related discrimination

People living with HIV often face discrimination due to their HIV status, which may be exacerbated due to characteristics such as age, economic or social status, ethnicity, gender, sexual orientation or gender identity, or other health conditions *(22)*. HIV-related discrimination can affect the enjoyment of rights, and may lead to physical abuse, denial of health or social services, or denial or loss of employment or education opportunities. HIV-related discrimination may be manifest in the criminalization of HIV nondisclosure, exposure and transmission, or in measures such as HIV-related travel restrictions, mandatory testing or employment restrictions *(23)*.

HIV-related stigma refers to the negative beliefs, feelings and attitudes towards people living with HIV, groups associated with people living with HIV (e.g. the families of people living with HIV), and other key populations at higher risk of HIV infection. HIV-related discrimination refers to the unfair and unjust treatment (act or omission) of an individual based on their real or perceived HIV status *(24)*.

HIV-related discrimination has negative implications for individuals (including impacts on health-care seeking behaviours, access to prevention and treatment services, treatment adherence, and mental health and well-being) and for the wider attainment of public health goals. For example, fear of stigma and discrimination may deter people from being tested for HIV *(25, 26)*. Self-stigma or stigmatization by family members, health-care providers or others may lead to stress, anxiety, social isolation or reduced quality of life. HIV-related discrimination may result in other social and economic barriers to access to services.

Inequality monitoring in HIV can improve understanding on how discrimination – and its impact – is experienced within populations. Over the past decades, various organizations have advanced efforts to monitor discrimination experienced by people living with or at increased risk of acquiring HIV – key populations (Box 10.4).

The Demographic and Health Surveys programme introduced indicators related to HIV discriminatory attitudes in the mid-2000s. This has enabled tracking of trends in discriminatory attitudes over time and exploration of inequalities in discriminatory attitudes between population subgroups. The *State of inequality: HIV, tuberculosis and malaria* report, for example, explored inequalities in HIV-related discrimination, including analysis of the prevalence

BOX 10.4. Key populations

Global actors, including the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund), the Joint United Nations Programme on HIV/AIDS (UNAIDS) and WHO, recognize five key populations at increased risk of HIV: men who have sex with men, transgender and gender diverse people, people who inject drugs, sex workers, and people in prisons and other closed settings *(27, 28)*. People from these populations face structural barriers, in addition to social, legal and other contextual barriers, that increase their risk of acquiring HIV and limit their access to essential services. Stigma and the resulting discrimination are linked to many of the factors that perpetuate higher risks among people from key populations.

Adopting a common approach to identifying and defining key populations promotes harmonized inequality monitoring efforts and continuity in terms of planning, prioritization and development of remedial interventions. WHO has developed technical guidance to assist countries in planning and monitoring HIV services among people from key populations, including guidance for the use of disaggregated data to better understand diversity within key populations *(29)*.

of accepting attitudes about HIV, disaggregated by age, economic status, education level, place of residence and sex *(30)*.

In 2019, UNAIDS published a framework for human rights-based monitoring of national HIV responses, including guidance for selecting and developing indicators related to stigma and discrimination *(31)*. Subsequently, guidance on community-led monitoring of HIV services was developed, which facilitates tracking specific experiences of discrimination from the perspective of health service users *(32)*. Such monitoring is part of efforts to reduce discrimination in these settings, harness and improve the skills of people living with HIV and their communities, and enhance trust and mutual accountability between service users and service providers *(32)*.

As of 2024, the UNAIDS Global AIDS Monitoring initiative provides guidance for the collection of data on several indicators on stigma and discrimination, including discriminatory attitudes among people in the general population; discriminatory attitudes among health facility staff; internalized stigma; stigma and discrimination within communities; stigma and discrimination within health-care settings; stigma and discrimination experienced by people from key populations; and avoidance of care-seeking *(33)*. Although data on most of these indicators are reported by only a small number of countries, having these indicators provides great potential for monitoring trends over time and in relation to programmatic responses to tackle the different forms and manifestations of stigma and discrimination across diverse settings.

Colonialism

Colonialism refers to “one group of people having the power to dominate, subjugate and/or exploit another group or groups of people, thereby enabling the misappropriation and extraction of resources in a large-scale and systematic manner” *(34)*. Historical and contemporary colonial practices encompass war, displacement, forced labour, removal of children, relocation, ecological destruction, massacres, genocide, slavery, intentional or unintentional spread of diseases, banning of languages, regulation of marriage, assimilation, and eradication of social, cultural and spiritual practices *(35)*.

Processes largely driven by the economic interests of monarchies and settler groups in the fifteenth to twentieth centuries resulted in the conquest, occupation and plunder of large territories and widespread displacement, trafficking and enslavement of large populations. Within the territories carrying out the campaign of colonialism or those subjected to it (i.e. colonies), the effects have been longstanding, including on the health of the population. The health implications of colonialism are both immediate and intergenerational, embodied within individuals, families and entire communities *(35, 36)*.

In many countries, indigenous or minority communities continue to live in imposed circumstances that are considered oppressive and exploitative, with unjust social, political and economic systems *(34)*. Legacies of colonialism and slavery constitute some of the most entrenched forms of systemic racism, racial discrimination, xenophobia and intolerance and are a threat to the realization of human rights and sustainable development *(37)*.

The findings derived from health inequality monitoring often reflect inherited and recalcitrant injustices in the form of inequitable health outcomes for population subgroups that have faced – and continue to face – disadvantage, neglect, or direct oppression and discrimination. The economic logic of colonialism still dominates the world order in many ways and leads to new pathways outside the health sector that determine the distribution and impact of disease burden *(38)*.

Colonialism deeply affects ecologies, configurations and definitions within the knowledge landscape. Evaluations of health initiatives are often carried out by groups and individuals who lack an understanding of – and residency in – the contexts they are studying and who may have "limited knowledge and understanding of the sociopolitical, cultural and health system contexts of countries, and yet produce policy recommendations based on their assessments" *(39)*. This mindset is a form of neocolonial domination, which imposes worldviews, methods and notions of expertise on populations while neglecting the views of local experts, communities and people with lived experiences. This has dire consequences for policy formulation, which may perpetuate or exacerbate health inequalities. Box 10.5 lists further reading on colonialism.

BOX 10.5. Further reading on colonialism

McCoy D, Kapilashrami A, Kumar R, Rhule E, Khosla R. Developing an agenda for the decolonization of global health. Bull World Health Organ. 2024;102(2):130. doi:10.2471/BLT.23.289949.

Decolonization, localization and WHO: history matters. Global Health Matters podcast. Geneva: World Health Organization; 2023 (https://tdr.who.int/global-health-matters-podcast/decolonization-localization-and-who, accessed 19 June 2024).

Example: ethnic-related discrimination and health inequalities in Brazil

With over 300 years of racialized colonialism, Brazil has a large multiethnic population *(40)*. Brazil was colonized by Portugal in the 1500s, and the population subsequently underwent drastic changes. The large majority of the Indigenous population was decimated or assimilated, and the country became a major destination for the African slave trade *(41)*. Brazil was one of the last countries in the Region of the Americas to abolish slavery, in 1888. Brazil's population has been shaped by several waves of migration from Germany, Italy, Japan, Lebanon and the Syrian Arab Republic, contributing to its unique cultural and ethnic diversity. Alongside the changing ethnic composition of the Brazilian population, there have been evolving approaches to categorizing ethnicity and race in Brazil, and there is a large variety in the terms used, including *Amarelos* (East Asian people), *Brancos* (White people), Indigenous Peoples, *Pardos* (people of mixed race) and *Pretos* (Black people) *(42)*.

Health inequality monitoring has been used in Brazil to shed light on the extent of inequalities and, along with other evidence, helps to inform the lasting impact of colonialism on the population. Data suggest socioeconomic inequalities persist, with people with darker skin tones experiencing increasing levels of discrimination *(40)*. For example, White populations reported income that was twice as high as that for Black populations in 1995, and 1.6 times higher in 2015 *(40)*. In the health sector, Black residents of Rio de Janeiro had higher prevalence of multiple health conditions, hospital admissions and mortality than people from other racial groups *(43)*. Self-rated health was 10–20% lower among Black and *Pardo* Brazilians compared with White Brazilians *(44)*. Similar effects were seen during the COVID-19 pandemic, when COVID-19 mortality was higher among Black Brazilians than among other groups *(45)*.

With a growing body of research establishing the relationship between ethnicity and health *(46)*, a number of policy interventions have been introduced in Brazil to address the legacy of racialized colonialism and inequalities. In particular, the National Policy for Comprehensive Health of the Black Population, established by the Brazilian Ministry of Health, acknowledges the history of unjust social, cultural and economic processes that have affected the living conditions of this population *(47)*. The Policy specifies affirmative actions and strategies to prioritize and achieve health equity and promote racial equality, guided by the use of racial classifications for priority-setting and decision-making. The Policy guarantees Black people access to health services in a timely and dignified manner, contributing to improved health of this population and reduced inequities on the basis of ethnicity, gender, gender identity, sexual orientation and class. With responsibilities for each sphere of management in the health system – federal, state and municipal – the Policy requires the creation of institutional structures and indicators for monitoring its implementation *(48)*.

Corruption

Corruption – “the abuse of entrusted power for private gain” – encompasses activities such as bribes, informal payments, embezzlement, nepotism and other forms of abuse of power *(49)*. Corruption constitutes a longstanding drain on health resources, systems strengthening and reform efforts. It is a barrier to economic growth, good governance, and basic freedoms and rights. It exacerbates inequalities within populations because people of different ages, sex and socioeconomic status experience corruption and its effects differently (Box 10.6).

Corruption in its various forms is a threat to the achievement of the Sustainable Development Goals (SDGs). It is addressed in SDG target 16.5, which is focused on introducing anti-corruption, transparency and accountability measures within and across Member States *(52)*.

The impacts of corruption are wide-ranging and the linkages similarly multifarious – for example, reporting of dysfunctional health systems, absenteeism, stockouts and waiting times are associated with payment of bribes *(53)*. Corruption in health systems arises in situations where health infrastructure is chronically underfunded, where regulatory oversight is lacking, and where the nature of governance lacks transparency *(53, 54)*. Corruption has links to colonialism, where exploitative practices and clientelism were established as norms and informal social structures and have remained even as countries have attained independence *(55)*.

BOX 10.6. Corruption and inequality

The 2019 Afrobarometer report Global Corruption Barometer Africa 2019 presents public opinion data on views on corruption and direct experiences of bribery across 35 African countries. In the year preceding the survey, more than a quarter of people who accessed public services, including health care and education, had paid a bribe. Economic-related inequality was evident – increasing wealth corresponded with lower likelihood of paying a bribe. Among the poorest people, 36% had paid a bribe, compared with 31% of moderately poor people, 25% of moderately well-off people, and 19% of the wealthiest people. Men (32%) were more likely than women (25%) to pay a bribe. Young people aged 18–34 years (32%) were more likely than people aged 55 years and over (18%) to pay a bribe. Variations were reported across countries: the percentage of people who had paid a bribe ranged from 5% in Mauritius to 80% in the Democratic Republic of the Congo *(50)*.

Various forms of corruption were evident in COVID-19 service delivery. Spanning diverse geographical settings, corrupt actions included informal payments, theft and embezzlement, favouritism, manipulation of data, unauthorized or corrupt absenteeism, and service provision malpractices such as overcharging or defrauding clients. These actions have negative direct and indirect consequences across populations and health systems, but they are often disproportionately harmful to women, poor people, and people from migrant or ethnic backgrounds *(51)*.

Anti-corruption has been a joint priority of several international health organizations, including the Global Fund, the United Nations Development Programme, WHO and the World Bank *(56)*.

Health inequality monitoring can serve as a vehicle for public transparency and accountability and can be part of efforts to expose and end corruption (e.g. the findings of the Afrobarometer survey in Box 10.6). Health inequality monitoring can be used to monitor types of corruption in health systems, including assessing the theft and misuse of information, employee nepotism, research misconduct, misuse of health services, and improper procurement processes and payment schemes, but data on these topics are not readily forthcoming and evidence may not be easy to compile *(57)*. The involvement of community councils, community-led monitoring and other social audit mechanisms that use monitoring can ensure bottom-up accountability and promote vigilance against corruption *(53)*.

Box 10.7 lists further reading on corruption.

BOX 10.7. Further reading on corruption

Anti-corruption, transparency and accountability. Global Health Action. 2020;13(Suppl. 1) (https://www.tandfonline.com/toc/zgha20/13/sup1, accessed 23 September 2024).

Reducing health system corruption. Geneva: World Health Organization (https://www.who.int/activities/reducing-health-system-corruption, accessed 19 June 2024).

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14. Just societies: health equity and dignified lives: report of the Commission of the Pan American Health Organization on Equity and Health Inequalities in the Americas. Washington, DC: Pan American Health Organization; 2019 (https://iris.paho.org/handle/10665.2/51571, accessed 19 September 2024).
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PART

3

Data for health inequality monitoring

11

Data requirements for health inequality monitoring

Overview

The most basic data requirement for inequality monitoring is disaggregated data. As used here, the term "disaggregated data" refers to population-level data presented by subgroups defined by a dimension of inequality, such as age, economic status, education level, place of residence, sex or subnational region. Disaggregated health data capture information about a health indicator (or determinant of health indicator) and information about an inequality dimension.

The selection of health indicators and dimensions of inequality defines the scope of health inequality monitoring, which depends on the availability of data from high-quality sources. Disaggregated data for health inequality monitoring can be obtained from a single data source if that source contains information about both health indicators and dimensions of inequality of interest. Alternatively, if common identifiers are present across different sources, the relevant information can be linked from multiple sources.

This chapter provides foundational information about disaggregated data for health inequality monitoring, including data source quality. It also gives an overview of common data sources used for health inequality monitoring. The chapter serves as an introduction to Chapters 12–16, which provide more in-depth discussions related to data for health inequality monitoring, and to the chapters in Part 4, which discuss analysis and interpretation of disaggregated data (Chapters 17 and 18) and summary measures of health inequality (Chapters 19–22). See Chapter 3 for general considerations and resources to guide the selection of health topics, health indicators and dimensions of inequality.

Disaggregated data

Health inequality monitoring requires information about health indicators (defined as a measurable quantity that can be used to describe a population's health or its determinants) and information about dimensions of inequality (the criteria upon which population subgroups are categorized for inequality

> Disaggregated data for health inequality monitoring contain information on health or determinants of health, by population subgroups. Disaggregated data can show underlying inequality patterns that are not evident from overall averages across a whole population.

monitoring – sometimes called "equity stratifiers"). When these two streams of information are combined, they yield disaggregated data on health or health determinants (Box 11.1).

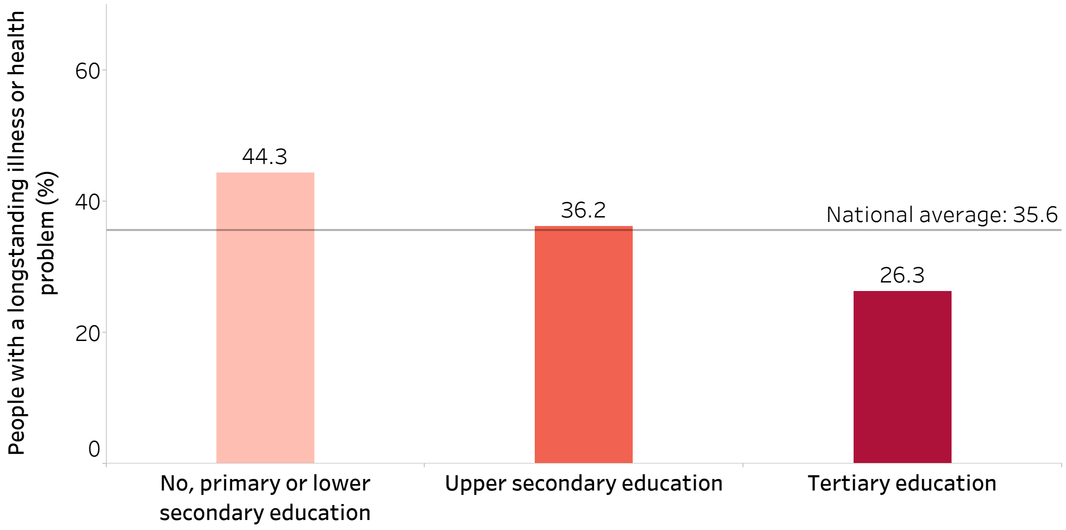
Disaggregated data can show underlying trends and patterns that would not be evident when using data that show the average value for a whole population. For example, among 36 countries in the WHO European Region, the median percentage of people having a longstanding illness or health problem between 2018 and 2020 was 35.6% (Figure 11.1). Data disaggregated by three education levels reveal that people with the lowest level of education (no, primary or lower secondary education) more often reported illness and health problems (median 44.3%) compared with people with upper secondary education (median 36.2%) and people with tertiary education (median 26.3%).

BOX 11.1. Disaggregated data: a note on terminology

Disaggregated data are specific to population subgroups, which are defined by a dimension of inequality such as age, economic status, education level, place of residence, sex or subnational region. Data that are aggregated at a population level (e.g. national average) can be said to be disaggregated when they are broken down according to a dimension of inequality. For example, the average self-rated health in a country could be disaggregated by sex and presented separately as disaggregated values for females and males.

Microdata (e.g. survey responses) are often collected at the individual level and then aggregated according to a particular inequality dimension. Therefore, disaggregated values are sometimes termed "aggregated group means". For example, self-rated health among men is the mean of self-rated health scores reported by individual men.

FIGURE 11.1. **Median percentage of people with a longstanding illness or health problem, by education level across 36 countries in the WHO European Region**



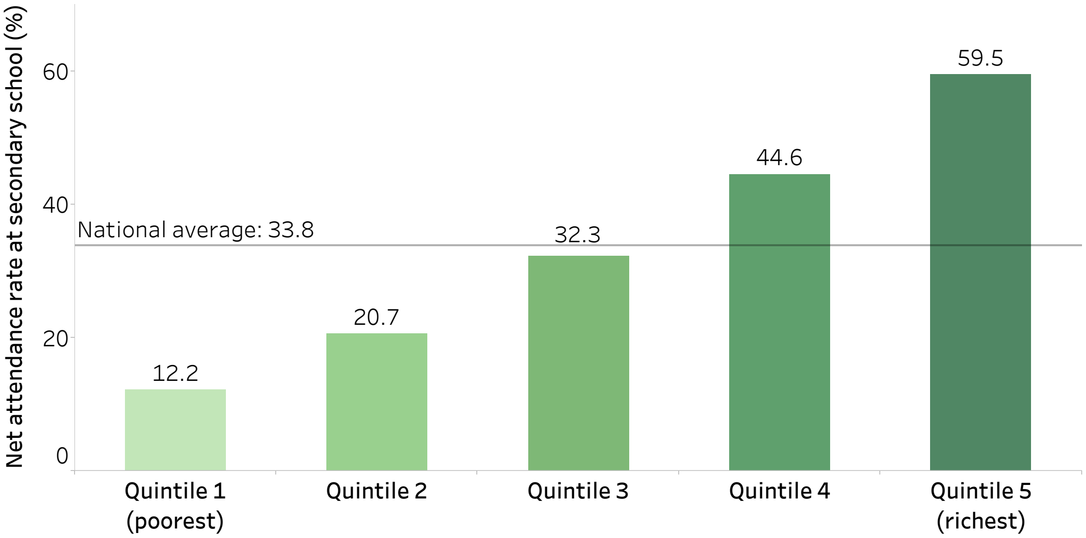
Source: derived from the WHO Health Inequality Data Repository Adult Health dataset *(1)*, with data sourced from Eurostat 2018–2020.

As another example, Figure 11.2 illustrates disaggregated data for a determinant of health – median net attendance rate at secondary school – in the WHO African Region between 2012 and 2021. The overall median attendance rate across 32 countries was 33.8%. When the data are disaggregated according to wealth quintiles, however, it becomes evident that the median attendance rate among the poorest quintile (12.2%) was substantially lower than the median attendance among the richest quintile (59.5%).

Disaggregation allows for comparisons across subgroups within a population and, if available, analysis of temporal trends. Disaggregated data permit initial insights into how dimensions of inequality intersect with health, which ultimately contribute to more targeted and efficient responses to combat inequities and improve health for all. To ensure disaggregation is meaningful, dimensions of inequality should capture factors that are relevant to the monitoring context (see Chapter 3). In some cases, data pertaining to the health experiences of certain populations must go beyond a single dimension, filtering by two or more dimensions simultaneously, a practice termed double or multiple disaggregation. Box 11.2 demonstrates how one factor – disability status – may be featured in disaggregated data in various ways.

> In the context of health inequality monitoring, double or multiple disaggregation is a starting point for exploring intersectionality. Intersectionality is a concept describing how interconnected dimensions of inequality (especially race/ethnicity, income/wealth and gender) interact to create different experiences of privilege, vulnerability or disadvantage.

FIGURE 11.2. Median net attendance rate at secondary school, by economic status across 32 countries in the WHO African Region



Source: derived from the WHO Health Inequality Data Repository Health Determinants dataset *(1)*, with data sourced from the most recent Demographic and Health Survey between 2012 and 2021.

BOX 11.2. Disaggregated data and disability status

The WHO *Global report on health equity for persons with disabilities* documents evidence on health inequalities and country experiences in advancing health equity in the context of disability *(2)*. Table 11.1 shows three examples of how disability status may be considered as part of health inequality monitoring. It can be included as a health indicator (Row 1) or dimension of inequality (Row 2). Disability status may also be applied to define the affected population (Row 3).

TABLE 11.1. Examples of disaggregation linked to disability status

Affected population	Health or health determinant indicator	Dimension of inequality	Disaggregated data
1 National population	Disability status	Sex (men and women)	Disability status among men versus women[a]
2 National population	Experience of violence or rape	Disability status	Experience of violence or rape among people living with a disability versus people without a disability[b]
3 People living with a disability	People at risk of poverty	Sex (men and women)	Risk of poverty among men versus women living with a disability[c]

[a] In most Organisation for Economic Co-operation and Development countries, women report higher incidence of disability than men *(3)*.
[b] People living with a disability are more likely to experience violence or rape *(3)*.
[c] The WHO Health Inequality Data Repository Disability dataset contains sex-related disaggregated data on people at risk of poverty among people living with some disability or severe disability *(1)*.

Health indicators

For the purposes of health inequality monitoring, health indicators are used to monitor performance, measure results against targets and assess accountability. Health and health-related indicators may address a variety of different aspects related to health, including health status, health outcomes, health service use, intervention coverage, health sector factors and determinants of health (Box 11.3). Composite indicators combine multiple health indicators into an index to summarize information about a health topic.

The selection of health and health-related indicators used for health inequality monitoring should reflect the defined purpose and intended impact of the monitoring activity. An initial consideration is the desired breadth of the health topic. Will the topic be narrowly defined? If this is the case, a smaller set of indicators directly linked with the topic would be most appropriate. For example, indicators may reflect the coverage of a particular intervention and associated health outcomes. As another example, indicators could be selected to show health service access across the continuum of care for a particular condition.

Alternatively, a broad lens may incorporate a wider selection of health indicators across aspects of the health sector and other health-related indicators.

BOX 11.3. Determinants of health

Determinants of health are factors that combine to affect the health of individuals and communities. Determinants of health include the social and economic environment, the physical environment, and the person's individual characteristics and behaviours *(4)*.

Social determinants of health are the conditions in which people are born, grow, work, live and age, and people's access to power, money and resources *(5)*. Monitoring inequalities in social determinants of health indicators (disaggregated by relevant inequality dimensions) can foster a deeper understanding of factors that may be associated with, or potential contributors to, health inequities and their underlying mechanisms (see Chapter 9).

The WHO Health Inequality Data Repository contains national-level disaggregated data for social determinants of health indicators, such as:

- indicators related to education, communication, employment and household characteristics, disaggregated by age, economic status, education, employment type, marital status, number of living children, place of residence, sex and subnational region;
- indicators related to child protection and female genital mutilation, disaggregated by age, economic status, education, employment status, marital status, number of living children, place of residence, religion, sex and subnational region;
- women's empowerment index indicators, disaggregated by economic status, education, place of residence and subnational region;
- development indices (e.g. Gender Development Index, Gini coefficient, Human Development Index, International Wealth Index, Theil Index) and their component indicators, disaggregated, as applicable, by economic status, place of residence, poverty status and subnational region;
- the Multidimensional Poverty Index, disaggregated by age, ethnicity/race/caste, place of residence, sex of household head and subnational region *(1)*.

The WHO Health Equity Assessment Toolkit contains an interactive feature that demonstrates the associations between health determinants and health indicators *(6)*.

For more examples of health indicators and information about selecting relevant health indicators, see Chapter 3. Chapter 17 covers defining and constructing health indicators.

Dimensions of inequality

Dimensions of inequality are the criteria used to define the population subgroups that serve as the basis of comparison for inequality monitoring. Certain inequality dimensions are commonly used in inequality monitoring because they have a high level of applicability across many health topics and settings. Additionally, data about these dimensions tend to be available in a format whereby they can be similarly constructed and compared across countries and health topics. These dimensions include age, economic status, education level, place of residence, sex and subnational region.

Other dimensions such as subnational region and disability status tend to be highly applicable across settings as inequality dimensions, although there are certain limitations to their use. In the case of subnational region, the number and composition of subgroups (i.e. regions) is unique to the country of interest, limiting comparability across settings. Data on disability status are not readily available in many settings.

Context-specific dimensions of inequality are numerous and varied, including caste or tribe, ethnicity or race, incarceration status, Indigenous identity, language spoken at home, marital status, migratory status, occupation, religion, and sexual orientation and gender identity. These dimensions of inequality have variable applicability, depending on the setting and health topic.

See Chapter 3 for more information about selecting dimensions of inequality, and Chapter 17 on their measurement and categorization.

Attributes of high-quality data sources

For the purposes of health inequality monitoring, data sources contain quantitative information about health indicators and/or dimensions of inequality for a population of interest. To the extent possible, data for health inequality monitoring should be obtained from sources that are reputable, with strong legitimacy and a high degree of policy relevance.

High-quality data collection systems share a number of general attributes *(7)* described by the acronym CART – credible, actionable, responsible and transportable (Box 11.4). Additionally, they should collect information in a way that is ethical and culturally appropriate, upholding the rights and interests of the populations they represent, including people's rights to govern their own information (see Chapter 4).

BOX 11.4. CART principles for strong data collection systems

CART – credible, actionable, responsible and transportable – highlights four key principles for strong data collection systems *(8)*:

- Credible data sources collect high-quality data and analyse them accurately.
- Actionable data sources collect data that can be used to inform or effect change.
- Responsible data sources seek to ensure the benefits of data collection outweigh the costs, including minimizing risks to the individuals from whom data are collected.
- Transportable data sources collect data that generate knowledge that can be generalized, as needed, for other programmes.

In some cases, monitoring will involve the use of a single data source that contains all relevant information. In other cases, data may be drawn from several different sources, including merging information from different sources about the same person or entity using individual or small-area identifiers (i.e. data linking).

Ideally, the sources selected for health inequality monitoring should contain data that are of high quality. Key attributes of data quality include relevance, credibility, accuracy, timeliness, methodological soundness, accessibility, completeness and reliability:

- Relevant data are those that meet the users' needs – that is, relate to the policy issue being monitored *(9)*.
- Credibility is the confidence that users place in the data *(9)*.
- Accuracy is the degree of closeness of estimates to the actual situation *(9)*.
- Timeliness refers to the degree to which reports are submitted on time according to established deadlines. Health information systems data are timely when they are up to date (current), and when the information (processing of data) is available when required to make decisions about the health of the population and to target resources to improve health-system coverage, efficiency and quality *(10)*.
- Methodological soundness is the application of the available international standards, guidelines and good practices in the production of data *(9)*.
- Accessibility is the ease with which users can find, retrieve, understand and use data *(9)*.
- Completeness is when all required data for the health indicator and inequality dimension are present and, if applicable, representative of the population of interest.
- Reliable data provide consistent estimates when collected repeatedly using the same procedures and under the same circumstances *(10)*.

Data sources should include readily accessible and up-to-date metadata (detailed information about the data) defining indicators and explaining the underlying methodologies, limitations and other considerations to assess the quality of the data and how they can be used. Efforts to support health data source quality improvements include the WHO SCORE (Survey, Count, Optimize, Review, Enable) for Health Data Technical Package (Box 11.5).

Potential sources of disaggregated data may not completely fulfil all these requirements. Indeed, the quality of the data always relies on the design and implementation of protocols related to the data source. Careful consideration may be needed to ensure the best data quality possible is achieved, weighing each of the attributes. In some cases, information about health and information about dimensions of inequality may need to be located and linked across different sources. In other cases, there may be a multitude of potential sources of data that could be used for monitoring. Chapter 15 contains further information about selecting data sources and addressing data gaps.

Any data quality concerns that may impact on the subsequent analysis should be noted and taken into consideration when interpreting and reporting the results of monitoring.

BOX 11.5. SCORE for Health Data Technical Package

The SCORE for Health Data Technical Package, developed by WHO and partners, serves as a harmonized package of effective interventions to tackle critical gaps and strengthen country health data *(11)*. These data are essential for planning and monitoring national and subnational health priorities, including the health-related Sustainable Development Goals. The SCORE global reports and dashboards provide insights into the strength of data sources in countries. The package of interventions supports the improved quality, availability, analysis, use and accessibility of data in countries.

General classes of data sources

WHO and partners acknowledge the importance of multiple well-functioning data sources as a component of a country-led platform for monitoring, evaluation and review (alongside sound policy and institutional environments; strong institutional capacity for data collection, management, analysis, use and dissemination; and effective mechanisms for review and action) *(12)*. Different data sources play a role in monitoring key health indicators across public health surveillance and practice, and systems productivity and effectiveness. Two major categories of data sources are commonly used for health inequality monitoring – population-based sources and institution-based sources.

> Comprehensive country health information systems should support the use of diverse data sources to monitor a broad range of health and health-related indicators.

Population-based sources collect data from a representative sample of a population, such as a household survey; or they contain information on every individual in a population, such as a civil registration and vital statistics system or census. Chapter 12 discusses population-based data sources in more depth.

Institution-based sources collect information in the course of administrative and operational activities. Examples of institution-based data include records kept by health facilities, such as disease registers or health service use records, or records kept by institutions outside the health sector. These sources are discussed in Chapter 13.

Health inequality monitoring may use other data sources that are not strictly population- or institution-based. For example, surveillance systems draw from both population- and institution-based data, usually with the purpose of detecting, reporting and responding to specific diseases or conditions in a time-sensitive way. Health facility assessments, including health facility censuses or health facility surveys, are conducted periodically within public and private health-care facilities to gather data about the facilities and the services provided. In the absence of reliable direct measures, modelled estimates derived by applying statistical methods to unreliable data may be necessary; the assumptions underlying such modelling methods, however, should be transparent and well documented. For more details about surveillance systems, health facility assessments and other sources of data, see Chapter 14. Chapter 15 addresses considerations for how to select data sources. Emerging and novel data sources are discussed in Chapter 16.

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12

Population-based data sources

Overview

Population-based data sources, such as household surveys, civil registration and vital statistics (CRVS) systems and censuses, are intended to be representative or completely inclusive of a defined population. They are important sources of data for health inequality monitoring. They contain information either from a representative sample of the population or from every individual in the population.

Household surveys are carried out in probabilistically selected samples of the population, meaning everyone in the population has a given chance of being selected. Household surveys are conducted at a particular point in time (yielding cross-sectional data) and may be repeated at regular intervals.

CRVS systems and censuses are designed to gather data systematically from every member of a population – although in many countries, these sources are not fully functional. CRVS systems collect data on an ongoing or rolling basis. Censuses are undertaken periodically, according to a set schedule (often every 10 years).

The aims of this chapter are to describe the characteristics of household health surveys, CRVS systems and censuses, and discuss how each can be useful for health inequality monitoring. The chapter addresses the strengths, limitations and key considerations for using these sources, and outlines possibilities for improvements to enhance their usability for monitoring inequalities. A better understanding of these data sources will prepare readers to assess their suitability for different applications of health inequality monitoring.

Household surveys

Household surveys are rich sources of disaggregated data and are well suited for inequality analyses *(1)*. Some household surveys are general in nature and may contain little or no health data. Other household surveys focus specifically on health or health determinants. For the purposes of health inequality monitoring, household health surveys – which collect detailed information centred around one or more health topics – are of particular importance, although other types of household survey (e.g. labour force surveys, income and living condition surveys, household budget surveys) may also contain relevant information.

Regardless of their topical focus, household surveys share several general characteristics. They collect data from a sample of individuals or households within the population rather than every individual or household within the population. This is termed a probabilistically selected sample when the likelihood of being selected is known. In most cases, surveys rely on complex survey sampling designs, which involve selecting the sampling units via multiple stages or phases.

When a sample is selected appropriately, it can provide information that is statistically representative of the entire population from which it was drawn. National household surveys are designed to be representative at a national or subnational level. Household surveys are not, however, typically designed with the purpose of having sufficient sample sizes in all population subgroups of interest for health inequality monitoring. To account for this, some surveys may oversample one or more subgroups of the general population that would otherwise be too small for disaggregation and analysis. Sampling design characteristics, including stratification, clustering, multistage sampling and weighting, need to be taken into consideration when analysing data from surveys (see Chapter 17).

Household health surveys

Household health surveys usually cover a large number of health (or health determinant) indicators within the same survey, all related to a similar theme, such as reproductive, maternal and child health; nutrition; noncommunicable disease risk factors; or communicable diseases. They also contain questions related to background demographic, social and economic characteristics of the respondents. Household health surveys may cover multiple themes across different modules (although some modules may not be included in every round of the survey).

Household health surveys typically gather self-reported information through interviews or self-administered questionnaires. Surveys might focus on understanding health status, use of health care, and health-related behaviours. They may also collect more objective information about health metrics through physical examinations and biomarkers (e.g. for assessing diabetes, HIV infection or anaemia). Although household health surveys are conducted in most countries, they tend to be a particularly important data source for health inequality monitoring in low- and middle-income countries, where data from CRVS or other sources may be less available or less reliable (see Chapter 5). Many countries conduct their own national household health surveys, but other surveys are administered by donor organizations, nongovernmental organizations or international organizations.

Multicountry household health survey programmes apply consistent methodologies to collect comparable data across multiple countries. Data from multicountry household health surveys can be used for benchmarking – that is, for comparing within-country inequalities between different settings and populations to get a broader understanding of the state of inequality. Two well-established multicountry household health survey programmes are the Demographic and Health Survey (DHS) Program of the United States Agency for International Development, and the United Nations Children's Fund (UNICEF) Multiple Indicator Cluster Survey (MICS). Box 12.1 provides details about these and other multicountry household surveys across selected health topics.

Strengths and limitations of household health surveys

A general strength of household health surveys for inequality monitoring is the inclusion of detailed information on an array of health (or health determinant) indicators and dimensions of inequality at the individual or household level, within the same dataset. This presents opportunities for disaggregation by diverse inequality dimensions. The use of common and well-documented methods

BOX 12.1. Examples of multicountry household surveys across selected health topics

The following examples of prominent multicountry household health surveys span different topics and settings. This list is not exhaustive. More information about each survey programme is available online.

Adult health and ageing:

- The WHO Study on Global AGEing and Adult Health (SAGE) is a longitudinal study focused on adults aged 50 years or over *(2)*. The study collects data from nationally representative samples in six countries. It contains information about the health and well-being of adult populations and the ageing process.
- The Survey of Health, Ageing and Retirement in Europe (SHARE) studies the effects of health, social, economic and environmental policies over the life course of citizens across 28 countries in Europe *(3)*.

Malaria:

- The Malaria Indicator Survey (MIS) is a standalone household survey that collects data on bed-net ownership and use, prevention of malaria during pregnancy, and prompt and effective treatment of fever in young children. Data collection may also include biomarker tests for malaria and anaemia. It has been conducted in over 30 countries *(4)*.

Noncommunicable diseases:

- The WHO STEPwise Approach to NCD Risk Factor Surveillance (STEPS) surveys cover key behavioural risk factors (tobacco use, alcohol use, physical inactivity, unhealthy diet) and biological risk factors (overweight and obesity, elevated blood pressure, elevated blood glucose, abnormal blood lipids), with expanded modules on other topics such as oral health, sexual health and road safety *(5)*. Since 2002, over 130 rounds of the survey have been conducted across all world regions and country income groups *(6)*.

Reproductive health:

- Reproductive Health Surveys (RHS) provide information about various aspects of reproductive health, including antenatal care, fertility, contraceptive awareness, knowledge and use, and sexually transmitted infections *(7)*. RHS were first conducted in 1975, when they were known as Contraceptive Prevalence Surveys. In more recent years, data collection has focused on eastern Europe and Latin America, although data are available for countries in other regions *(8)*.
- Performance Monitoring for Action (PMA) surveys include key indicators of family planning use, water access, sanitation and health. They cover 11 countries *(9)*.

Reproductive, maternal, newborn and child health:

- DHS have been conducted in over 90 countries, covering diverse topics and dimensions of inequality relevant to reproductive, maternal, newborn and child health. Standard DHS are typically conducted about every five years *(10)*.
- The MICS Program spans 120 countries, providing internationally comparable data on women and children *(11)*.

Tobacco:

- The WHO Global Adult Tobacco Survey (GATS) is a nationally representative household survey that collects information on prevalence of tobacco use, secondhand tobacco smoke exposure and policies, cessation, knowledge, attitudes and perceptions, exposure to media and economics *(12)*. It has been implemented in more than 30 countries *(6)*.
- The WHO Global Youth Tobacco Survey (GYTS) collects information from students aged 13–15 years to monitor tobacco use among youth, and to guide the implementation and evaluation of tobacco prevention and control programmes *(13)*. More than 500 rounds of the GYTS have been conducted in over 180 countries, territories and areas *(6)*.

to measure health indicators and inequality dimensions (including indicator frameworks and criteria) makes the estimates more reliable. It also helps to ensure the estimates are consistent and comparable across settings. Because data are collected at the individual level, they may be well suited for complex inequality analyses, such as multiple regression and compound vulnerability and advantage assessments (see Chapter 25).

Household health surveys are also advantageous in terms of their versatility to adapt to changing data needs. Many surveys are scheduled to be conducted on a recurring basis, such as every three to five years, but they may be done, in whole or part, on an ad hoc basis. Further, survey questions and methodologies can be updated and adapted between survey rounds to reflect emerging health issues, and selected survey modules may be included or excluded.

There are possible downsides to this versatility, namely that changing survey questions may limit the ability to compare like measures over time. Nevertheless, repeating surveys can generate comparable data that are useful for tracking changes in health inequalities over time.

Using surveys, it is possible to collect data pertaining to universally relevant metrics (which can be harmonized and compared across countries) along with integrating setting-specific considerations that reflect more local priorities and realities. For example, the DHS makes available several optional modules that may be added to complement the core content of the surveys. In 2022, three new optional modules included child well-being and household structure, human papillomavirus (HPV) vaccination and mental health *(14)*.

Like all data sources, the quality of the component data is contingent on the design and implementation of the underlying methods. There may be cases where data from household health surveys are incomplete or inadequate for the intended inequality monitoring (Box 12.2). This may be related to the survey instrument design – for example, because certain dimensions of inequality were not captured in data collection instruments (e.g. measures of sexual orientation or gender identity) or certain subcategories were not reflected in the response options (e.g. ethnic minorities or specific religious affiliations). It may also reflect logistical challenges, such as certain regions being excluded because they are inaccessible due to conflict or other humanitarian crises. Response bias may be a concern, because people experiencing disadvantage tend to be undersampled – and although there are strategies to mitigate response bias, they may not allow for subsequent disaggregation.

Other issues may arise if the data collection activities are poorly executed, such as interviewers not receiving sufficient training, or delays in data collection, processing and publishing (which may be more likely to occur during periods of uncertainty such as the COVID-19 pandemic). Depending on the timing of the inequality monitoring activity, the data may not be timely and therefore may be less useful for tracking the impact of ongoing equity-oriented interventions. On a practical note, household health surveys are resource-intense and typically expensive to carry out, and therefore they may be conducted less frequently or have limited sample sizes.

To enhance the completeness of the data source, additional improvements and investments in the data collection exercise may be required. To improve the relevance of the data and reduce differential response bias, survey modules should be developed in consultation with diverse stakeholders involved in and impacted by the collection and use of the data (e.g. conducting focus groups and piloting data collection instruments). Consultation and engagement with the people conducting inequality analyses may also be warranted (see Chapter 4).

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BOX 12.2. Sampling and sample size limitations

A potential limitation to the use of household surveys in health inequality monitoring relates to the issue of small sample sizes for some population subgroups, depending on the dimension of inequality of interest. Household health surveys are generally designed to draw precise conclusions about the overall population, but they may not be representative of smaller population subgroups or remote or otherwise difficult-to-access geographical areas. This could be due to members of the small subgroups having a lower chance of being selected than everybody else. Additionally, subgroup estimates based on small sample sizes have high levels of uncertainty and are subject to suppression rules when displaying results.

Therefore, some surveys may not be suited for double or multiple disaggregation – which involves filtering data according to two or more dimensions of inequality simultaneously – because of sample size and sampling design considerations. These smaller subgroups may, however, be highly relevant for inequality monitoring. For example, the sample size of a nationally representative survey may be sufficient to estimate health indicators by subnational region (i.e. single disaggregation), although the sample size may not be sufficient to disaggregate further by a second dimension within those subnational regions, such as age, economic status or sex.

If it is anticipated that the survey will have smaller subgroups within a population, this problem can be mitigated by oversampling. This involves recruiting larger samples from smaller minority groups, even though these subgroups may represent a relatively small proportion of the overall population. Combining multiple years of data is another strategy that may be appropriate to address the problem of small sample size for a population of concern.

Online repositories and tools have been developed to support the accessibility of household health survey data by enabling access to datasets, access to accompanying metadata (detailed information about how data are collected and how indicators are calculated), and, in some cases, access to data exploration and analysis features. The WHO Health Inequality Data Repository, for example, features several datasets sourced from multicountry household health surveys, including DHS, MICS and RHS *(15)*.

Civil registration and vital statistics systems

CRVS systems are an essential part of a country's administrative and statistical infrastructure, capturing crucial information about vital events within the population. They aim to collect vital event information about all members of the population on a continuous basis to contribute to, in combination with census data, key population statistics. These statistics serve as a cornerstone of public health and other population-level planning.

The scope of health information available from CRVS systems centres around births, deaths and causes of death. In countries where these systems are fully functioning, they register all births and deaths and compile other vital statistics, including cause of death information. Some CRVS systems also record marriages and divorces. They usually contain the minimum information about certain dimensions of inequality – age, place of residence and sex – and some also collect information such as occupation and ethnicity.

The operation of CRVS systems is designed to follow a series of steps with clearly demarcated roles and procedures (Box 12.3). As the name suggests, there are two components to CRVS systems – civil registration and vital statistics *(17, 18)*. Civil registration is the legal component,

BOX 12.3. Operational components of CRVS systems

The Ten Milestones CRVS framework outlines 10 sequential steps required to ensure all births and deaths are reported, recorded, certified and incorporated into the vital statistics of a country *(16)*. The civil registration subsystem begins with the notification process, which captures the minimum essential information related to births or deaths by a designated informant (Step 1).

Active notifications are sent directly to the local civil registrar for validation and official registration. Passive notifications require a family member to fill out a form and declare the event themselves (Step 2).

After validation and verification processes, the civil registration office formally registers the event (Step 3), and the information is stored in permanent archives (Step 4). Legal certificates are issued certifying the event (Step 5), and information is shared across government systems (Step 6).

The vital statistics subsystem entails aggregating and summarizing information on vital events, yielding a report of vital statistics. Data about vital events are compiled (Step 7), the quality is assessed (Step 8), and vital statistics are generated (Step 9). The statistics are published and disseminated – for example, as annual national statistics in a public repository accessible to users (Step 10).

whereby vital events are registered in accordance with the legal requirements of the country. In many cases, civil registration systems are intended to be continuous, permanent, compulsory and universal, adhering to strict national standards, providing the legal documents required by individuals during their entire life course. In other cases, however, registration may be required only for specific purposes, such as probate or obtaining certain benefits, and therefore is neither compulsory nor universal.

Civil registration often falls under the ministry of the interior or justice or local government. The health sector, however, has a contributory role in strengthening CRVS systems, because health workers are usually present surrounding births and deaths and can support the timely and accurate reporting of related information.

Drawing from civil registrations and censuses, vital statistics systems compile and disseminate statistics pertaining to vital events of interest, such as live births, adoptions, legitimations, recognitions, deaths and fetal deaths, and marriages, divorces, separations and annulments *(17, 18)*. As countries establish and build capacity for CRVS systems, they may progress from sentinel registration (at certain surveillance sites), to sample registration (capturing a representative sample of the population), to full registration *(19)*.

CRVS data are important for public health decision-making, such as developing policies and planning services *(20)*. They provide foundational information about fertility, mortality, life expectancy, burden of disease and emerging health needs. They may be a useful input to monitor inequalities related to these topics. For example, fertility statistics have implications for monitoring the need for family planning, school enrolment and immunization coverage, and for conducting epidemiological studies. In addition to their use in inequality monitoring, mortality statistics are used to understand health-care requirements, monitor interventions and prioritize health needs.

Strengths and limitations of data from CRVS systems

Once they are established, fully functional and covering all members of the population, CRVS systems serve as the most timely and reliable source of data on fertility, mortality and cause-of-death indicators. Data from CRVS systems, therefore, are particularly well suited for monitoring related to these notifiable events. Monitoring inequalities in life expectancy, for example, when the data are of adequate quality, can provide insights into the implications of underlying socioeconomic inequalities and risk factors associated with different causes of death among different subgroups *(21)*.

For the purposes of health inequality monitoring between population subgroups, the health data from CRVS systems are powerful when linked with information on inequality dimensions. CRVS systems usually contain information on dimensions of inequality, such as age, ethnicity, Indigenous identity, location and sex. In some cases, CRVS systems include limited information about other socioeconomic variables that are useful for inequality monitoring, such as education level, literacy and occupation. They may also include identifiers, such as municipality of residence, that can be linked with sources of data on other dimensions of inequality, presenting expanded opportunities for inequality monitoring.

Beyond the high-income countries of the Americas, Europe and the Western Pacific, the quality of national CRVS systems is highly variable and is often in need of improvement *(22)*. In many countries, CRVS data are lacking altogether due to large gaps in registration of vital events, lack of adequate resources, weak data collection systems, or incomplete legislative bases for requiring registration. Even where registration exists, the data may be of low quality, with missing information or significant biases, and therefore insufficient to serve their basic purposes. Evaluations of CRVS data quality may entail assessing the coverage of the CRVS system and completeness of data to determine their usability for monitoring.

Strengthening the role of the health sector in collecting birth and death information is an important part of establishing more complete and reliable CRVS data within populations (Box 12.4), which in turn will enhance the quality of inequality monitoring. For recording cause-of-death information, the use of the WHO International Form of Medical Certificate of Cause of Death is recommended for comparable and standardized data collection. This helps to ensure the underlying cause of death is reported in a reliable and systematic fashion *(23)*. Standardized International Classification of Diseases (ICD) coding for causes of deaths is instrumental for the production of standardized, comparable and reliable statistics for use in health inequality monitoring. Strengthening the capacity of physicians in ICD-compliant medical certification of deaths is crucial for the collection of reliable data about causes of death.

BOX 12.4. Strengthening the role of the health sector in CRVS systems

With its network of services and unique access to populations at critical life stages, the health sector has a role in leading, contributing to and strengthening CRVS systems *(16)*. WHO and UNICEF have developed guidelines to more effectively mobilize the health sector to support CRVS systems. The *WHO civil registration and vital statistics strategic implementation plan 2021–2025* emphasizes strong leadership in the health sector, building of local capacity, and inclusion of marginalized populations to ensure no one is left behind *(20)*.

The use of digital technology offers an unprecedented opportunity to improve the efficiency and accuracy of notifications for CRVS systems, and the subsequent processes of registering, aggregating and linking information. Internet access and mobile networks have enabled more timely and complete reporting of data from remote locations. In addition, online open-source platforms have made guidance surrounding data collection and the implementation of CRVS systems more widely accessible. Implementing national identification systems facilitates interoperability of CRVS systems with health and other administrative databases to deliver better services and reduce identity theft and fraud *(24)*.

Censuses

A census is an official enumeration of a population, with systematic data collection from all members of the population. Many countries conduct national population and household censuses every 10 years (or in some cases, every five years). Additional censuses are sometimes conducted at subnational levels. Censuses provide essential information on population characteristics including age, economic status, ethnicity or race, geographical area, household composition and size, marital status and sex. Censuses are a comprehensive source of statistical information for economic and social development planning and administration. Various methodologies have been developed to conduct censuses (Box 12.5).

Censuses are not usually health-focused, but they can include measures of health status and retrospective data on household or maternal mortality (although this is not common practice). Census data available for small geographical areas are useful for health-sector planning – for example, to determine access to health services or distribution of health workers. In settings where CRVS systems are lacking, the census may be used to gather information about births and deaths from proxy respondents. Like household surveys, censuses are often crucial sources of information on inequality in the social determinants of health, a vital part of inequality monitoring.

Strengths and limitations of census data

Major strengths of censuses for health inequality monitoring lie in their comprehensive coverage and collection of data on small geographical areas. The data collected through the census, although often lacking health data, can provide complete and accurate information pertaining to key demographic and socioeconomic dimensions of inequality. This information can serve as an important source of data about population sizes (useful, for example, for reweighting survey estimates), and socioeconomic information at the small area level (which can help to inform the selection of relevant dimensions for monitoring).

For the purposes of health inequality monitoring, the usefulness of the data may rely on the ability to link the data with other sources using small area identifiers such as postal codes or neighbourhood names. In some countries, census data contain identifying information at the individual level (e.g. through personal identity numbers), although access to and use of these data are highly restricted. More commonly, census data aggregated at the level of postal code or neighbourhood may be used to determine the average level of education or income for the area, which could then be linked with other sources of health information, such as primary care records, hospital episodes, vaccination records and mortality. Similarly, deprivation indices, which combine information across several socioeconomic dimensions of inequality to construct small-area level estimates, may be useful for health inequality monitoring (see Chapter 17). Data linkages often exist in high-income countries, but they may be lacking in many low- and middle-income countries.

BOX 12.5. Census methodologies

Traditional census methodology involves the active collection of information from individuals and households on a range of topics at a specified time. Data collection, which may be done through long- and short-form questionnaires, occurs in a specified enumeration area over a short period of time. This ensures data collection is universal – covering all members of the population – and simultaneous. Short forms contain questions intended for universal coverage. Long forms, collecting more detailed information, are distributed to a sample of the population. Another common design involves the completion of a medium-length form by all members of the population. Censuses conducted through this traditional method have fewer and less complex data adjustments, because the raw data constitute all inputs (noting that non-response and the need for data validation, correction and imputation are part of traditional census processing).

Although most countries continue to use the traditional census approach, alternative census methodologies are gaining popularity *(25)*. Alternative approaches may produce more frequent and timely statistics and require lower budgets and fewer inputs from the population, although they rely on more advanced technical capacities to process the data. These approaches include:

- rolling censuses, whereby information is collected through continuous cumulative surveys covering the whole country over a longer period of time;
- ad hoc sample surveys, conducted to provide information on topics not available from administrative sources, or for the purpose of making adjustments to poor-quality data in registers;
- existing sample surveys and registers, whereby information is collected from and linked across existing data sources.

Register-based censuses involve downloading information from a population register. Administrative censuses involve linking data from administrative sources to provide either a continuous or 10-year snapshot of the population. Both approaches provide additional dimensions of inequality not readily obtained from in-person questionnaires, although they do not capture items that can be obtained only through more traditional means, such as subjective health status.

Censuses are often scheduled to occur every 10 years and therefore the data may become out of date. In some settings, the timing of census data collection is not consistent, with delays due to reasons such as cost and complex logistics. Additionally, the period of data collection for a census may be lengthy, especially if financial or human resources are lacking. Census data can, however, be useful to “fill in” population numbers and make projections for the years between two consecutive censuses.

Use of population-based data sources for inequality monitoring

Population-based sources contain information that is representative of a base population, making them candidates for use in health inequality monitoring. Household health surveys, CRVS systems and censuses have different strengths and limitations, resulting in different applications for monitoring (Table 12.1).

TABLE 12.1. Considerations for using population-based data sources for health inequality monitoring

Data source	Strengths	Limitations	Opportunities to strengthen
Household health surveys	Surveys may include comprehensive information about health and dimensions of inequality Survey questions and methodologies can be adapted between survey rounds to address emerging issues Surveys are representative of national populations, regardless of whether they have contact with health or other administrative systems Repeating surveys over time generates comparable data useful for tracking changes in health inequalities Multicountry surveys that generate harmonized data across multiple settings facilitate benchmarking	Surveys may not be representative of smaller population subgroups or geographical areas Surveys may produce point estimates with high levels of uncertainty or that are subject to data suppression Surveys may be subject to sampling and non-sampling errors Surveys may be conducted infrequently, and data may become obsolete	Repeat surveys on a regular basis Increase the sample size of minority groups to ensure sufficient representation across subgroups Use reweighting to account for under-enumeration and response bias Harmonize questions across countries to facilitate benchmarking (e.g. through use of global frameworks to define health indicators and inequality dimensions)
CRVS systems	Designed to contain comprehensive, timely data about births, deaths and cause of death Routinely record information that enables disaggregation by age, place of residence or sex	Functioning CRVS systems require a high level of cooperation, coordination and investment across government agencies (or clear legal responsibility and funding of a single agency) and the health sector, which may be weak or lacking CRVS systems tend to lack information about socioeconomic inequality dimensions	Expand civil registration coverage to entire population (e.g. progressing from sentinel to sample to full registration) Build capacity for use of standardized international instruments to record cause-of-death data and ICD coding Expand collection of data on dimensions of inequality Collect information about personal or small-area identifiers to enable linkages with other data sources
Census	Data cover the entire population and provide accurate denominator counts, including by population subgroup Identifiers at small geographical levels, where available, are useful for linking with data from other sources	Health information tends to be limited Data collection occurs infrequently (usually every 5 or 10 years), and therefore may not be timely	Collect information about individual or small-area identifiers to enable linkages with other data sources Consider rolling, register-based or administrative censuses to improve frequency of data collection

CRVS, civil registration and vital statistics; ICD, International Classification of Diseases.

A first consideration is the availability of disaggregated data. Health data from household health surveys can typically be disaggregated according to multiple inequality dimensions, although the ability to disaggregate to small subgroups or geographical areas may be limited by small survey sample sizes. The possibility to meaningfully disaggregate CRVS data, however, tends to be very limited. Although the possibility exists, CRVS systems, even where highly functional, do not often include information on socioeconomic dimensions of inequality. CRVS systems are a rich source of data pertaining to births and deaths, but the scope of health information is narrower than that contained in household health surveys. The ability to link across data sources (see Chapter 15) provides expanded opportunities for the disaggregation of CRVS data. Censuses, with limited or no health data, tend to be rich sources of data about dimensions of inequality and the social determinants of health (such as economic status, education level or housing). In countries where census information is more limited, these data may not be directly useful for inequality monitoring, unless they are linked with another source through an individual or small-area identifier. In other countries, however, extensive inequality monitoring of health and health determinants using census data in conjunction with other data sources is common.

A further consideration for the use of these sources in inequality monitoring pertains to coverage. Although these data sources are aimed at representing or including the entire population, in reality they may fall short of this aim in different ways. Censuses often undercount certain vulnerable populations. In the United States of America, for example, migrants, homeless people, people from the LGBTQI+ community, children in foster care and people living with a disability are among the populations at risk of being missed *(26)*. If not addressed through corrective measures, the implication of these gaps may be exacerbated further in household surveys when survey sampling frames are derived from census data.

Census data have a role in supporting the quality and use of other data sources. For example, information derived from the census is crucial for the design of household health surveys. It helps to ensure survey samples are designed to be representative of the entire population. In settings where other health data sources such as CRVS systems are weak or have incomplete coverage, the census may include questions about recent births and deaths. This information, collected through secondhand proxies such as parents or children, helps to correct for underreporting. Even cause of death, when evident, has sometimes been included in censuses, although these data are often of poor quality unless standardized verbal autopsy questionnaires are used.

Census data can also be used to determine accurate denominator estimates, which is applicable for the use of institution-based data to calculate rates or coverage. For example, although data from institution-based sources may contain information about the number of people who use a particular health service that they need (and this may be available disaggregated by age, location, sex and other dimensions), census data can be used to estimate the total population of people who need that service, including people who did not use the service. For more information on institution-based data sources, see Chapter 13.

Census data and household surveys are essential for ascertaining the distribution of social determinants of health across different social groups, which is crucial for monitoring inequality.

Data quality is an important consideration for the use of any data source for inequality monitoring. The adoption of standardized approaches, definitions and tools can greatly enhance the reliability and accuracy of measurements and support great comparability between populations. For example, using globally standardized definitions and criteria to define health indicators and inequality dimensions in household health surveys enables the practice of benchmarking. Adopting standard instruments and coding for recording cause of death is recommended for all CRVS systems.

The timeliness of population-based data sources is variable, owing to their different designs and overarching purposes. CRVS systems are designed to collect data on a continuous basis, while household health surveys and censuses are typically conducted as snapshots of the population, repeated on a recurring basis. These schedules impact the frequency with which inequality monitoring can be repeated.

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Institution-based data sources

Overview

Institution-based data sources capture an array of sources that collect data during administrative and routine activities. This broad class of data sources is diverse in scope and the type of information collected. Institution-based data sources may collect data within the health sector (e.g. at clinics, hospitals or other health service points) or outside of it (e.g. as part of food and agricultural, occupational, police, tax or welfare records). Institution-based data include information collected by commissioners and funders of health care, such as large-scale purchasing organizations and medical insurance agencies. Institution-based data sources may contain information about health indicators and/or dimensions of inequality. This information may be available at an individual level or for small areas such as districts or municipalities.

This chapter describes the general characteristics of various institution-based data sources within the health sector (individual, service and resource records) and provides an overview of sources outside the health sector. It covers considerations for assessing the quality of these data sources and outlines their potential applications for health inequality monitoring, including how they may be used in conjunction with other sources. It offers insights into how institution-based sources are part of the data landscape for health inequality monitoring, and how inequality monitoring can benefit from strengthened and expanded institution-based data sources.

Institution-based data sources within the health sector

Institution-based data sources within the health sector contain routine and administrative information collected and recorded by and at health facilities (i.e. clinics, hospitals, and other public, private or community-based health service points). Data are collected through individual, service and resource records *(1)* and function as data inputs into overarching routine health information systems (RHIS; see Box 13.1). By design, data are collected from all health facilities and clinical services (ideally capturing the public and private sectors), thereby yielding a rich source of information about disease and health status; preventive measures such as vaccination and reproductive health services and screening; and the broader operations of the health sector.

BOX 13.1. What are routine health information systems?

RHIS are systems to regularly record, analyse, report and present routinely collected data from health facilities and by health facility staff. The data within RHIS provide information about the services delivered at health facilities, and information about individuals accessing those facilities, including their health status. RHIS data are primarily used for monitoring health service performance, for operational management of health facilities, including planning. Regular collection and analysis of these data allows frequent and current assessments of population health at the district level. RHIS data are also part of health-sector reviews at the national and subnational levels and may be useful for inequality monitoring activities, especially if district-level data can be linked to other sources of data about relevant dimensions of inequality.

The WHO Toolkit for Routine Health Information Systems Data supports the introduction of standards for health data collection at facilities, capacity-building to optimize analysis, and use of routine facility data, promoting an integrated, standards-based approach using a set of internationally recommended standardized core indicators with standard analyses, visualizations with dashboards, and guidance for data use *(2)*.

Definitions of institution-based data sources in the health sector and approaches to classifying health data sources vary across contexts and applications. The United States Agency for International Development definition, in its resource *Health information system strengthening: standards and best practices for data sources*, includes “routine, administrative data sources as well as cross-sectional data collected through health facility assessments” *(3)*. The WHO Health Metrics Network definition, in the second edition of the *Framework and standards for country health information systems*, includes “institution-based sources generate data as a result of administrative and operational activities [within and outside the health sector]” *(1)*. For the purposes of this book, routine data generated across all health facilities (i.e. institution-based data sources within the health sector, discussed in this chapter) are considered separately from health facility assessments and other sources that collect data about health facilities, which are covered in Chapter 14.

Institution-based data sources include sources that collect information in the course of administrative and operational activities at institutions. Institution-based sources contain data only about people who have interacted with the institution.

Individual health records capture information to manage health services provided to individual clients in health institutions or through outreach in the community *(1)*. They include primary care consultation records; case reports and disease records routinely produced by health workers; records on individual clients to monitor growth or antenatal and delivery care; and information in special disease registries, such as for cancer. The type of information encompasses individual demographics, health status, risk factors and medical history data. Individual records are retrievable by health workers and can provide a longitudinal assessment of an individual’s progress and outcomes.

The increasing digitalization of health and medical records allows data to be standardized, managed, aggregated, shared and analysed more easily. Electronic health records are nearly ubiquitous in high-income country contexts, but this is not (yet) the case in low- and middle-income countries. Increasingly, low- and middle-income countries are introducing simpler individual medical record systems that capture client profiles and essential information for case management, providing longitudinal data for disease prevention and control programmes (see also surveillance systems, covered in Chapter 14).

Health service records at the health facility level contain service-generated data such as testing and diagnosis, financial costs, activity statistics, quality of care, care offered and treatments administered *(1)*. Ideally, they should collect data using a standardized reporting form and a systematic manner that permits comparisons across facilities, regions and time (noting that facilities may have different protocols due to health information system fragmentation or multiple managing authorities, which limits data comparability). A primary use of service records is to yield locally relevant data for managing local health services and generating national statistics on health service use, health service coverage and health system performance. To estimate health service coverage, the data derived from health service records may need to be combined with denominator estimates (the number of people targeted or the population in the catchment area) derived from other sources. In low- and middle-income countries, data from health service records may be more readily available than data from electronic health records.

Resource records contain information about the quality, availability, readiness and logistics of health service inputs *(1)*. This includes data about the density and distribution of health facilities, and data related to human resources for health (according to qualifications and training), budgets and expenditures, medicines, and other core commodities and services (sometimes referred to as the logistics management information system). The use of geographic information system software may aid in assessing the location of service delivery sites and administrative boundaries and catchment areas (see Chapter 16).

Institution-based data sources outside the health sector

Outside the health sector, institution-based sources include records kept by other institutions such as national statistical offices, the police, veterinary services, insurance companies, environmental health authorities, tax and welfare agencies, and occupational health agencies. These records are numerous and diverse. They may contain information about health and/or determinants of health (Box 13.2). They may also be sources for information about dimensions of inequality – in which case, they may need to be linked to sources of health data for use in health inequality monitoring.

Strengths and limitations of institution-based data sources

General strengths of institution-based data sources are that the data tend to cover large numbers of people or large population areas and are generated on a recurring basis. The data are widely available across sectors, because almost every government ministry (e.g. education, finance, health, justice, social welfare) has administrative records that could be used to source data for health inequality monitoring. When functioning well, institution-based data sources contain consistent and accurate data. Data quality, however, can vary and is contingent on the standards and practices surrounding data collection, processing and access (see Chapter 11). In addition to quality issues, data comparability may be a limitation if, for example, definitions are not harmonized across ministries; international definitions are not used; or administrative records are discontinued, changed or altered over time to align with shifting policy, legislation, regulation or political environments. The Data Quality Assurance (DQA) toolkit provides a harmonized approach for assessing and improving the quality of health facility data (Box 13.3).

BOX 13.2. Examples of health-related institution-based data sources outside the health sector

- The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene sources data about water, sanitation and hygiene indicators from ministries of water and sanitation, education and health, and regulatory agencies *(4, 5)*.
- Data on the health of people in prisons and other closed settings are collected by administrative systems in such settings and collated by the responsible government institution. These sources may also contain information about relevant dimensions of inequality (e.g. age, ethnicity, sex) and other details about the criminal history of individuals.
- Data about migrants, including information on the migration of health workers, can be sourced from administrative records. For example, information about new entries of migrants can be traced through administrative registration for residence or working permits from interior affairs or immigration services, foreign employment departments and other administrative services or border registration *(6)*. Cross-border data, including routine screening of passengers, may be collected by the ministry of aviation or transportation. Information such as age, country of origin, legal status and sex may be available. For more on inequality monitoring among refugee and migrant populations, see Chapter 5.

BOX 13.3. Data Quality Assurance toolkit

Recognizing the importance of ensuring high-quality data from health facilities, the DQA toolkit (previously known as the Data Quality Review) was developed to provide a harmonized methodology and common language applicable across diverse contexts *(7)*. The objectives of the DQA toolkit are to institutionalize a system for assessing data quality; identify weaknesses in data management systems and interventions for system strengthening; and monitor the performance of data quality over time. The methodology is a multipronged approach that includes desk reviews and site assessments, carried out as part of routine and regular data-quality checks and discrete or cross-sectional assessments.

Institution-based data sources within the health sector can provide detailed information about uptake and outcomes of health services in a particular setting. This is especially the case for disease programmes with dedicated financing and support for monitoring and reporting. The breadth of data and how information is recorded, however, reflect the underlying administrative purposes and may limit the usefulness of the data for inequality monitoring. For example, administrative records often contain information about geographical location, but data about multiple other inequality dimensions, especially socioeconomic factors, tend to be limited.

Institution-based data sources may be limited in their coverage because they generally collect information only from people or populations that interact with a given institution and for whom records are kept. Medical or employment records, for example, do not provide information on people who do not interact with the health sector or people who are not formally employed. Missing data may be an issue if records are incomplete or contain errors, or if an individual does not have a required form of identification such as a health card or national identification. The possession of official or appropriate identification can be problematic for people in vulnerable groups and settings, such as Indigenous Peoples, refugees and transgender people. In such cases, data from institution-based sources are unlikely to be representative of the whole population in a particular area, and household health surveys may be an important complementary data source (see Chapter 12).

There may be differences in accessibility and scope of data from public, private and community institutions, with implications for health inequality monitoring. Data from public sources are more likely to be linked across other public sources and to be nationally reported, with more systematic data collection and reporting protocols. Data from private institutions may not have standardized records and, depending on the context, may be difficult to access by people outside the institution. Data from private institutions may be more likely to be excluded from national collation and reporting. Likewise, data from community or nongovernmental facilities may be overlooked in national reports, unless facilities are part of national networks.

Across countries, there is variability in the extent to which institutional records can be internally integrated and aggregated, which has implications for the ability to make comparisons within and across countries. In the health sector, some countries are able to integrate data across different levels of care (e.g. primary, secondary and tertiary) and can track individuals through the continuum of care. In other countries, separate data collection and analysis systems may be in place due to lack of linking mechanisms, lack of information technology systems or infrastructure interoperability, or lack of information-sharing mechanisms between facilities. Health sectors of some countries may be more integrated than others, but this brings other legal, governance and information technology challenges.

The use of standardized electronic medical records and protocols across institutions helps enhance the reliability and comparability of data, especially when there are protocols for checking data completeness, consistency and accuracy (and measures to adjust statistics based on such findings). The use of electronic records creates possibilities for aggregating data, such as across facilities within an area. Electronic forms are, however, subject to limitations that can arise if data entry and coding are inaccurate or if there is a systematic error (e.g. a default code that is applied when information is not available or not entered can lead to misleading inferences that would not be encountered with paper forms). Additionally, there is no defined standardized mechanism for data-sharing. In contexts where paper records are still used, errors may occur during data registry or data entry or due to the physical degradation of records.

The accessibility of institution-based sources may prove a substantial barrier to the use of these data in some applications or contexts. Accessing individual health records, for example, requires that records are sufficiently anonymized to protect confidentiality and/or data security measures are in place to regulate who can access the data and when, where and for what purposes the data can be used. In some cases, data held by private institutions may have tight restrictions on external access, allowing the data to be used only in legally mandated reporting. For data that are to be linked across data sources, personal or small-area identifiers such as postal codes need to be retained – which may make anonymization particularly challenging, leading to complex and time-consuming procedures to gain access to the data *(8)*.

Use of institution-based data sources for inequality monitoring

Institution-based data sources have some advantages over other data sources for use in health inequality monitoring. Compared with household health surveys and censuses (see Chapter 12), data from institution-based sources are collected closer to real time, which allows for more timely reporting and tracking of trends. Also, administrative data are collected as a part of routine activities, providing a more feasible and affordable alternative to many population-based sources. Compared with civil registration and vital statistics systems and census data, institution-based data sources in the health sector represent a greater, albeit different, range of indicators about health services, outcomes and health sector activities, along with basic information derived from individual profiles such as age, location, occupation or sex.

Data from institution-based sources in the health sector are often collected at local levels of the health-care system, thus presenting opportunities for monitoring inequalities between lower administrative levels such as districts or municipalities. The inclusion of small-area identifiers enables the practice of data linking, whereby data are combined across multiple sources through common overlapping information (see Chapter 15). For example, health data collected at the district level can be combined with district-level socioeconomic data (generated through other institutional sources, censuses or surveys), yielding district-level disaggregated data for inequality monitoring. Data linking at the individual level may also be possible, provided individual-level identifiers are present in both data sources and appropriate ethical protocols and data security protocols (see Chapter 4) are in place.

When using data from institution-based data sources to derive rates or coverage, the challenge of estimating denominator values may arise. For example, an institution-based data source may contain information about the number of people who received a health service but not the number of people eligible for or in need of receiving that service. As another example, an institution-based data source may contain information about the number of people diagnosed with a particular health condition but not the total size of the population. In some cases, the denominator data can be estimated based on information from another source, such as a census, a different administrative data source or a routine population estimate, although there may be limitations. For example, the timing of data collection efforts may be misaligned between data sources, leading to unreliable denominator estimates. Furthermore, people may access services outside the area where they live and therefore may not be represented in the appropriate denominator group if it is derived from the catchment area (although if the usual residence is recorded on the service record, indicators may be constructed using the area of residence rather than the area of service usage). Where available, geospatial data such as satellite images may be an alternative source to estimate denominator values (see Chapter 16).

To enhance the usability of institution-based data sources for health inequality monitoring, sources could expand the collection of data about key inequality dimensions such as age, geographical location, sex and socioeconomic factors. This would ensure different dimensions of inequality could be linked to relevant indicators of health and/or health determinants. In many contexts, greater efforts are needed to facilitate sharing and exchange of data across sectors, which may entail strengthening collaborations across various sectors and levels of government.

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14

Surveillance systems, health facility assessments and other sources of data

Overview

The two major classes of data sources for health inequality monitoring are population-based sources (e.g. household health surveys, civil registration and vital statistics (CRVS) systems, censuses) and institution-based sources (e.g. administrative records from health or other sectors). There are, however, many other sources that may be used for health inequality monitoring. Surveillance systems and health facility assessments contain elements of both population-based and institution-based sources. Relevant data may also be derived from health and academic research, nongovernmental organizations, corporate entities and elsewhere. For certain applications of inequality monitoring, such sources contain data about health indicators and/or dimensions of inequality, helping to fill information gaps.

Surveillance systems draw from a range of data sources to monitor a specific disease or condition (e.g. public health emergencies), aimed at triggering a response. They may collect data actively or passively; may represent the population through comprehensive or sentinel designs; and may apply different case definition criteria. Health facility assessments, including health facility sample surveys and health facility censuses, provide detailed information relevant to health service delivery at health facilities. Other sources of data, such as those derived from health research, health-care financing analyses and modelling exercises, use various methods to collect data for specified purposes and topics of interest.

This chapter discusses the main characteristics of surveillance systems and health facility assessments, highlighting how they may be used for health inequality monitoring. It also acknowledges the possibility of using data from a variety of other sources.

Surveillance systems

The purpose of surveillance systems is to detect, report and respond to specific notifiable or reportable conditions. They rely on inputs about health events from population-based and institution-based data sources and may also integrate other sources of ad hoc data. Data may be collected actively (e.g. in clinics and camps serving refugees and displaced groups, or during outbreaks from known diseases) or passively through other established data sources. In addition to information about the specific condition, the minimum essential surveillance data required to guide response and prevention efforts include the time, place and basic characteristics about the affected person, which are often limited to age, place of residence and sex (although surveillance systems may also collect information about a wider range of dimensions of inequality). Surveillance systems may be designed as sentinel or comprehensive, or a combination of both (Box 14.1) *(1)*.

Surveillance systems encompass a broad set of methods for handling data from a range of sources. They may rely on established standard case definitions, systematic reporting protocols, laboratory capacity, centralized reporting and analysis, and responses to early warning signals, as applicable to their function (Box 14.2). Although surveillance systems have traditionally been designed for epidemic-prone communicable diseases, they have also been developed for other purposes, such as monitoring public health trends, vital events, chronic diseases, risk factors and demographic information. Digital public health surveillance, which relies on data from digital sources such as social media, news media, discussion forums, internet search engines and other web-based sources, is covered in Chapter 16.

A patchwork of surveillance systems exists nationally and internationally, addressing diverse aspects of public health. These systems are part of emergency responses. They cover a variety of diseases and threats. In some contexts, they may play a role in collecting demographic information. For example, outbreak disease surveillance systems aim to track cases of epidemic-prone diseases and their risk factors. They rely on frequent reporting by health facilities, including laboratories, as the main source of data. Risk factor surveillance collects information on noncommunicable diseases, often focusing on data obtained through surveys. Demographic surveillance systems are common in countries where the coverage of CRVS systems is very low. Although they are not representative of the wider population, they help to provide an overview of basic information, such as population-level deaths and causes of death *(5)*.

Some of the key challenges associated with surveillance systems stem from financial and health workforce demands, because these systems are costly to establish and maintain and require well-trained epidemiologists. Working with country partners, WHO has developed numerous surveillance systems. The WHO COVID-19 Detailed Surveillance Data Dashboard,

BOX 14.1. Sentinel and comprehensive surveillance systems

Sentinel surveillance systems identify a selection of health facilities that are required to report, often with intensified timely data collection. This approach allows for tracking patterns in reporting cases and is appropriate for common diseases that do not require immediate public health action (e.g. diseases that are not targeted for eradication or elimination, such as influenza and other viral respiratory diseases).

Comprehensive (also known as universal) surveillance systems require that all sources report diseases or hazards that are subject to mandatory notification under notifiable diseases lists. This approach enables immediate public health action, because a single case may be sufficient to warrant action. It is suited for situations such as diseases targeted for eradication or elimination, contaminated food or medicine, severe diseases with a high potential for spread, and severe adverse reactions or death following use of medicines or vaccines.

Surveillance systems may be a combination of sentinel and comprehensive approaches, such as across different parts of a country or during different times of the year *(2)*.

BOX 14.2. Indicator-based and event-based surveillance functions

Conventional surveillance systems tend to rely on indicator-based surveillance *(1)*. This is a form of passive surveillance that makes use of the routine reporting of health information according to standardized case definitions. These data, which tend to have high reliability, are typically obtained passively through the health-care system, such as through local public health units, laboratories, registers or surveys. Indicator-based surveillance is used to monitor the frequency, origin and distribution of reportable diseases. Data obtained through passive surveillance may include information on inequality dimensions and are likely to be useful for inequality monitoring over time. For example, in the United States of America, the Notifiable Infectious Disease Data Tables, prepared by the Centers for Disease Control and Prevention, report weekly-aggregated data for national notifiable infectious diseases and conditions *(3)*.

Event-based surveillance is a hallmark of early warning systems *(1)*. It relies on a more directed approach to detect emerging events and public health threats through ad hoc data sources such as the internet, media, informal networks or big data. Event-based data can enhance the sensitivity of a surveillance system because they can provide information before human cases occur or before an event is detected or reported through conventional means. Information detected through event-based surveillance may be unstructured and unreliable, and it does not necessarily adhere to case definitions. This form of surveillance is usually put in place when faced with an outbreak. It may have more limited applications for health inequality monitoring, especially if information about inequality dimensions is not available. At the onset of the COVID-19 pandemic, many event-based surveillance systems emerged, including wastewater monitoring, and data collected for small geographical areas, which enabled early prediction of case increases *(4)*.

for example, includes data related to COVID-19 cases, deaths and case fatality ratios, disaggregated by age and sex *(6, 7)*. In the wake of the COVID-19 pandemic, and with the aim of strengthening global health emergency preparedness, response and resilience, attention has turned to the concept of collaborative surveillance, which emphasizes establishing intentional collaboration across diverse surveillance systems as part of strengthening coordinated actions *(8)*.

Use of surveillance system data for inequality monitoring

Surveillance systems can generate standardized data according to specific case definitions, yielding data that can be compared across settings, over time and between populations. Data from high-quality surveillance systems tend to be up to date and produced frequently across multiple sites or settings. This can enable regular, repeated inequality monitoring and benchmarking, provided data on dimensions of inequality are collected alongside health data or the data can be linked to other sources containing information about dimensions of inequality. See Chapter 15 for more information on data source linking.

Surveillance systems can provide data for certain health indicators (e.g. notified cases), but corresponding information on dimensions of inequality may be more limited. For example, the WHO *State of inequality: HIV, tuberculosis and malaria* report included data on tuberculosis (TB) case detection rate, sourced from national TB surveillance systems. The available dimensions of inequality data enabled disaggregation by age and sex, but not socioeconomic dimensions, because data were not systematically available for all countries *(9)*. In some cases, surveillance systems may provide a stream of data that can be linked to other data sources to enable inequality monitoring.

In general, the inclusion of small-area identifiers alongside data from surveillance systems may enable linkages and expanded use for health inequality monitoring. For example, information derived from surveillance systems about the numbers of disease cases in subgroups (numerators) would need to be combined with information about the population sizes of those subgroups (denominators, derived from a census or other source) to yield population rates, which could then be used for inequality analysis. Likewise, if a surveillance system is monitoring interventions, it may be necessary to calculate intervention coverage by linking to another data source for denominator values. For more information about defining and constructing health indicators, see Chapter 17.

In some cases, surveillance systems may yield data about small numbers of people and/or short reporting periods, making them less useful for inequality monitoring because the data are non-reportable or provide imprecise estimates due to insufficient sample sizes. This may be addressed by aggregating data across population subgroups and/or time periods before analysis. Users of surveillance data should consider data gaps and data quality when planning and interpreting inequality analysis.

Ideally, inequality monitoring requirements should be considered in the design and operation of surveillance systems to ensure they are fit for that purpose. The accessibility of surveillance system data, and therefore their usefulness for health inequality monitoring, is enhanced when national, regional or global dashboards are maintained.

Health facility assessments

Health facility assessments include health facility sample surveys and health facility censuses. These assessments periodically collect information about health facilities and the services they provide. Using trained enumerators, they gather data through various inventories such as health resource inventories, interviews with staff and clients, and observations of service deliveries. Whereas health facility surveys are conducted on a representative sample of health facilities within a country (ideally including both public and private), health facility censuses include all facilities in the country. Health facility assessments rely on a current master facility list as a reference list for facility censuses and as a facility sampling frame for facility surveys.

For the purposes of this book, health facility assessments are discussed separately from data sources that collect data at health facilities in the course of routine administrative and operational activities (see Chapter 13). There are four main ways that health facility assessments differ: data collection occurs on a periodic rather than an ongoing basis; data are collected by external enumerators rather than facility self-reporting; the assessments encompass a greater scope of information on health system inputs and outputs; and the assessments can provide information on staff and client satisfaction and client consultation processes *(10)*. Therefore, data from health facility assessments can be used to complement and validate routinely collected data from health facility records. A health facility assessment should be conducted every three to five years using standardized methodologies and instruments (Box 14.3).

Use of health facility assessment data for inequality monitoring

If standard methodologies and instruments are used, health facility assessments yield comparable data across settings. These sources contain rich data about health facilities and services. Ideally, health facility assessment data should be available and representative at the subnational level, making them useful for within-country inequality monitoring.

BOX 14.3. Standardized methodologies and instruments for conducting health facility assessments

The WHO Harmonized Health Facility Assessment (HHFA) is a comprehensive health facility survey that assesses the availability of facility services and the capacity of facilities to provide the services at required standards of quality *(11)*. It covers a range of key primary health-care services and basic hospital services. The HHFA generates objective information on services offered, key resources (including infrastructure, trained staff, guidelines, equipment, diagnostic capacity, essential medicines and commodities), and management, finance and quality assurance systems. The HHFA updates and expands on the previous WHO facility assessment, the Service Availability and Readiness Assessment (SARA) *(12)*.

The WHO Health Resources and Services Availability Monitoring System (HeRAMS) is a rapidly deployable and scalable system that supports countries with the standardized and continuous collection, analysis and dissemination of information on the availability of and accessibility to essential health resources and services *(13)*. HeRAMS is intended for contexts where limits to access, security, time and resources do not favour traditional means of assessment and monitoring, such as the HHFA.

The United States Agency for International Development Service Provision Assessment (SPA) is a health facility survey that collects data on service availability and quality of care measures, including physical and human resources, provision of care, and experiences of care through direct observations of consultations and post-consultation interviews with clients. SPA includes a focus on antenatal care, family planning, maternity care, and services for children who are unwell *(14)*.

World Bank Service Delivery Indicators (SDI) surveys measure primary health-care service delivery, with an emphasis on capturing the experience of the "average" citizen. In addition to measuring the availability and functioning of key medicine, equipment and infrastructure at health facilities, SDI surveys also measure health-care provider knowledge and ability using standardized clinical vignettes, absenteeism and caseload *(15)*.

Data obtained through health facility assessments are typically available at the facility or small-area level and suited to ecological analysis (i.e. analysis based on aggregated or grouped rather than individual-level data). For example, district-level health information may be combined with district-level socioeconomic information to assess socioeconomic-related inequalities in health across districts (see Chapter 25 for more about ecological analysis). Linkages with other data sources at a small-area level can further enhance possibilities for inequality monitoring. Combining facility-level data with household survey data, for example, can enable more complex inequality analysis by allowing for adjustments for the type or quality of facility that people report receiving care from (which may account for some difference in care-seeking behaviours). Linking may be done in combination with geospatial data, such as travel distance or catchment areas around health facilities, to assess inequalities in health-care distribution and access (see Chapter 15).

In some cases, it may be possible to link at the individual level through exact-match linking of individuals in population data to the exact health facility they attended, allowing for assessment of systematic differences in care-seeking behaviour between individuals with different characteristics, such as economic status. Box 14.4 contains examples of how health facility assessment data have been used to monitor inequalities.

Other data sources

Data from other sources not covered in earlier sections of this chapter and in Chapters 12 and 13 are sometimes used to fill information gaps when monitoring health inequalities. These data sources may present possibilities for inequality monitoring in populations excluded from or underrepresented in other sources, or possibilities for inequality monitoring pertaining to understudied health topics or inequality dimensions. Such data may derive from health and academic research, social media, corporate entities or elsewhere, and include exploratory studies, large-scale established research programmes, monitoring and evaluation, client surveys and client feedback.

For example, at the beginning of the COVID-19 pandemic, WHO monitored country and ministry of health reporting on social media platforms to track cases and deaths, before mandatory weekly country reporting was put in place. As another example, throughout the COVID-19 pandemic, Canada leveraged nontraditional data sources and explored the potential of artificial intelligence web scraping to overcome timeliness issues and data gaps in traditional case-based information for provinces and territories *(22)*.

Estimates modelled or triangulated from multiple data sources are another potential source of data for health inequality monitoring, especially if reliable direct measures are not available and if estimates are available across population subgroups. Modelled estimates draw from diverse types of information, such as epidemiological and programmatic data, taking into account the quality of available data sources (especially routine surveillance and surveys), expert opinions, and other factors such as underreporting, overdiagnosis and underdiagnosis.

BOX 14.4. Examples of health facility assessment data used in health inequality monitoring

Across 17 low- and middle-income countries, health facility data from SARA and SPA were linked with household health survey data from the Demographic and Health Survey (DHS) and the Multiple Indicator Cluster Survey (MICS) to explore obstetric service availability, readiness and coverage within and between countries *(16)*.

A study in Malawi examined the relationship between distance to services and immunization coverage in a rural population, using facility data from the 2013–2014 Malawi SPA, linked with individual data from the 2015–2016 DHS *(17)*.

In Côte d'Ivoire, a health provider assessment was conducted in a health facility census using adapted questionnaires from SARA and SPA *(18)*. Information was linked to care-seeking data from MICS.

In Mali, data from DHS and SARA were combined to assess the service environment and service use in the country at the regional level *(19)*.

A study conducted in rural Ethiopia explored the association between distance from health facility and early neonatal mortality in rural areas. The study used health facility data from the Ethiopian Emergency Obstetric and Newborn Care Needs Assessment, a cross-sectional facility-based census of nearly all public hospitals, health centres and private clinics in the country, and data from the DHS *(20)*.

The Gavi, the Vaccine Alliance Full Country Evaluations Project in Bangladesh, Mozambique, Uganda and Zambia conducted joint health facility surveys with the aim of understanding and quantifying the barriers to and drivers of immunization programme performance. Data collection methods included interviews of health providers, direct observation of facility areas, direct observation of child vaccinations, and assisted observation of immunization sessions *(21)*.

Modelling is most often used to generate prevalence, incidence, mortality and morbidity estimates and to create estimates that are comparable across countries. If estimates are available by population subgroup, inequality dimensions are usually limited to age or sex. In some applications, modelling exercises have been used to derive estimates across wealth quintiles *(23)*. For more discussion on the use of modelled estimates, see Chapter 15.

These sources are varied and diverse in terms of their scope, methods and quality and therefore will not be covered here in depth. The data requirements and attributes of high-quality data sources (see Chapter 11) can be used to help assess their suitability for use in health inequality monitoring. For further discussion of novel and emerging data sources for inequality monitoring, including geospatial data, mobile and web-based surveys, health tracking applications and digital public health surveillance, see Chapter 16.

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15

Selecting data sources and addressing data gaps

Overview

Health inequality monitoring requires data, which may be obtained from a variety of different sources. The selection of a data source or sources with sufficient and adequate data for health inequality monitoring requires consideration of data availability (what sources exist, what data do they contain and how easily can they be accessed?); data quality (what quality standards do the data meet?); and data suitability (how well do the data serve the purpose of a particular inequality monitoring application?). Data may be available from multiple potential sources, but there are other cases where sources do not contain all relevant data or the data are of poor quality or are otherwise inadequate. In some cases, data sources may be lacking altogether, indicating that efforts and investments may be needed to develop them.

Building on Chapters 12–14, which overview the main data sources used for health inequality monitoring, this chapter considers how to select data sources for health inequality monitoring. It provides strategies and insights for assessing data availability, weighing the strengths and limitations of data sources, selecting from among multiple data sources, and navigating situations of low data availability. It introduces techniques such as data source mapping and data source linking, with examples and tools to support these practices.

Assessing data availability

To streamline the assessment of data availability, it is helpful to clarify the general parameters for a specific application of health inequality monitoring – for example, to identify which populations, health topics and/or dimensions of inequality will be the focus of inequality monitoring (see Chapter 3), noting that the specifics of monitoring may be determined or revised based on the availability of data.

Taking an inventory of existing data sources covering the relevant population, health topic or inequality dimension provides insights into the range of existing sources that may be relevant for inequality monitoring. The data source mapping process described below is a systematic approach to cataloguing the contents and characteristics of existing data sources. The common data sources for health inequality monitoring (see Chapters 12–14) provide a solid starting point.

Data source mapping

Data source mapping is an exercise that helps to assess data availability for health inequality monitoring. It is a process by which data sources are systematically enlisted and their properties detailed. Each source is appraised for its suitability for inequality monitoring *(1)*. By creating an inventory of available data, the exercise helps determine where data for health inequality monitoring can be sourced. It also facilitates cross-referencing between data sources. Data source mapping can expose gaps that indicate where additional data collection is required or where means for enabling data links may be introduced.

Data source mapping involves four main steps and a possible fifth step. Creating sequential and cross-referenced tables for each of the steps facilitates the process. Quality assessments of relevant data sources should accompany the data source mapping exercise. Considerations related to data quality can be recorded as notes in the corresponding sections of the tables or as separate documentation (see Chapter 11).

The first step is to create a list of available data sources, specifying the source type (e.g. census, administrative source, household survey, civil registration and vital statistics (CRVS) system), the name of the source, and the year(s) of data collection. Alongside each source, other pertinent information can be noted, such as the frequency of data collection, data representativeness and data accessibility.

The second step involves assessing the dimensions of inequality data contained in each source. This can be done by creating a second table that is an expanded version of the first table, making note of the available dimensions of inequality contained within each source, and the year for which data are available. Quality considerations specific to the corresponding inequality dimension should be recorded. For easy reference during the next steps of data source mapping, each source can be listed in a separate row and assigned a unique data source reference number.

The third step involves assessing the availability of data about health indicators of interest. Health indicators can be listed as rows. The unique data source reference numbers from the second table are indicated for sources that contain corresponding data about the health indicator. If needed, the indicator definition can be noted for future reference. If the definition of an indicator differs between data sources, the indicators should be listed as separate rows. Data quality considerations pertaining to the health indicator should be noted.

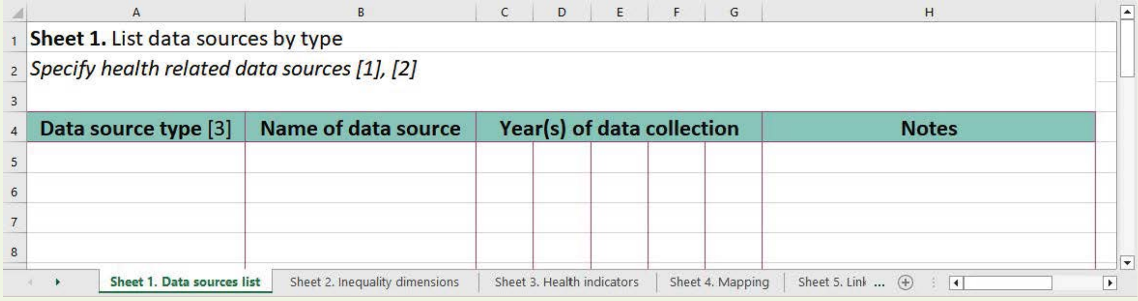
The fourth step is to integrate information from the second and third steps. This indicates the data sources that contain both health indicators and dimensions of inequality data. The health indicators remain as rows, and the dimensions of inequality are listed as columns. The unique data source reference numbers are then translated from the second and third tables to show where data are available.

A fifth step entails identifying possibilities for linking data using common identifiers across sources.

The steps of data source mapping, and in particular the type of additional details extracted, can be tailored to reflect the specific application of inequality monitoring. A series of worksheets for data source mapping is available online (Box 15.1). For an example of the application of data source mapping techniques in Indonesia, see Annex 7.

BOX 15.1. **Table templates for data source mapping and data source linking**

WHO has developed worksheet templates for data source mapping and data source linking. The worksheets allow users to input and organize information about available data sources. They are available online and can be downloaded and modified for use *(2)*.



Sheet 1. List data sources by type

Specify health related data sources [1], [2]

Data source type [3]	Name of data source	Year(s) of data collection	Notes

Selecting among multiple data sources

In some cases, there may be multiple data source options that cover the relevant health indicator or inequality dimension data requirements for the population of interest. These two streams of data for inequality monitoring do not necessarily need to be sourced from a single data source. Indeed, data about health and data about inequality dimensions can be linked across different sources using common identifiers (see *Data source linking* below).

Situations may arise where data about the same or similar health indicators or inequality dimensions are available in multiple sources. To determine which source is most suitable, the strengths of each data source should be weighed against its limitations. The suitability of a data source can be evaluated in three ways, considering its inherent purpose and attributes, the general data quality, and its relevance to a specific application of inequality monitoring.

The major types of data sources used in health inequality monitoring have different inherent purposes, reflected in their design and the type of information that they collect (see Chapters 12–14). For example, multicountry household health surveys are appropriate for expansive assessments of the state of inequality in the topic covered by the survey, including comparisons across countries. CRVS systems collect a more limited scope of data and are better suited for monitoring certain inequalities related to birth and death indicators within a country (although linking CRVS data with census or institution-based sources may open opportunities for monitoring of other indicators).

Understanding the inherent purpose of the data source (i.e. what the data source is designed to do) allows for assessment of quality (i.e. how well that data source fulfils its stated purpose). General data quality considerations relate to the relevance, credibility, accuracy, timeliness, methodological soundness, accessibility, completeness and reliability of the data (see Chapter 11). For example, the purpose of an institution-based recordkeeping system may be to record detailed health information and basic demographic information for individuals visiting a clinic: a system that relies on non-standardized paper forms is likely to have lower reliability, methodological soundness and accessibility than a system using standardized electronic forms (see Chapter 13).

Taking into account the considerations above, the overarching scope and purpose of a particular application of inequality monitoring help to define what is deemed a "suitable" data source. There will be variability across different inequality monitoring applications in terms of how recent the data need to be; whether data across multiple time points are required; whether combining data across several years is required to have a large enough sample size for disaggregation (see Chapter 17); the frequency at which the data should be collected; and what population (or populations, if benchmarking is a requirement) should be covered by the data source. For example, monitoring inequalities during the peak of a pandemic requires data covering the entire affected population that are produced quickly and are available on a frequent basis (e.g. daily or weekly) without delay.

On a practical note, additional considerations pertain to data accessibility. It is important to consider the requirements to gain permission to access the data, and whether they can reasonably be met within the timeframe of monitoring. Additionally, consider whether the data are available in a format that is compatible with analysis software, and whether they require "cleaning" to remove values that are incorrect, unreliable, duplicated, outlying or otherwise unsuitable.

Strategies for navigating data scarcity

For certain applications of inequality monitoring, data may be limited or lacking altogether. The following subsections discuss strategies for navigating such situations. If there are no data sources that contain information about both streams of data for health inequality monitoring, but each stream of data is available from a different source, there may still be options to enable monitoring to proceed. Data source linking may be possible if all sources contain a common identifier, such as a personal identity number or postal code. In some cases, empirical measures may not be available, and modelling may be done to yield estimates for population subgroups. Parallel efforts to advocate for expanded and improved data collection may also be warranted.

Ultimately, however, if the necessary data are not available or the quality of available data is deemed too poor, health inequality monitoring cannot proceed as planned. The focus of monitoring may need to be adjusted to accommodate the data that are currently available, selecting health indicators and dimensions of inequality accordingly. Limited data availability for inequality monitoring should be flagged as an area for attention during the planning and design of subsequent data collection activities.

Data source linking involves merging information about health indicators and dimensions of inequality from different data sources using a common identifier.

Data source linking

Data source linking is a useful option to pursue if information about health indicators and dimensions of inequality is available in two or more different data sources. Linking data from multiple sources is possible only if there are common identifiers across sources. Identifiers may be at the individual level (e.g. personal identity numbers) or the small-area level (e.g. postal codes). These identifiers serve as common tags and are used to link sources. Exact matching relies on a unique identifier variable in all sources. Probability matching is an indirect means of linking data across data sources using multiple matching variables. This technique relies on the probabilities of agreement and disagreement for a greater number of matching variables to link between records *(3)*.

Data source linking for the assessment of inequalities is a common practice across many settings. Data source linking at the individual level is particularly feasible in countries where each citizen has a unique identification number for different administrative and health purposes (e.g. filing taxes, registering civil events such as births, marriages and deaths, enrolling in health insurance, making social insurance contributions and claims, being admitted to hospital, or filling medical prescriptions). For example, income derived from tax registers has been linked to death records to assess economic-related inequality in life expectancy *(4)*. Access to and use of individual data and their record linkages are strictly governed and protected, and – if use is permitted – subject to access, privacy and ethical standards.

Data linking using small-area common identifiers may be part of ecological analyses, where health and dimension of inequality information pertains to a small-area level, such as a district, census tract or neighbourhood. For example, deprivation indices combine multiple streams of socioeconomic information into a score for the small area, which can then be linked with health indicator data to assess inequality *(5)*. Additional examples of linking between data sources are provided in Box 15.2.

BOX 15.2. Examples of data source linking

The following examples illustrate linking data sources using individual and small-area identifiers for inequality analyses.

A study among adults in Canada measured inequalities in preventable mortality between populations that reported different sexual orientations. It also explored whether the association between sexual orientation and preventable mortality was mediated by one or more variables related to social and material resources. To conduct the analysis, data were linked at the individual level using personal health numbers between the Canadian Community Health Survey and the Canadian Human Mortality Database (which contains information about all deaths registered through vital statistics registries). The results showed that LGBTQI+ people experience more preventable deaths than heterosexual people, and that higher mortality could be explained by differences in marital status and income *(6)*.

A study in Buenos Aires, Argentina explored inequalities in life expectancy related to neighbourhoods and neighbourhood-level socioeconomic factors. The study obtained georeferenced data from death registry records in the vital registration system, which were aggregated at the neighbourhood level (i.e. census units consisting of about 5000 households). Socioeconomic data for census units were obtained from the 2010 census. Analyses were conducted for men and women. The study reported gaps in life expectancy between neighbourhoods in both sexes. For both men and women, differences in life expectancy were reported between the areas with the highest and lowest socioeconomic status *(7)*.

Assessments of the possibility for data linking can be conducted as an extension of the data source mapping exercise described earlier in this chapter. Drawing on the tables created in the first four steps of data source mapping, a fifth table can be created, listing all relevant common identifiers, as well as the unique data source number (imported from Step 2) of sources that contain information about each corresponding identifier. (See Box 15.1 for information about worksheet templates and Annex 7 for an example of data source mapping, including data source linking, in Indonesia.)

After exploring whether data linking is possible, there are a few additional considerations. If proceeding with data linking, experienced data managers or analysts may be consulted to assist with merging data sources using statistical software. It is important to adhere to data protection protocols to ensure confidentiality is maintained, especially if working with individual-level data.

Modelled estimates

Modelling exercises help to fill in data gaps in time or place using existing data sources. Modelling is particularly useful when the availability of reliable empirical measures is restricted, or when relevant information is dispersed across multiple data sources. For example, modelling may be a useful way to generate estimates for health outcomes associated with stigma or for outcomes that are illegal or have a fluctuating legal status, such as HIV status, abortion, use of drugs or alcohol consumption. When modelling yields estimates for population subgroups, the data may be useful for inequality monitoring. Modelled estimates are derived using statistical methods, drawing from available data sources and expert opinions and accounting for known or suspected biases. Estimates should be documented following the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) (see Chapter 23) *(8)*.

Global monitoring that relies on modelled estimates can provide a useful general assessment of global and regional inequalities and trends. For example, the WHO *State of inequality: HIV, tuberculosis and malaria* report included modelled annual estimates of HIV and tuberculosis incidence and mortality and certain HIV testing and treatment indicators to explore sex-related inequality *(9)*. The generation of estimates, however, is subject to several limitations and assumptions *(10)*. Therefore, modelled estimates are less ideal to inform country programme planning and implementation, which ideally should be guided by high-quality empirical data.

Advocating for expanded and improved data collection

Existing sources that contain data of poor quality require strengthening. For example, groups that experience discrimination or exclusion are sometimes not captured adequately in data collection efforts. Depending on the setting, data sources may exclude people living in remote or conflict-affected areas, people engaged in sex work, people who use drugs, people in prisons and other closed settings, migrants and refugees living outside camps, and people for whom aspects of their lives are criminalized, undocumented or hidden.

To explore and expose gaps in the data, reports may choose to publish incomplete data, with sufficient caveats, highlighting the need for improvements. If reporting poor-quality or insufficient data, quantifying the level of uncertainty in the results can help to ensure transparency around the limitations in the data. Overall, efforts to advocate for expanded and improved data collection can drive changes that open new possibilities for inequality monitoring. This is an opportunity for engagement with stakeholders to ensure data collection practices are inclusive, culturally appropriate and respectful (see Chapter 4).

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16

Emerging and novel data sources

Overview

Over the past decades, there has been an emergence of novel data sources and technological advancements of existing sources that have potential application to health inequality monitoring. The data sources discussed in this chapter – including geospatial data, mobile and web-based surveys, health tracking applications and digital public health surveillance (DPHS) – can enable data collection in near real time and at fast speeds. These sources can collect data at granular levels, at large volumes, and pertaining to a large number of people, often with low resource inputs. Data collection through these sources may be done for the purposes of monitoring health or inequality dimensions, or for other purposes. These data sources have existed for some time but are rapidly developing and gaining more recognition in the field of population health monitoring.

Rapid advancements in technology have enabled the collection of an increasingly higher volume of data at increased quality. There is ever-growing analytical and computational power and the ability to link information across data sources. Artificial intelligence has a rapidly developing role in streamlining and accelerating how data are collected, processed and analysed *(1)*. The resulting "big data" – datasets characterized by huge volumes of frequently updated data that may be collected through means such as the internet, mobile phones and satellite imagery *(2)* – offer new opportunities to better understand how health varies across different population groups. The relevance of digital health – the development and use of digital technologies to enhance the efficiency, accessibility and quality of health systems *(3)* – has been recognized widely in accelerating achievement of universal health coverage and advancing global development goals *(4, 5)*.

The objectives of this chapter are to introduce the key characteristics of a selection of emerging data sources (although these are not exhaustive) and to discuss their strengths and limitations for health inequality monitoring. These sources may provide data inputs for the preparation and analysis of disaggregated data and summary measures of health inequality (see Chapters 17–22), but they are also particularly relevant to the further inequality analysis techniques discussed in Chapter 25.

Ethical considerations for data use and access

As the application of technology for the collection and use of data grows, increased consideration of ethical issues is warranted, including those pertaining to ensuring inclusivity and equity, protecting privacy and confidentiality, and fostering transparency and trust, such as establishing fair data ownership and accessibility protocols. Inequalities in access to and use of digital technologies, including mobile devices and internet connectivity – the "digital divide" – create population bias in data collection using digital tools. Knowledge and technical skills differ greatly across population groups (e.g. social and age groups) and ownership and use of digital technology *(6, 7)*. Differences in terms of network connectivity, access to electricity, usability of devices, and integration with existing information technology systems are other contributing factors *(8)*. Individuals may be hesitant to share sensitive health information on digital platforms, fearing potential misuse or breaches of confidentiality – especially people from communities experiencing historical or contemporary marginalization and people at risk of discrimination. Making data available that pinpoint populations that experience disadvantage may put those populations at risk of being further marginalized. There is an ethical responsibility to protect information through privacy and confidentiality standards. Transparency in how data are used can help build trust between the public and public health systems. Users need to be aware of and provide consent for the collection and use of their data.

Equitable access to digital resources and long-term investment in the underlying infrastructure, data standards, governance and analytical capacity are vital prerequisites for inequality monitoring data sources. The WHO *Classification of digital interventions, services and applications in health* supports the process of planning and implementing digital health components to address health system challenges and advance health goals *(9)*. For digital health safety, transparent and reliable regulatory frameworks are needed to ensure the use of data is transparent and privacy rights are protected, including personal identifiable information and protected health information *(10)*. For more information about data governance and data security considerations, see Chapter 4.

Geospatial data and technologies

Geospatial data are data about objects, events or other features that have a location on the surface of the earth *(11)*. Geospatial data typically combine location information (usually coordinates on the earth), attribute information (the characteristics of the object, event or phenomena concerned), and often temporal information (the time or lifespan at which the location and attributes exist). The data may include objects represented through a single fixed location point (e.g. a health facility), objects with an aerial extent such as polygons and lines represented through a collection of location points (e.g. administrative regions or roads), and continuous features represented through a gridded mesh of values each representing a quantity for a defined spatial unit, such as a 1 × 1 km square area (e.g. terrain, land surface attributes or population distribution).

Geospatial technologies are the tools that allow the creation, management, editing, analysis, modelling, visualization and sharing of geospatial data and their attributes. The three main geospatial technologies are satellite imagery, used mostly to create spatial datasets through observation (widely used by road vehicle drivers around the globe); Global Positioning System (GPS) software, used mostly to create spatial datasets through pinpointing the location of objects; and geographic information system (GIS) software, used to manage, analyse and visualize data in many fields and sectors, including health.

Geospatial data are collected in a number of ways. They can be collected via satellite imagery, which has the advantage of providing relatively frequent global coverage of many types of information. Mobile GPS receivers can collect spatial data containing location and boundaries and the association of attribute data to specific locations (referred to as geographic data or geographic information). For example, mobile GPS can record the location of a specific household and information about the vaccination status of the children in that household, or whether that household received an insecticide-treated bednet. Geospatial data may be collected through environmental sensors (which provide information about air quality, water quality, noise, temperature and weather) or as part of traditional data collection activities. Geospatial data may also be collected via mobile applications and location information enabled on, for example, social media posts.

Working with geospatial data requires the application of geospatial software and the use of dedicated geospatial databases. Although the task of collecting, managing and analysing spatial data has traditionally required specialized knowledge, the increasing availability of geospatially enabled services on mobile devices and the production of custom geospatial dashboards have made these technologies more accessible to a wide range of users, especially at the stages of data collection and visualization.

Geospatial data have many applications in health (Box 16.1). A key feature of geospatial analytics is that it enables the understanding of complex spatial patterns and trends, which may otherwise be hidden (see Chapter 25). It also allows aggregation of all types of information to different geographical units, such as districts, local government areas, health facility catchment areas and other units of programmatic significance, which can aid targeted decision- and policy-making.

The Demographic and Health Survey (DHS) Program Spatial Data Repository has published datasets that contain spatially modelled estimates of a number of DHS indicators relevant to health inequality monitoring, including health outcomes (e.g. anaemia, stunting), health access indicators (e.g. vaccination status, delivery at health facilities) and other socioeconomic factors (e.g. tobacco consumption, population using an improved water source) *(12)*. It also contains geospatial datasets of population, climate and environmental indicators used as covariates (Box 16.2). Other geospatial data sources that are freely accessible

BOX 16.1. Applications of geospatial data in health

- Surveillance, monitoring and response: mapping demographic and health data is part of monitoring disease outbreaks or other public health concerns such as natural disasters, environmental health risks or the effects of climate change. It helps to quantify effects on health, analyse spatial distributions, identify hotspots, provide early warning systems, and track changes over time and space. This information can help public health officials respond quickly and appropriately.

- Optimizing health-care delivery: using maps supports health-care planning and delivery, such as analysing the distribution of health facilities in relation to the prioritized population, mapping physical accessibility to health facilities, estimating distances and travel times between health facilities and communities to identify populations with limited access to care, planning mobile and community health delivery, testing resource allocation scenarios, and optimizing the routing of emergency services.

BOX 16.1. *continued*

- Epidemiological studies: investigating the spatial relationship between environmental factors (e.g. air pollution, water quality and climate change) and disease burden or disease vectors can serve to strengthen understanding and prediction of disease risk factors, transmission patterns and epidemiological spatiotemporal dynamics, helping to inform prevention and control measures.
- Filling data gaps: geospatial models can be used to extrapolate information measured at specific locations such as survey points to obtain estimates at unsampled locations. They can enhance availability of data on demographic characteristics (e.g. population density), socioeconomic factors (e.g. income or poverty levels) and health indicators for areas in which empirical data might not be available. For example, spatially modelled population estimates using micro-census data and geospatial covariates are used extensively to support the optimization of health service planning and resource allocation, and to provide denominators for monitoring coverage in the absence of recent census data.
- Organizational coordination: geospatial data are used to map and share data across organizations to plan and deliver humanitarian assistance and emergency responses, and to coordinate efforts between the health sector and other sectors more effectively.
- Health information system interoperability: the use of common and agreed geographic references in a country (e.g. authoritative information about administrative boundaries) serves as a powerful interoperability standard to enable the triangulation of data sources within and beyond the health sector.

BOX 16.2. The DHS Program geospatial covariates

DHS geospatial covariate datasets contain population, climate and environmental data at a 5 × 5 km spatial resolution collated from several publicly available sources *(13)*. The original sources collected geospatial data via remote sensing and modelling. The datasets are referred to as covariates because they contain data that can potentially influence outcomes of interest collected in surveys, such as health status. Geospatial covariate datasets include the population of children aged under five years, population density, travel time to a high-density urban centre, nightlight (nighttime light emissions), rainfall, temperature, elevation and aridity.

include WorldPop for global- and country-level data on population demographics and other developmental indicators *(14)*; LandScan for high-resolution global population data *(15)*; the United Nations Environment Programme Global Resource Information Database (GRID-Geneva) *(16)* and UN-SPIDER *(17)* for environmental data; NASA Earth Observation Data for data based on satellite imagery *(18)*; GRID3 data on human settlements, population and health infrastructure *(19)*; and geodata in the Humanitarian Data Exchange platform *(20)*.

Strengths and limitations of geospatial data

Geospatial data open new possibilities concerning the data that can be used for within-country inequality monitoring. This may provide more intuitive understanding of health inequalities, and support programme planning at local administrative levels *(21)*. Visualizing data on maps or overlaying different sources and types of geospatial data can help identify patterns of inequality that are not immediately apparent when assessing disaggregated data alone. This can help pinpoint areas being left behind, concentrations of populations experiencing historical or contemporary disadvantage, or concentrations of diseases or conditions that require further public health programming. Mapping summary measures of inequality can also help to identify regions or areas with higher inequalities for a health indicator. Mapping data at smaller geographical levels can support local-level service delivery planning and decision-making, referred to as microplanning *(22)*.

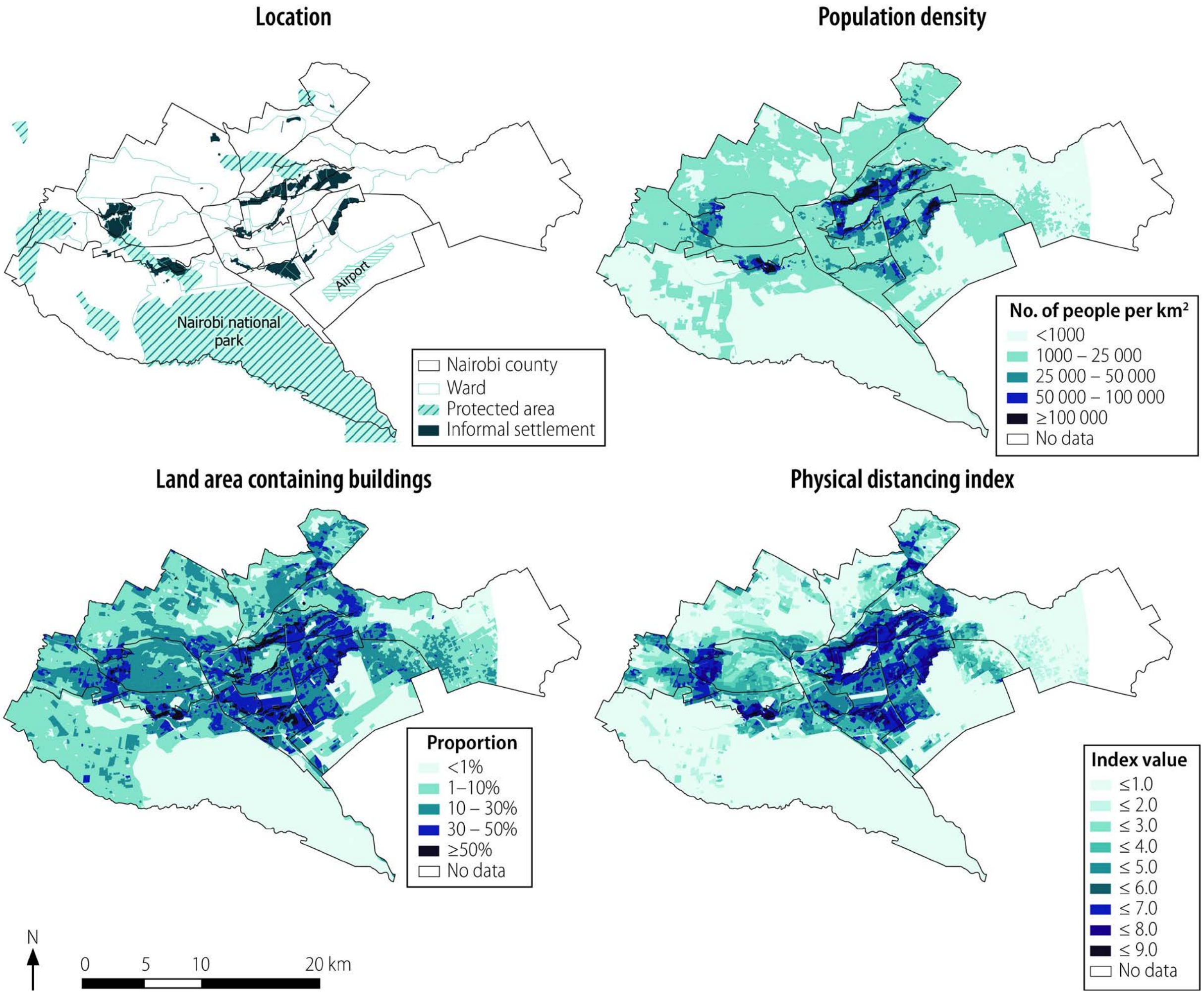
Geospatial data that incorporate individual-level information such as location of residence, treatment outcomes and mortality can enhance understanding of health inequalities and enhances the precision of health interventions. Maps can be used to track population risk factors at granular levels, such as the spatial distribution of the *Plasmodium falciparum* parasite that causes malaria *(23)*; to inform public health measures, such as using population and building density to calculate an index of physical distancing during the COVID-19 pandemic (Figure 16.1); and to identify concentrations of populations experiencing vulnerability to support the planning of health interventions such as routine immunization among, for example, nomadic groups (Figure 16.2).

Many household surveys have started routinely collecting the geographical location of surveyed clusters or households, including DHS, Multiple Indicator Cluster Study (MICS; for surveys in the MICS 7 round and later) and Living Standard Measurement Study (LSMS). This practice enables types of analysis that are not possible with traditional data sources, such as model-based geostatistics, ecological correlation, distance, proximity and cluster analysis, which can bring new insights to inequalities (see Chapter 25).

In addition, by overlaying or comparing health data with demographic, socioeconomic and environmental information at subnational levels, geospatial analysis can reveal patterns related to dimensions of inequality that may be unavailable in other data sources. For example, linking geospatial data used to model poverty rates at small subnational levels with health data can identify how health differs across populations with different rates of poverty. In the absence of income data, nightlight satellite imagery has been used as a proxy for measuring economic status because it captures wealth, consumption, and spending on investment and infrastructure *(26)*. At the same time, nightlight can also reflect areas of higher light, noise pollution and social vulnerability *(27)* (see Box 16.3). Geospatial data collected using cameras, however, are limited to the field of view of the camera and may not capture hidden characteristics of groups that are not visible, such as migrant status or health status. Geospatial data on other environmental factors such as air quality, elevation and aridity can be used to understand inequalities related to the type of environments in which people live.

Although much progress has been made to increase the availability and accessibility of geospatial data, particularly through open data policies and regulations, remaining challenges to geospatial data openness include intellectual property restrictions, privacy and security concerns when highly granular geospatial information is collected and shared, confidentiality, standardization and interoperability

FIGURE 16.1. **Using maps to inform COVID-19 control measures in Nairobi, Kenya**



These maps were not produced by WHO. The designations employed and the representation of countries and areas in these maps may be at variance with those used by WHO and do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

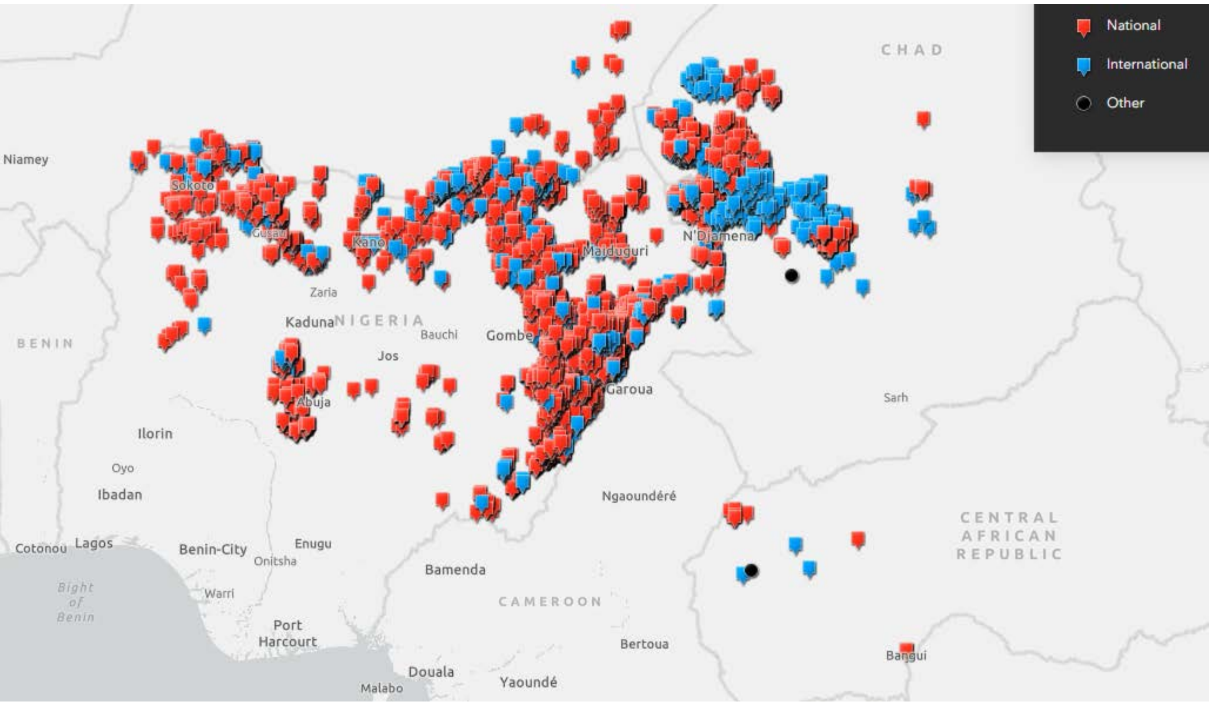
Source: Chamberlain, Macharia and Tatem *(24)*, with data from May 2022.

(29). Sustainable and cost-effective use of geospatial data for inequality monitoring and decision-making requires investment in strengthening geospatial data management technical capacity human resources *(22)*. A framework of policies, strategies and national commitment is required to incorporate geospatial data and technologies into the health information system.

Geospatial data quality relies on guidelines, standards and protocols for the management and recording of data. Data collected with insufficient accuracy and adherence to agreed standards can lead to errors, with an impact on decision-making. For example, if geospatial data about the transportation network are not up to date, then distance analysis will be inaccurate. To manage this, national spatial data infrastructures that aim to facilitate the production, standardization and sharing of geospatial data, including the development of open data geospatial catalogues, are becoming increasingly common in countries. These are backed by international standards for geographic information metadata *(30)*.

Geospatial data present concerns for confidentiality and geoprivacy (e.g. individual rights to prevent disclosure of the location of their home, workplace, daily activities or trips), necessitating measures to ensure privacy during the sharing, use and analysis of geospatial data. This is achieved, for example, through anonymization, data aggregation or introduction of randomized shift in geospatial coordinates (as practised in DHS clusters) *(31)*. Countries may exhibit differences in the availability and application of governance mechanisms. Potential or existing legal and policy considerations on sharing these data with law enforcement or other security bodies must also be taken into account.

FIGURE 16.2. Mapping locations of nomadic groups across Cameroon, Central African Republic, Chad, Niger and Nigeria



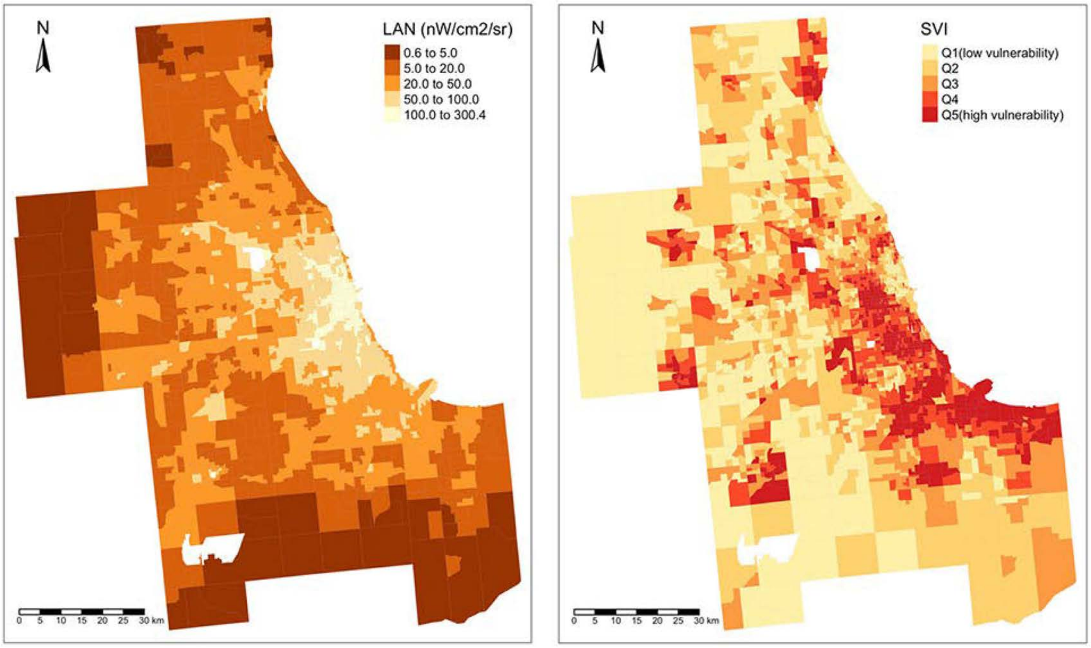
This map was not produced by WHO. The designations employed and the representation of countries and areas in this map may be at variance with those used by WHO and do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Source: Geospatial Research, Analysis and Services Program and WHO Regional Office for Africa GIS Centre *(25)*, with data from 2021.

BOX 16.3. Nightlight satellite imagery and social disadvantage in Chicago, United States of America

Figure 16.3 shows two maps of the city of Chicago. The left map depicts nightlight, with lighter colours indicating higher levels of light. The right map depicts levels of social disadvantage, with darker colours indicating higher levels of vulnerability. The images show a rough correlation between higher nightlight exposure and social disadvantage, revealing complex interactions between the environment and socioeconomic conditions *(28)*.

FIGURE 16.3. Using maps to show light exposure at night and level of social disadvantage, by census tract in the greater Chicago area, United States of America



LAN, light exposure at night levels; SVI, social vulnerability index.
LAN is measured in nanowatts per centimetre squared per steradian (nW/cm^2/sr).

These maps were not produced by WHO. The designations employed and the representation of countries and areas in these maps may be at variance with those used by WHO and do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Source: NASA Earthdata *(28)*, with data from 2020.

Mobile and web-based surveys

Mobile surveys gather responses from participants using mobile devices through mobile networks. Mobile surveys include Short Message Service surveys, in which text messages are used to collect data from participants; interactive voice response surveys that contact respondents through voice calls but rely on prerecorded questions instead of live interviewers; and computer-assisted telephone interviews, in which interviewers call respondents to collect data. Web-based surveys are completed over the internet, with participants providing responses via an online method, such as a link from an internet advertisement, a mass email or a special application preinstalled on a device. A special type of web-based surveys is the recruitment and administration of questionnaires to users of social media platforms, such as Facebook and X (formerly Twitter). Examples of mobile and web-based surveys are provided in Box 16.4.

BOX 16.4. Examples of mobile and web-based surveys

The following are examples of prominent multicountry mobile and web-based surveys, including those administered via social media platforms, across various topics and settings. This list is not exhaustive. More information about each survey is available online.

Mobile surveys:

- The World Health Survey Plus, which collects data to monitor progress towards population health targets and health-related Sustainable Development Goals, includes both web-based and mobile phone surveys *(32)*.
- The Partnership for Evidence-Based Response to COVID-19 survey collects economic, epidemiological, population movement and security data via phone surveys across 19 African countries *(33)*.
- COVID-19 mobile phone surveys conducted by the United States Centers for Disease Control and Prevention in Ecuador and Sri Lanka provides decision-makers with swift information about knowledge, practices, symptoms, conditions and testing availability *(34)*.
- The Rapid Mobile Phone Survey is a surveillance tool of the WHO Regional Office for the Americas to quickly assess noncommunicable disease policies and interventions *(35)*.
- The Rapid Mortality Mobile Phone Surveys project is a multicountry study that began in December 2020 with the aim to develop and validate methods for timely (excess) mortality estimation in low- and lower-middle-income countries *(36)*.
- LSMS high-frequency telephone surveys are carried out by the World Bank in Burkina Faso, Ethiopia, Malawi, Nigeria, Uganda and the United Republic of Tanzania *(37)*.

Web-based surveys:

- The International Sexual Health and Reproductive Health study provides data about sexual and reproductive health in selected countries during the COVID-19 pandemic with collection via an online survey link disseminated through local, regional and national networks *(38)*.

BOX 16.4. *continued*

- The Health Information National Trends Survey regularly collects nationally representative data in the United States of America about knowledge of, attitudes towards and use of cancer- and health-related information *(39)*.
- The University of Maryland COVID-19 Trends and Impact Survey, in partnership with Facebook, provides data related to COVID-19 symptoms, knowledge, behaviours and testing on a daily basis from Facebook users in 114 countries (with survey weights) between May 2020 and June 2022 *(40)*.
- The Climate Change Opinion Survey sampled more than 100 000 Facebook users from nearly 200 countries and territories, asking respondents about their knowledge of and attitudes and behaviour towards climate change issues *(41)*.
- The Survey on Gender Equality at Home is a research collaboration between Equal Measures 2030, Facebook, Ladysmith, UN Women and the World Bank. The survey was conducted in July 2020 to capture household gender dynamics during the COVID-19 pandemic *(42)*.

Like traditional surveys, probability-based sampling techniques may be used in collecting data from a sample of the prioritized population (see Chapter 12). Respondents can be selected at random via a digit dialling approach, from a list of valid mobile telephone numbers provided by a mobile network or telecom operator, or from a list of numbers obtained from a previous household survey or health programme. Many web-based surveys are non-probabilistic surveys, where the probability of a population member being included in the sample is unknown. In these cases, respondents may be recruited by following a link or banner to a survey placed on a webpage (referred to as river sampling or opt-in panels) or invited via a mailing list or social media advert. The sampling technique used has implications on data analysis methods and the validity of results. The composition of respondents in the sample is usually compared with sociodemographic information from other data sources (such as a census or representative baseline survey) to set or adjust the relative weights of respondents *(43)*.

Strengths and limitations of data from mobile and web-based surveys

Mobile and web-based surveys have several advantages for health inequality monitoring compared with traditional household surveys. They allow researchers to reach a large number of potential respondents from diverse populations, from specific prioritized demographic groups, from locations that are dangerous or remote, and from locations with very limited access to health services. Surveys administered via these channels can be cost-effective because they can be delivered rapidly and do not require travel or human resources for face-to-face interviews, and therefore they can provide timely and rapid data for inequality monitoring. Data quality can also be improved through the use of real-time data quality checks, prefilled answers based on respondent online profiles, and validation of respondents' locations.

Traditional household health surveys typically are only representative at national or first administrative levels, and therefore disaggregated estimates at subnational levels are often less reliable. In contrast, the increase in mobile telephone ownership and internet connectivity has enabled collection of data from larger sample sizes, which can increase the precision of disaggregated indicator estimates. Moreover, repeated mobile and web-based surveys can deliver trend data over time, enabling more nuanced analyses than cross-sectional analyses and the evaluation of public health interventions in a timely manner. For example, the COVID-19 Trends and Impact Survey collected data in 114 countries on a daily basis, supporting real-time understanding of how COVID-19-related symptoms, behaviours and testing varied across population groups and settings, informing relevant decision-making *(40, 44)*.

These survey modes can be used to collect inequality data in situations where face-to-face interviews are challenging or impossible. They are particularly suitable during health emergencies, where there is a great need for health data for decision-making but personnel movement is restricted or there are safety concerns for personnel. For example, the use of mobile and web-based surveys was demonstrated in the 2014 Ebola outbreak in western Africa; in the 2017 drought- and conflict-related food insecurity crisis in Nigeria, Somalia, South Sudan and Yemen; and during the 2020–2022 COVID-19 pandemic *(45–47)*. High-frequency data collection allows the addition of new or updated questions in response to policy inquiries during an evolving crisis. Moreover, for populations such as refugees and migrants, mobile and web-based surveys are increasingly common for collecting data, opening more opportunities for inequality monitoring *(48)*. For more on inequality monitoring in emergency contexts and among refugee and migrant populations, see Chapter 5.

Mobile and web-based surveys carry some limitations. Although mobile telephone and internet penetration continues to grow globally, its coverage remains low in certain areas and for some populations, causing sampling biases in mobile and web-based surveys. This is especially true in lower-income countries *(49)*. Variation in literacy, computer literacy, language and willingness to participate in surveys can also cause bias. This has implications for monitoring inequalities, because certain subgroups (such as those that are remote, older, or experiencing vulnerability or poverty) tend to have lower mobile telephone and internet access and use and thus are underrepresented; disaggregated estimates for these groups may not be reliable. Although mobile and web-based surveys commonly ask for demographic information from respondents, it may be difficult to link the survey sample to a national population and establish sampling weights that counteract this bias when the demographic distribution of the users of a telephone or internet service is not known *(43)*. Biases may also be caused by self-selection, which occurs when the respondents who decide to participate in a survey differ systematically from the people who do not participate. Biases may also be due to attrition, which occurs when respondents who drop out of the survey differ from respondents who complete the full survey. Such bias exists in all types of surveys, but it is less an issue for traditional household surveys where interviewers are present.

Caution must be exercised when using data from mobile and web-based surveys for inequality monitoring purposes, recognizing the potential gaps in representation and consequential biases. Integrating data from various sources is essential to mitigate these limitations and foster a more comprehensive understanding of health inequalities.

Health tracking applications

Health tracking applications use mobile devices such as smartphones, wearable devices, medical devices equipped with Wi-Fi (also referred to as the Internet of Medical Things) and other wireless devices to collect or generate health and health-related data. This data collection method has been supported by the rapid increase in smartphones and internet access globally. Health monitoring via mobile technologies is an element of mobile health (mHealth), defined as the use of mobile devices for medical and public health practice. (Note, however, that mHealth also expands to the use of mobile devices for communication between individuals and health services, consultation between health professionals, and access to health information *(50)*.) It is also linked to personal or personalized health (pHealth), where data are owned, managed and self-monitored by the individual and can provide a horizontal and holistic view of that person's health, including health behaviours, risk factors and lifestyle *(51)*.

Health tracking applications can be classified as passive or active. Passive applications generate or derive health data using sensors, whereas active applications rely on manual user input *(52)*. Wearable devices are passive data collection tools that can be used for continuous and real-time health monitoring, such as related to physical activity, sleep, and heart and respiration rates. Some devices are used in clinical settings to monitor people with chronic disease or health risks (e.g. pulse oximeters that detect oxygen levels, blood glucose monitors, and data gloves that monitor hand mobility in people with neurological conditions). Others are nonclinical, used by the general population to collect personalized data about their own life and well-being (e.g. smartwatches and smart rings that collect general data about activity, heart rate, stress levels and sleep). The data collected are usually made available via a software application for self-monitoring or for monitoring by a health professional. COVID-19 proximity tracking and contact tracing apps, which passively record proximity of the user to other app users within a prespecified radius for a certain amount of time, are another example of passive health tracking applications. Health apps that require the manual entry of information such as diet, weight, physical activity, medication and mental health are examples of active data collection tools.

Strengths and limitations of data collected via health tracking applications

When health data collected by tracking applications are linked to other personal data, such as age, location or sex, or linked to other datasets containing information related to the individual's place of residence, it opens possibilities for health inequality monitoring. Linking health data to a person's location can reveal insights about environmental and social influences on health. It facilitates analysis of how certain health behaviours, health risk factors or responses to public health interventions may differ across population groups *(53)*. Data linking requires common identifiers, such as personal identity numbers or postal codes (see Chapter 15).

An advantage for health inequality monitoring is that tracking applications offer real-time data collection, large samples and higher precision, allowing for continuous monitoring of health metrics and broad outreach across population groups. Health tracking applications can also support the monitoring of inequalities in health indicators that are difficult to monitor via other data collection methods. For example, data collected via applications for mood tracking and stress management can augment understandings of how mental health differs across population groups. Wearable devices can also be used by people in remote settings where access is difficult or when a person cannot travel to a clinic or hospital because of their illness or disability, therefore supporting inequality monitoring of certain groups experiencing disadvantaged or vulnerability.

Compared with household surveys that sometimes collect biodata samples (e.g. blood pressure, blood sugar, height, weight), wearable devices are a low-cost and efficient way of collecting large quantities of health data, which supports more reliable disaggregated estimates. They also remove recall bias and incorrect self-judgements about health levels that may be encountered with surveys. Moreover, they are more likely to provide an accurate and representative measure of an individual's physical status than a snapshot of data collected during a routine hospital appointment or household survey. Therefore, this has the potential to increase data quality for inequality monitoring.

The digital divide in access to and use of mobile technologies, discussed above in *Ethical considerations for data use and access*, can affect the completeness and representativeness of the health data collected via health tracking applications. Health literacy and health-consciousness are prerequisites to using and understanding health tracking devices, particularly those that are nonclinical, because this requires an understanding of the links between health behaviours and health outcomes, ability to obtain information over the internet, and interest in self-monitoring health. Access to and use of health tracking devices, including expensive medical devices, may be more common among more affluent people. Additionally, cultural and linguistic diversity can pose challenges in designing inclusive digital health tools that cater to diverse populations. This means that data for certain population groups of interest may be lacking or unreliable for inequality monitoring.

Privacy and data protection must be considered within the context of health tracking technology. The digital tracking of individuals' health status may be controversial in some circumstances, such as among migrants or other groups who lack legal status in particular settings. Data collected via wearable devices are often commercially owned – individuals need to provide informed consent for use of their data, and access to these data by organizations may require specific data-sharing agreements and processes before they can be used for inequality monitoring purposes. The quality of health applications is also a consideration – an app should be proven to be accurate, useful, usable and used in order to be assessed as a high-quality data source for inequality monitoring. Medical app accreditation programmes, in which apps are subject to formal assessment or peer review, are a recent development that aims to provide clinical assurances about quality and safety of applications.

Digital public health surveillance

Public health surveillance is the continuous collection, analysis and interpretation of health-related data, aimed at detecting disease and implementing control measures (see Chapter 14). DPHS uses information from social media, news media, discussion forums, internet search engines and other web-based sources to detect disease and facilitate public health responses *(54)*.

These digital sources can be used for infoveillance and infodemiology *(55)*. Infoveillance, a type of event-based surveillance, pulls data from various online sources to identify emerging health threats and at-risk populations, with the primary aim of surveillance. Infodemiology is the study of the determinants and distribution of health information and misinformation *(56)*, with the aim of informing public health policies and actions. These are both based on the idea that there is a relationship between population health on the one hand, and information and communication patterns in electronic media on the other hand. Changes in information and communication patterns on the internet can be an early sign of changes in population health. Conversely, changes in information and communication patterns – such as misinformation or a public health campaign – could also have a negative or positive impact on population health.

There are various methods of extracting public health information from online sources. Keyword searches or natural language processing (computer programs that process text or speech) can be used to identify content on specific health topics. Data from search engines can provide information about the number of searches pertaining to a specific topic from a specific region. Social media posts can also be used to track evolving situations during outbreaks. Crowdsourced data over the internet represent an example of participatory surveillance, whereby information or opinions are gathered from people in real time. Owing to the volume and types of data in digital sources, DPHS often uses machine learning algorithms (mathematical models used to learn or uncover underlying patterns embedded in data). Some examples of DPHS are provided in Box 16.5.

Strengths and limitations of digital public health surveillance

Although standard surveillance systems can provide data for certain health indicators, corresponding information on dimensions of inequality may be more limited (see Chapter 14). DPHS can provide increased opportunities for inequality monitoring due to the flexibility of real-time and rapid data collection across large groups of the population and even globally. Trends in specific population groups and dimensions of inequality can be monitored, because DPHS can capture information related to groups experiencing disadvantage who do not come into contact with more traditional medical-based surveillance systems. It also offers possibilities for surveillance in low-resource settings, when infrastructure, capacity and resources for traditional surveillance systems are limited. DPHS also has applications in crisis settings, when rapid and real-time information is important. Moreover, it opens the possibility of monitoring inequality in topics such as misinformation.

Given that complicated biases exist in internet and social media data, digital data are often best used to supplement rather than replace traditional public health surveillance data sources for health inequality monitoring. DPHS can suffer from problems of accuracy due to sample bias and overinterpretation of findings (i.e. seeing differences or trends where none exist).

The digital divide affects the representativeness of DPHS data, creating sample bias. This may be addressed to some extent through weighting to adjust samples to be representative of populations,

BOX 16.5. Examples of digital public health surveillance

The following examples of DPHS span different topics and settings. This list is not exhaustive. More information about each data collection is available online.

- SENTINEL processes data from X (formerly Twitter) to identify self-reports of illness and predict disease occurrence and potential outbreaks *(57)*.
- InfluenzaNet (in Europe) and Outbreaks Near Me (in Canada, Mexico and the United States) are online participatory surveillance systems for influenza based on self-reported symptoms volunteered by participants *(58, 59)*.
- HealthMap brings together different online data sources, including online news, eyewitness reports, expert-curated discussions and official reports through an automated process to achieve a comprehensive view of the current global state of infectious diseases *(60)*.
- Google Trends is a free open-source tool used to track and observe internet search activity. It has been used, for example, for surveillance of COVID-19 and influenza, and for plague outbreaks in Madagascar *(61)*.

but ascertaining demographics can be challenging. Interpreting data from DPHS to make assessments about inequalities is often a difficult task, and there is a risk of poor or incomplete data, leading to weak or misleading conclusions. The data collected via DPHS efforts often capture public awareness or indirect measures of disease *(62)*. Trending topics in social media can be self-perpetuating due to social media algorithms and can be influenced by media attention or confounded due to other events happening at the same time. Moreover, when online content changes frequently, the assumptions made when algorithms were developed may no longer hold true. This can lead to the diminished accuracy of conclusions drawn from DPHS over time if algorithms are not updated. For example, Google Flu Trends, a program built to predict influenza based on people's web searches, was discontinued after it failed to accurately predict prevalence. This yielded important lessons for DPHS regarding the need for accurate and continually updated algorithms *(63)*.

DPHS requires specialized technological capacity and skills, which may limit its use for inequality monitoring in certain contexts. For DPHS systems to be cost-efficient, they require automated programs to manage and analyse the data, potentially large start-up costs, and regular upkeep to maintain the accuracy of algorithms. Moreover, digital data are not owned by the public – the data are collected by private companies, and therefore continued access is a requirement for conducting DPHS.

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PART

4

Analysis and reporting

17

Preparing disaggregated health data

Overview

Disaggregation is the process of breaking down data into smaller units or sets of observations. For health inequality monitoring, disaggregated health data present information by population subgroups, defined by one or more dimensions of inequality. Disaggregated health data are a requirement for monitoring health inequalities within populations because they allow for comparisons between the health of population subgroups that are not evident from overall averages across a whole population. For example, they facilitate health comparisons between rich and poor populations, across districts within a country, and among groups with distinct levels of education.

The analysis of disaggregated health data provides initial insight into inequalities within a defined population. Disaggregated data are key inputs to calculating summary measures of health inequality. Their characteristics guide the selection of summary measures that are appropriate to describe inequality (see Chapter 19). Careful consideration is warranted, therefore, when defining and calculating health indicators and inequality dimensions and subsequently deriving disaggregated data.

This chapter presents technical considerations related to the preparation of disaggregated health data for analysis, with a focus on health indicator data and dimension of inequality data. The chapter addresses multiple disaggregation and analysis of disaggregated data pertaining to distinct measurement levels (individual, household and small area). This chapter complements Chapter 3, which discusses general considerations and resources to guide the selection of health indicators and inequality dimensions. It is a continuation of the inequality monitoring process that follows the selection of data sources discussed in Chapter 15.

General considerations for preparing data

Preparing disaggregated data for analysis requires a thorough understanding of the dataset. This is derived from reviewing metadata. Metadata – data that define and describe other data – give specific information about data collection and variables. Several types of metadata are important to review. Data sources and processing documentation include information about data entry, data cleaning, data tabulation and recoding of datasets. Information about missing data or imputations in the dataset is particularly important because it helps with understanding potential limitations of, and interpreting, the dataset. Indicator calculation methodology includes the sources for numerators and denominators and details about how to define and construct indicators of interest. Documentation about inequality dimensions details how dimensions are defined and constructed.

Relevant documentation should be collated and updated as the data are further processed and analysed. For instance, data codebooks or dictionaries are documents that detail the variables, structure, content, and layout of datasets. Publishing (or otherwise making available) metadata alongside the reporting outputs of health inequality monitoring enables rigorous inspection of the protocols and decisions used to derive the analysis results, making the analysis more transparent and trustworthy. Detailed metadata can enable replication and assessment of the analysis. Notably, metadata should detail the construction of all variables, including health indicators and dimensions of inequality. For more information about reporting methods and metadata, see Chapter 23.

Part of preparing data may include data cleaning and de-identification. Data cleaning is the process of editing, correcting and structuring data within a dataset so the data are correct, consistent and usable for analysis. Data cleaning may also entail identifying, handling and interpreting missing data. Data cleaning will be more extensive if starting with raw data that have not been previously processed, coded or formatted, than if starting with data that have already been partly or fully processed. Inequality analysis often involves analysing individual-level data from surveys or administrative sources, and therefore it is important that data are de-identified (i.e. personal information is removed). This serves to protect the privacy of individuals if the data or the results of monitoring are shared. See Chapter 4 for more on data security considerations.

When sourcing data from household surveys that rely on complex survey sampling designs, the design of the survey should be taken into consideration and included in the metadata. Complex sampling designs involve the selection of sampling units through multiple stages or phases. Designs include stratification, clustering, multistage sampling and weighting (see Annex 8). Survey datasets do not always include variables for all of these elements – but if they are included, they must be taken into consideration to produce point estimates and standard errors that are accurate and representative of the population. If the characteristics of the sampling design are ignored, disaggregated estimates and confidence intervals might be inaccurate. For example, ignoring clustering will tend to yield standard errors that are too small, while ignoring stratification will tend to yield standard errors that are too large.

Oversampling of minority groups in surveys allows for sufficient sample sizes across population subgroups and helps to ensure disaggregated data can be used for health inequality monitoring.

A variety of analysis software applications may be used for processing and preparing data for analysis. As the functionality of software applications advances, they are increasingly user-friendly and adept with a range of statistical methods and the production of data visuals. WHO has developed statistical codes and eLearning courses to support the use of several software applications, including Excel, R and Stata, for the preparation of disaggregated datasets *(1, 2)*.

Defining and constructing health indicators

For a given health inequality monitoring exercise, one or more health indicators are selected to represent a topic or area of focus. The selection of relevant health indicators requires consideration of the scope of monitoring, policy and planning needs, and contextual and cultural factors (see Chapter 3). Data availability is another consideration. Modelled estimates, which may be used when reliable empirical data are not available, entail certain limitations and assumptions that should be acknowledged and taken into consideration (i.e. that the information on which estimates are based may be outdated, incomplete or derived from a different context) *(3)*. Once health indicators are selected and source data identified, the statistical criteria for indicator definitions must be defined, along with methods for their computation. These specifications should be recorded as part of the accompanying metadata.

Universal and context-specific indicator definitions

There are different approaches to defining health indicators. Universal (or standardized) indicator definitions may be adopted, aligning with criteria published by a group or organization. Where applicable, they specify standard criteria for both numerators and denominators. For example, the *Global indicator framework for the Sustainable Development Goals* promotes the use of standardized methods for measuring and defining over 230 unique indicators *(4)*. (The Framework also specifies that indicators should be disaggregated, where relevant, by various inequality dimensions.) As another example, the second edition of the WHO *Global reference list of 100 core health indicators (plus health-related SDGs)* contains universal indicators and corresponding definitions for use in monitoring global health priorities related to health status, risk factors, service coverage and health systems *(5)*. In both examples, the promotion of universal indicator definitions facilitates the comparison of data across settings and over time. For more examples of global health indicator lists, see Chapter 3.

In some cases, it may be preferable to adopt a context-specific (or non-standardized) indicator definition that aligns with a specific priority or accounts for a circumstance particular to the monitoring context. For example, although there are universal indicator definitions for the coverage of modern contraception use, they may need to be adapted in different contexts: the numerator may need to account for the types of contraception methods available within a country, and the denominator may be limited to certain age ranges or to married women due to norms or sensitivity around collecting such information from younger or unmarried women. Similarly, for the indicator of coverage of births attended by a skilled birth attendant, the question of which types of health professional are considered to be skilled attendants may be answered differently across countries, depending on local education and training requirements. In other cases, context-specific indicator definitions may reflect constraints related to data collection or availability.

Composite health indicators

A composite health indicator is an index composed of several individual indicators within a health topic. The main benefits of using composite health indicators lie in their potential to summarize information across multiple indicators, providing a concise metric that can be compared over time or between populations. The use of data across multiple individual indicators provides a larger number of underlying observations, which may enhance the statistical reliability of the indicator.

There are certain limitations to the use of composite health indicators *(6)*. There may be a lack of transparency about the components of composite indicators, and the underlying data, measures and statistical methods. Compared with simple indicators, composite indicators are more disconnected from the underlying health phenomenon being measured and may mask the differences and relationships between component indicators. Composite indicators can be flawed by virtue of any of their components being biased.

The development of high-quality composite indicators is a technically rigorous process. It entails development of a theoretical framework, selection of indicators, multivariable assessment of indicators, weighting and aggregation of indicators, and validation of the composite indicator *(7)*. Several examples of universal composite health indicators have been developed for global monitoring across different topics, including universal health coverage, using the service coverage index *(8)*; reproductive, maternal, newborn and child health, using the composite coverage index *(9)*; and women's social independence, using the survey-based women's empowerment index *(10)*.

Absolute and relative scales

Health indicators are generally measured as absolute counts or in relative terms such as proportions or rates. Health indicators that reflect absolute counts measure the number of occurrences or events in a defined time and place. For example, the number of maternal deaths and the amount of government health expenditure are absolute counts. A limitation of absolute counts is that it is difficult to make comparisons between populations with different sizes or age structures. Absolute counts can, however, be useful to understand the overall situation in a given context. They can provide numerator values for relative measures.

Indicators measured in relative terms are constructed as ratios by dividing one quantity (the numerator) by another (the denominator). A proportion is a type of ratio where the numerator is a subset of the denominator. For example, the percentage of births attended by skilled health personnel is the number of births attended by skilled health personnel (numerator), divided by the total number of live births (denominator). HIV-related mortality has been defined as the total number of people who have died from HIV-related causes per 1000 population. A rate is a type of ratio measuring the frequency of occurrence in a population over a specified period. For example, the adult mortality rate may be defined as the probability of dying between the ages of 15 and 60 years per 1000 population per year. The adolescent fertility rate has been defined as the number of births to women aged 15–19 years per 1000 women in that age group per year. For inequality analyses, there are advantages to using health indicators expressed in relative terms because they permit more salient comparisons between population subgroups, between settings and over time.

Crude and standardized indicators

In some cases, indicators may be specified as crude or standardized. Crude estimates express the numerator as a proportion of the current affected population (the denominator). Standardized estimates, sometimes termed adjusted estimates, account for variables that would be expected to hinder comparisons between two populations or two points in time, such as age or sex distribution. For instance, age-standardized estimates of hypertension may be preferable to crude estimates if comparing the prevalence of hypertension (which is known to increase with age) between populations with different age structures, or within the same population over time.

Linking data sources to calculate indicators

The calculation of health indicators, typically performed using statistical software, may involve linking between sources that contain data about either the numerator or the denominator of a health indicator. This process is the same as the data source linking protocol described in Chapter 15, relying on the presence of a common identifier in both sources. Data source linking is subject to certain limitations that arise if data are collected at different points in time, if different data collection methods are used, or if the population represented in the numerator is not the same as the population represented in the denominator (applicable if data are linked at a small-area level). Linking between data sources, however, is a common practice in health monitoring. For examples of linking between sources to construct health indicators, see Box 17.1.

Another possibility exists in linking individual-level data to create longitudinal indicators, which could be used to highlight inequalities over time and along a continuum of care. In well-developed health systems, for example, individuals with cancer may be tracked from first presentation, to diagnosis, treatment and outcomes. These linked data could enable an understanding of inequalities along the pathway if combined with other sources of data about the individual, such as economic status, ethnicity, place of residence and sex.

Measuring and categorizing dimensions of inequality

Alongside health indicators, dimensions of inequality – the criteria upon which population subgroups are categorized for inequality monitoring – represent the other stream of information contained in disaggregated

BOX 17.1. Examples of linking between sources to construct health indicators

The following examples showcase the use of numerator and denominator data from distinct sources, linked through a common identifier, to calculate health indicators:

- WHO Global Health Estimates, including indicators related to death and disability, are produced using data from multiple consolidated sources, including national vital registration data, estimates from WHO technical programmes, United Nations partners and interagency groups, and the Global Burden of Disease and other scientific studies *(11)*.
- COVID-19 mortality in Canada was assessed using information from vital statistics systems about the number of deaths, combined with population denominator information from the census *(12)*. In one case, the source was an integration of data from the 2016 short-form Canadian census and provisional COVID-19 mortality data from the Canadian Vital Statistics – Deaths database *(13)*. This data linkage allowed an identification of COVID-19 mortality rates between 1 January 2020 and 31 March 2021 across the social and demographic characteristics of individuals living in private dwellings. In another case, the source was an integration of the 2016 census area profile data with preliminary COVID-19 mortality data from the Canadian Vital Statistics – Deaths database *(13)*. This second data linkage allowed an identification of COVID-19 mortality rates between 1 January and 31 December 2020 across neighbourhood-level social and economic characteristics.
- An analysis of COVID-19 vaccination inequality in California in the United States of America used data about the cumulative count of residents vaccinated in each county (numerator, collected from the California Health and Human Services Agency), linked to data about the total population of each county (denominator, collected from the 2019 census), to produce estimates of the daily proportion of residents vaccinated in each county *(14)*. These data were then linked to county-level sociodemographic vulnerability index scores to explore trends in sociodemographic-related inequalities in vaccine coverage.

health data. Some of the dimensions of inequality commonly used in health inequality monitoring include age, economic status, education level, place of residence, sex and subnational region, although there are many others with global and local applicability. Similar to the process of selecting health indicators, the dimensions of inequality selected for inequality monitoring should align with the scope, purpose, context and data availability of the monitoring exercise. See Chapter 3 for more on inequality dimensions.

Dimensions of inequality may be defined, measured and categorized into subgroups in different ways, which should be noted in metadata. Increasingly, standardized approaches are being developed to promote consistency and comparability in how dimensions of inequality are measured and categorized into subgroups. There are, however, context-specific reasons why alternative approaches may be adopted. Examples of various measurement criteria for common dimensions of inequality are provided below, with discussions of considerations for their categorization (i.e. how they are broken into subgroups) and the process of multiple disaggregation in the following subsections.

Measurement criteria for common dimensions of inequality

Dimensions of inequality can be measured using different criteria or classifications, which may be applied at individual, household or small-area levels. Decisions about how to measure dimensions of inequality should consider what is appropriate for the monitoring context, the intended purpose of monitoring, and what is nondiscriminatory and acceptable within the affected population. On a practical note, data availability and the specifications of data collection can be important factors when making decisions about the measurement of dimensions of inequality (considering the available data sources, and how information about dimensions of inequality were collected and recorded).

Demographic characteristics

Age may be measured as an absolute number in years or as a range of years. In the case of infants, age may be measured as days, weeks or months, as relevant. For preterm infants, gestational age (weeks of pregnancy completed) may be a relevant measure. For upper age bands, consideration is warranted regarding whether to use an open-ended top age group (e.g. adults aged 85 years or older). This may introduce bias in age standardization when comparing populations with different distributions of adults who are very old. Data sources that record date of birth present multiple options for how age is subsequently measured and categorized *(15)*.

Recommendations for universal age groupings for reporting on health data have been suggested. Age groupings of five years for all health data are endorsed, except for children younger than five years, for whom finer disaggregation is recommended. Deviations may be warranted in certain circumstances, such as to account for statistical and methodological limitations. The widespread adoption of these recommendations would harmonize age-disaggregated data and enhance their usability and comparability across settings *(15)*.

Sex refers to the “different biological and physiological characteristics of females, males and intersex persons, such as chromosomes, hormones and reproductive organs” *(16)*. Sex is usually recorded at birth as female or male and is subsequently categorized as girl or boy, or woman or man. Data sources rarely distinguish between sex recorded at birth (as recorded on official documentation such as birth certificates) and self-reported sex. Increasingly, however, a distinction is drawn between sex assigned at birth and gender identity (referring to a deeply felt, internal and individual sense of one’s own identity with respect to gender).

Gender, which is a separate but related concept, refers to the socially constructed norms, stereotypes, roles, expressions and identities of boys, girls, men, women and gender-diverse people. As a social construct, the notion of gender varies between societies and can change over time. Several approaches to measuring gender have been proposed, which require contextual consideration *(17, 18)*.

Socioeconomic characteristics

Economic status can be measured through direct measures such as income or consumption, or through proxy (also called indirect) measures such as assets, housing and access to services (noting that housing and access could also be used as indicators in their own right). Indices of economic status may be constructed using multiple direct and/or proxy measures. Direct and proxy measures of economic status have varying applicability in different contexts (see Annex 9). Wealth (or asset) indices have been used extensively as a measure of economic status, especially in low- and middle-income countries. Multicountry household surveys, such as the Demographic and Health Surveys (DHS), are particularly useful for constructing wealth indices because they contain harmonized data across countries (Box 17.2).

Education is often measured as the number of years of education, the highest level of education attended, or the highest level of education completed. Standard requirements have been developed to classify educational activities. The International Standard Classification of Education, for example, lays out internationally agreed characteristics and definitions for nine levels of education spanning early childhood education to post-secondary levels of education *(20)*. These levels are often aggregated into two or three broad categories (see *Consider how the inequality dimension data were recorded* below for more information).

Geographical characteristics

Place of residence classifications vary considerably depending on the context. What constitutes urban and rural may be determined through population concentration and density, administrative designations, sectoral employment (e.g. agriculture), or infrastructure and services. To enhance the international comparability of place of residence measurements for global monitoring, the United Nations Statistical Commission endorsed the Degree of Urbanization approach, which is a standard method to measure the urban–rural continuum *(21)*. See Chapter 5 for more about health inequality monitoring in rural and remote settings.

Subnational regions of countries refer to the geographical areas defined by administrative divisions. There is variability across countries regarding the naming of administrative divisions and the number of levels of divisions. The most

BOX 17.2. The Demographic and Health Surveys wealth index

The DHS wealth index can be constructed to determine the relative ranking of households in a country *(19)*. It is based on asset ownership (e.g. televisions and bicycles), housing construction materials, and access to water and sanitation facilities. The wealth index is constructed at the national level and is based on principal component analysis. Because the DHS wealth index is a relative measure, it shows the economic position of the individual's household in relation to other households in the country. Therefore, when DHS wealth indices are applied to assess and compare the extent of health inequalities across countries, they reflect the relative positions of richer versus poorer people within each country (which may not be comparable on an absolute scale).

centralized administrative divisions (e.g. provinces or states) are termed first administrative level, which consist of second administrative level divisions (e.g. districts, municipalities or counties), and so on. In Europe, the Nomenclature of Territorial Units for Statistics (NUTS) classification is a hierarchical system for dividing territories into administrative levels for the purpose of collecting, developing and harmonizing European regional statistics *(22)*. NUTS consists of three levels (NUTS 1, 2 and 3), defined in consideration of population thresholds and administrative divisions of Member States.

Deprivation indices

Deprivation indices are constructed using data reduction techniques (e.g. factor analysis) applied to data on multiple dimensions of inequality (e.g. income, employment, housing, crime, education, access to services and living environment) *(23)*. Deprivation indices may be constructed at the level of the household or individual, but they are often measured at a small-area level (e.g. a census tract, electoral ward, postal code area or municipality). Inequality analyses sometimes entail ranking areas according to their deprivation index values and constructing groupings such as deciles or quintiles.

Several deprivation indices have been developed, spanning local, national and global applicability. For example, in the United States, a neighbourhood-level area deprivation index has extensive applications for health equity research, policy and community action. The index includes dimensions related to income, education, employment and housing quality, and data are visualized in the Neighborhood Atlas *(24)*. As another example, the socioeconomic deprivation status (SDS) measure for monitoring health inequalities combines eight indicators across two domains – education (years of schooling and school attendance) and living standards (cooking fuel, sanitation, drinking water, electricity, housing and assets) *(25)*. The SDS measure has been applied to measure inequalities in the coverage of reproductive and maternal health interventions in low- and middle-income countries and territories *(26)*.

Categorizing dimensions of inequality

Categorizing dimensions of inequality involves deciding on the technical criteria for how population subgroups are formed (i.e. determining the number and composition of the subgroups). Health inequality monitoring requires data pertaining to at least two population subgroups per inequality dimension (Box 17.3). The categorization of dimensions of inequality is contingent upon how the dimension data were recorded or measured, limitations related to small sample sizes, and the intended purpose of the monitoring exercise. For example, explorations intending to characterize the gradient of inequality across economic groupings require more than two subgroups.

BOX 17.3. Binary, ordered and unordered dimensions of inequality

When a population is divided into two subgroups, the inequality dimension is described as binary. When the population is divided into more than two subgroups, the inequality dimension may be described as ordered (if the subgroups can be logically ranked, such as from poorest to richest) or unordered (if the subgroups have no natural ranking, such as subnational regions). The implications of binary or nonbinary inequality dimensions that are ordered or unordered are discussed further in Chapters 19–21 on summary measures of health inequality.

Consider how the inequality dimension data were recorded

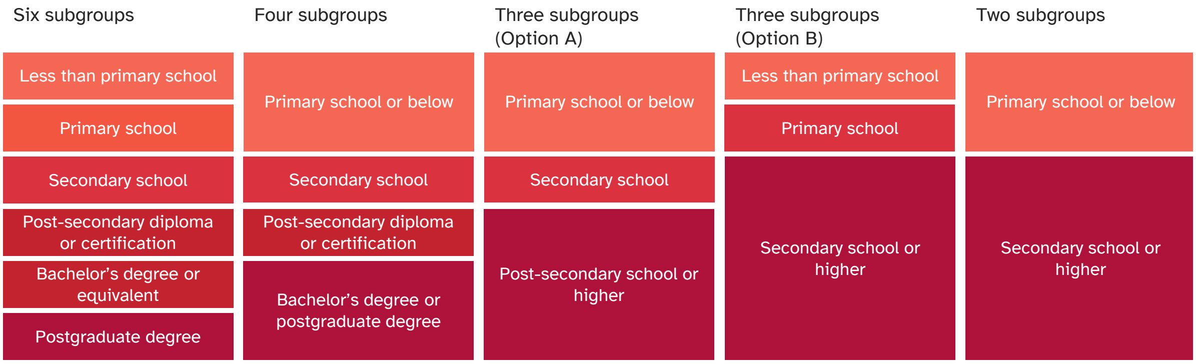
The measurement of a given inequality dimension is a primary consideration for how it can be categorized into subgroups. A dimension of inequality that is measured with more granularity (i.e. with more detailed information) allows for a greater range of options for forming subgroups. For example, consider the categorization of education subgroups when education is measured as the highest level completed, and data correspond to six response options – less than primary school, primary school, secondary school, post-secondary diploma or certification, bachelor's degree or equivalent, and postgraduate degree. Potential options for categorizing subgroups are shown in Figure 17.1. There are multiple options for categorizing the dimension as six or fewer subgroups – including options with the same number of subgroups but different composition (as demonstrated by options A and B for three subgroups). With the extent of available information in this example, however, it would not be possible to categorize education into more than six subgroups.

For dimensions of inequality recorded as continuous variables, subgroups may be constructed based on ranking and dividing the population into equally sized tertiles (three groups), quartiles (four groups), quintiles (five groups), deciles (10 groups), percentiles (100 groups), and so on. For example, monitoring of economic-based inequalities may compare health indicators between wealth quintiles (the poorest 20% versus the richest 20% of the population) or deciles (the poorest 10% versus the richest 10% of the population) *(27)*. In this case, the determination of the number of subgroups entails consideration of resolution issues (see Chapter 18) and sample size (see below).

Sample size considerations

Sample size constitutes another important consideration when using certain data sources, such as household surveys or surveillance systems. The sample size of population subgroups is especially pertinent if the data source was originally designed to be representative of a larger population and not of smaller subgroups identified for inequality monitoring. If a population subgroup has a small sample size, the resulting estimate will be less reliable than a population subgroup with a large sample size. In some cases, small sample sizes may pose a risk to confidentiality, whereby individuals with unique or rare characteristics may be identifiable, especially if data files can be linked, merged or matched with other information sources.

FIGURE 17.1. Categorizing education subgroups: selected examples of categories based on data with six responses



Six subgroups	Four subgroups	Three subgroups (Option A)	Three subgroups (Option B)	Two subgroups
Less than primary school	Primary school or below	Primary school or below	Less than primary school	Primary school or below
Primary school			Primary school	
Secondary school	Secondary school	Secondary school	Secondary school or higher	Secondary school or higher
Post-secondary diploma or certification	Post-secondary diploma or certification	Post-secondary school or higher		
Bachelor's degree or equivalent	Bachelor's degree or postgraduate degree			
Postgraduate degree				

The examples shown in this figure do not represent all possible categorizations.

If no data are available for one or more subgroup, the possibilities for further inequality analysis are limited.

Sample size refers to the number of people on which the disaggregated (subgroup) estimate is based – that is, the denominator used to calculate a disaggregated estimate.

The categorization of dimensions of inequality can help to circumvent limitations posed by small sample size. Subgroups with low sample sizes can sometimes be combined with data from other response groups to form one subgroup that consequently has a larger sample size. Consider the categorization of education subgroups using household survey data. Although information may be collected about six education categories (see Figure 17.1), the sample size for certain responses may be very small. For example, in a population where the overall level of education is high, there may be only a few surveyed individuals who respond that their highest level of education was "less than primary school". The estimate for this subgroup may therefore be unreliable, with a high degree of uncertainty. The "less than primary school" and "primary school" subgroups could be combined as "primary school or below". This can help to generate estimates that are based on larger sample sizes and therefore are more reliable (although estimates are still subject to uncertainty and potential bias).

In some cases, however, it may not make sense to combine the response options, and therefore the response with the small sample may need to be flagged as "based on small sample size" for transparency or may need to be excluded from reported if the sample size is critically low (Box 17.4). Calculating the standard error or confidence intervals for disaggregated data estimates is helpful to show the reliability of estimates. The coefficient of variation (the ratio between the standard deviation and the mean) serves as another tool to flag estimates with low precision. In the literature, thresholds between 10% and 20% have been used, with estimates exceeding the specified threshold considered unreliable *(30, 31)*.

In the longer term, the possibility of low sample size can be accounted for in the design of household surveys. If certain minority subgroups are especially relevant for monitoring, the survey sample design can be revisited to ensure oversampling of individuals from these groups (see Annex 8).

BOX 17.4. Thresholds for flagging or dropping estimates based on small sample sizes

Data sources follow different protocols regarding estimates based on small sample sizes. For example, the DHS Program requires estimates of intervention coverage based on sample sizes of 25–49 cases to be flagged. In general, estimates based on sample sizes of fewer than 25 cases are not reported *(28)*. The WHO COVID-19 Detailed Surveillance Data Dashboard requires at least 100 cases for disaggregated data to be reported *(29)*.

In Canada, COVID-19 mortality rates were reported based on numerators (numbers of deaths). For household or individual characteristics, such as dwelling, economic status or sex, rates based on death counts below 10 were suppressed. For small-area characteristics, such as concentration of people who are a visible minority or recently immigrated to Canada, rates based on death counts below five were suppressed *(12)*.

Aligning with the monitoring purpose

The categorization of dimensions of inequality should aim to enhance the impact and relevance of monitoring. As with all aspects of health inequality monitoring, the categorization of dimensions of inequality should be informed by a detailed understanding of the health topic, affected population and monitoring context.

If inequality monitoring includes benchmarking of within-country inequality (comparing inequality across similar areas or populations) or tracking inequalities over time, the categorization of dimensions of inequality should be consistent to promote greater comparability. Although more precise data with greater granularity may be available for certain populations or time periods, aggregation may be required to ensure there are similar numbers and composition of subgroups across all populations. For example, the WHO Health Inequality Data Repository contains data about reproductive, maternal, newborn and child health indicators derived from household surveys, disaggregated by education *(32)*. To enable meaningful comparisons across countries, education categorizations are made for three subgroups – “no education”, “primary education” and “secondary or higher education”. For certain countries, however, no data are reported for the “no education” category because the sample size is too small. A tailored analysis in such countries would be warranted for more relevant, context-specific explorations of education-related inequality.

Multiple disaggregation

Intersectionality is a concept originating in the social sciences, defined as the coexistence of multiple characteristics and identities that together compound disadvantage due to the interactions among them. Through double or multiple disaggregation, health inequality monitoring can serve as a starting point of exploring intersectionality.

Double disaggregation involves applying two dimensions of inequality simultaneously. Multiple disaggregation applies more than two dimensions.

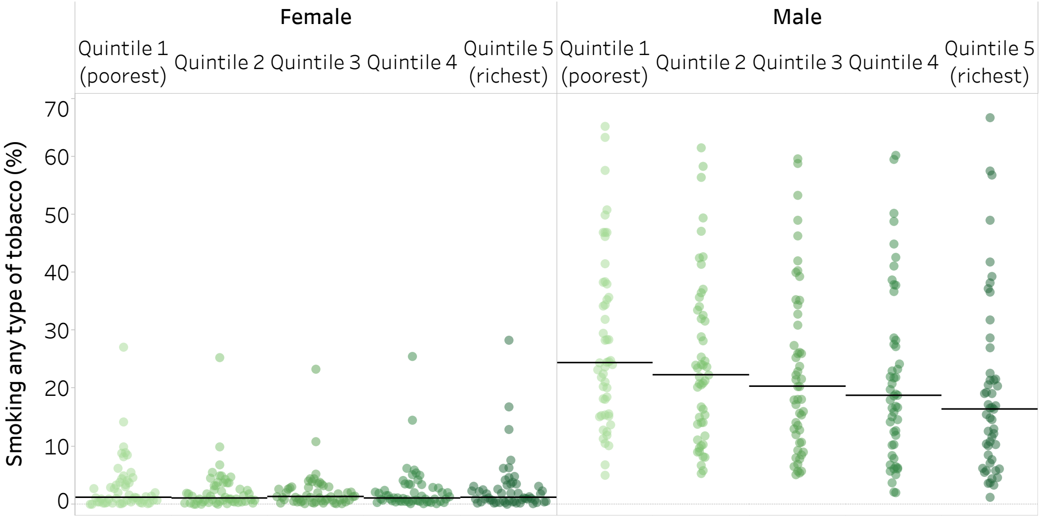
For example, a health indicator may be disaggregated by place of residence to show the situation in rural versus urban areas. There may also, however, be important differences between the rich and poor populations within rural and urban areas, which could be explored through double disaggregation by both economic status and place of residence. This would yield data about priority populations such as rural poor populations and urban poor populations. Box 17.5 contains examples of double-disaggregated data pertaining to tobacco use.

The practice of multiple or double disaggregation is subject to the above considerations for measuring and categorizing dimensions of inequality. As data are disaggregated into increasingly smaller subgroups, however, sample size is more likely to become a limitation. In addition, as more forms of disadvantage are taken into account, the degree of inequality observed is likely to become larger – generating smaller and more numerous subgroups will capture more of the extreme aspects of the inequality dimension compared with fewer subgroups. See Chapter 18 for further discussion of resolution issues. Multiple regression analysis techniques, discussed in Chapter 25, provide other avenues for exploring the association between health and multiple dimensions of inequality.

BOX 17.5. Examples of double disaggregation

Figure 17.2 shows double disaggregation of the prevalence of smoking of any type of tobacco. Data for 50 countries are double disaggregated by economic status (wealth quintiles) and sex (female, male). There were distinct overall patterns of economic-related inequality in tobacco smoking among females and males. In males, the median values across countries show a stepwise gradient, with the highest prevalence in the poorest quintile (24.4%) and the lowest prevalence in the richest quintile (16.4%). In females, the median level of tobacco smoking prevalence is similarly low across all wealth quintiles (ranging from 1.1% to 1.3%).

FIGURE 17.2. Smoking any type of tobacco, by economic status, for females and males, aged 15–49 years in 50 countries



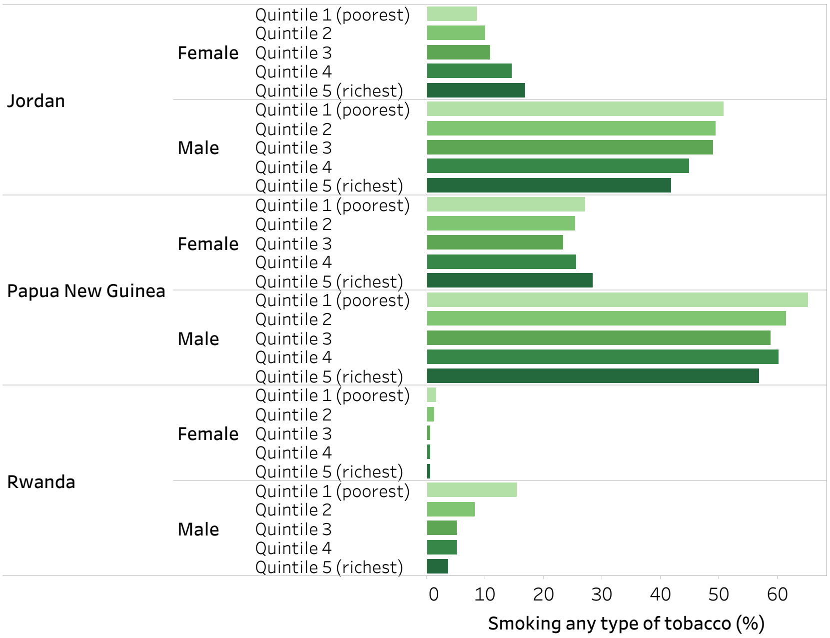
Each country is represented by multiple circles (one for each subgroup). Horizontal lines indicate the median across countries.

Source: derived from the WHO Health Inequality Data Repository Adult Health and Nutrition dataset (*32*), with data sourced from the most recent Demographic and Health Surveys between 2010 and 2021.

Figure 17.3 shows the pattern of economic-related inequality in females and males aged 15–49 years in Jordan, Papua New Guinea and Rwanda. Within each of these countries, the data reveal different patterns in females and males. In Jordan, economic-related inequality in tobacco smoking among females showed a pro-poor gradient, with lower prevalence among poorer quintiles. Among males in Jordan, nearly half smoked tobacco, with higher prevalence in poorer quintiles and lowest prevalence in the richest quintile. In Papua New Guinea, tobacco smoking in females showed a mixed pattern across wealth quintiles, with the highest prevalence in the richest and poorest quintiles. In males, prevalence was highest in the poorest quintile and lowest in the richest quintile. In Rwanda, there was no economic-related inequality in tobacco smoking in females, and the overall prevalence was low (0.9%). Males, by comparison, had higher smoking prevalence in the poorest quintile compared with the four richer quintiles.

BOX 17.5. *continued*

FIGURE 17.3. **Smoking any type of tobacco, by economic status, for females and males aged 15–49 years, three selected countries**



Source: derived from the WHO Health Inequality Data Repository Adult Health and Nutrition dataset *(32)*, with data sourced from the Demographic and Health Surveys in 2017 (Jordan and Papua New Guinea) and 2019 (Rwanda).

Preparing data at individual, household or small-area levels

Health indicators and dimensions of inequality can be prepared at individual, household or small-area measurement levels – any of which can potentially be applied when analysing inequalities. Measures of individual characteristics (e.g. use of a health service or education attainment) can be summarized at the small-area level (e.g. district-level health service coverage or average education level in a district). A scoping review of inequalities in COVID-19 vaccination demonstrated how articles presented vaccination coverage data at the level of individuals (percentage vaccinated), small areas (including percentage vaccinated by county, municipality, postal code area, province, state or census area), and institutions (including percentage vaccinated by nursing home or school) *(33)*. The vaccination coverage data were then disaggregated by various inequality dimensions, which were usually (but not always) measured at the same level as the corresponding COVID-19 vaccination indicator (see examples in Table 17.1).

TABLE 17.1. **Examples of assessing inequality in COVID-19 vaccination coverage using data prepared at individual and small-area levels**

Concept	Health indicator example	Inequality dimension example	Disaggregation
Individual-level health indicator and dimension of inequality data	Receipt of COVID-19 vaccine by individual	Education level of individual	Percentage of vaccinated individuals across different levels of education
Individual-level health indicator data and small-area-level dimension of inequality data	Delayed or missed COVID-19 vaccine by individual	Area-level social vulnerability index score	Percentage of individuals who delayed or missed a COVID-19 vaccine dose in areas with high, medium or low social vulnerability index score
Small-area-level health indicator and dimension of inequality data	Neighbourhood-level rate of vaccination	Social vulnerability index of municipality	Percentage of neighbourhoods that received vaccination by social vulnerability index of municipality

Source: examples are drawn from articles included in a scoping review of within-country inequality in COVID-19 vaccination coverage *(33–36)*.

The choice of level at which to prepare the data carries certain assumptions and should align with the purpose of the monitoring exercise. For example, in many applications of inequality monitoring, economic status is expressed at the household level, with the implicit assumption that income or assets are shared among household members. Individual-level data disaggregated by economic status would answer different questions about inequality than comparisons based on the economic status of a municipality. This decision also depends in part on the data source. Household surveys collect information from individuals and households, and thus tend to be suited for preparation at the individual or household level. Censuses, on the other hand, may be limited to household- or area-based levels of analysis. Data sources that contain information about small-area identifiers can sometimes be linked, enabling preparation at that level.

In cases where data at the individual or household level are limited, the use of data at the small-area level may enable an expanded scope of inequality monitoring, drawing from a wider selection of data sources. In some countries, deprivation indices have been developed and applied at the level of census tracts, electoral wards, postal code areas or municipalities (see *Deprivation indices* above). Care is required when presenting and interpreting dimensions of inequality measured at the small-area level, because area-level data do not reflect the situation for all individuals within that area. See Chapter 18 for more on ecological fallacy.

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18

Interpreting disaggregated health data

Overview

Disaggregated health data, which present health data by population subgroups, serve as a starting point for understanding the patterns and trends of inequalities in populations. The visual inspection of disaggregated data provides a cursory way to get a sense of the direction and magnitude of inequalities for a given indicator and time point. This can be done readily for binary dimensions of inequality groupings to identify which subgroup is performing better and which is performing worse, and to assess the extent of the gap between the two. When data are available for a large number of subgroups, displaying data graphically can facilitate the process of data inspection, because it can reveal patterns more easily than trying to make sense of multiple data points across columns and rows of a table.

Disaggregated data can convey information about inequalities in a straightforward and transparent manner, although certain issues related to their interpretation emerge upon close inspection. How can patterns in disaggregated data be described? With what degree of certainty do estimates represent their respective subgroups? When are the disaggregated estimates significantly different? What share of the population is captured in each subgroup – and what are the implications when the population share is uneven across subgroups? What considerations are required when comparing sets of disaggregated data across health topics, between populations (as part of benchmarking), and over time (as part of assessing inequality trends)? Consideration of these questions lends more robust insights into the data and nuances their interpretation.

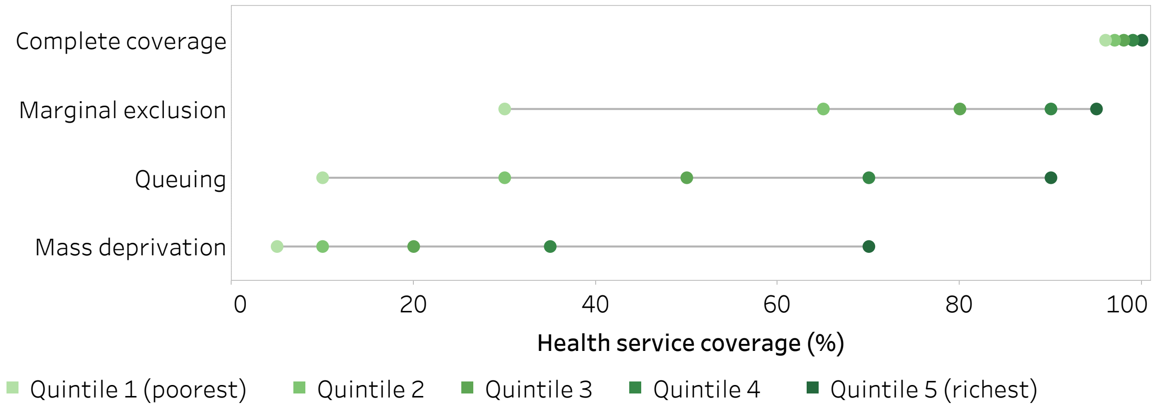
This chapter presents strategies and fundamental considerations for interpreting disaggregated data. The objective is to facilitate a rigorous understanding of the conclusions derived from inspecting and comparing disaggregated data. It includes discussions on describing characteristic patterns in disaggregated data, accounting for underlying qualities and issues related to subgroup data, and generating valid comparisons of disaggregated data. A detailed understanding of the preparation of disaggregated data and their interpretation (covered in Chapter 17 and in this chapter, respectively) is a helpful precursor for the use of summary measures of health inequality (see Chapters 19–22). Reporting disaggregated data and summary measures is covered in Chapter 23.

Characteristic patterns in disaggregated data

For subgroups that are ordered (i.e. where they can be logically ranked, such as with age, economic status or education), describing characteristic patterns across disaggregated data can be a compelling way to assess and report disaggregated health data *(1)*. Alongside each of these patterns, a corresponding response or intervention can also be proposed as a general starting point for further action (see Annex 10). See Chapter 8 for more about equity-oriented policy-making.

Figure 18.1 demonstrates four patterns of inequality in a health service coverage indicator (measured as percentage) across wealth quintiles, using hypothetical data. In this type of figure (known as an equiplot), the health indicator estimate is plotted on the bottom axis, and the subgroups are represented by coloured circles. The four characteristic patterns are labelled to the left. The top row shows complete coverage. All quintiles have around 100% coverage, indicating universal coverage of this health service with almost no inequality. A response to this situation is continued monitoring to ensure coverage remains high for all. The second row demonstrates a pattern of marginal exclusion, where the poorest quintile has much lower coverage than the four richer quintiles. An appropriate response here may involve targeting the poorest subgroup. The third row is a queuing or linear pattern, whereby there are increases in coverage across each of the quintiles. A combination (or gradient) approach, with differentiated targeting across the population subgroups may be warranted. The bottom row illustrates the mass deprivation pattern, where most of the population – that is, all but the richest quintile – has low levels of coverage. In this scenario, a population-level response may be required to reach all or most of the population. For examples of these characteristic patterns of inequality in countries, see Box 18.1.

FIGURE 18.1. Illustration of patterns of inequality in health service coverage across wealth quintiles



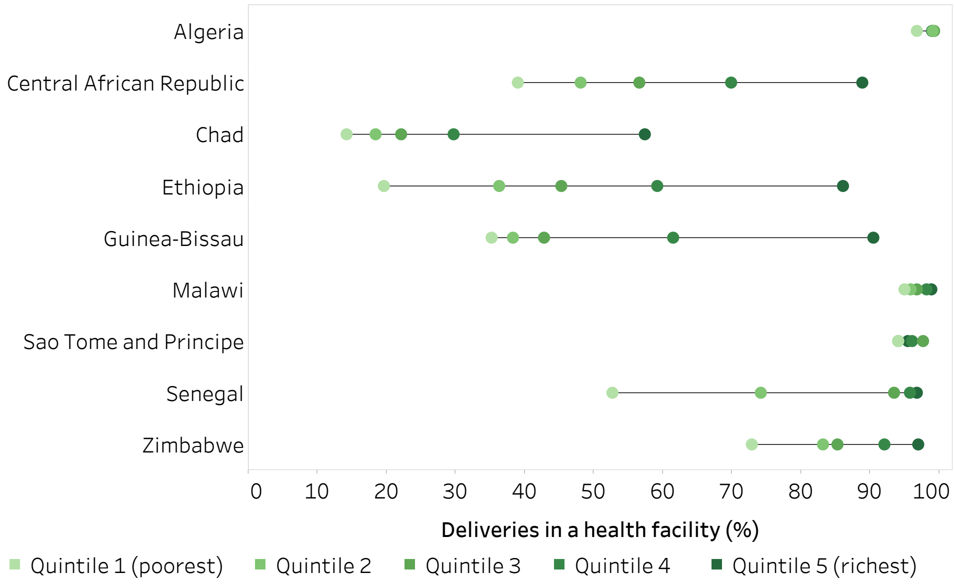
Horizontal lines show the range between the lowest and highest subgroup estimates.

BOX 18.1. Examples of characteristic patterns of inequality in disaggregated data

The following example shows characteristic patterns of inequality observed across wealth quintiles for deliveries in a health facility for nine selected countries in the WHO African Region with Demographic and Health Surveys (DHS) or Multiple Indicator Cluster Surveys (MICS) data available from 2019 or 2020 (Figure 18.2).

A queuing pattern was evident in the Central African Republic and Ethiopia, where the percentage of deliveries in a health facility increased in a stepwise pattern across wealth quintiles. Senegal and Zimbabwe demonstrated a marginal exclusion pattern, where the percentage of health facility deliveries was considerably lower in the poorest quintile compared with the four richer quintiles. Mass deprivation was observed in Chad and Guinea-Bissau, with a considerably higher percentage of health facility deliveries in the richest quintile compared with the four poorer quintiles. A universal pattern of high percentage of health facility deliveries was reported in Algeria, Malawi and Sao Tome and Principe.

FIGURE 18.2. **Deliveries in a health facility, by economic status, nine selected countries in the WHO African Region**



Horizontal lines show the range between the lowest and highest subgroup estimates.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(2)*, with data sourced from the Demographic and Health Surveys in 2019 (Ethiopia, Senegal) and from Multiple Indicator Cluster Surveys in 2019 (Algeria, Central African Republic, Chad, Guinea-Bissau, Sao Tome and Principe, Zimbabwe) and 2020 (Malawi).

Measures of uncertainty and significance

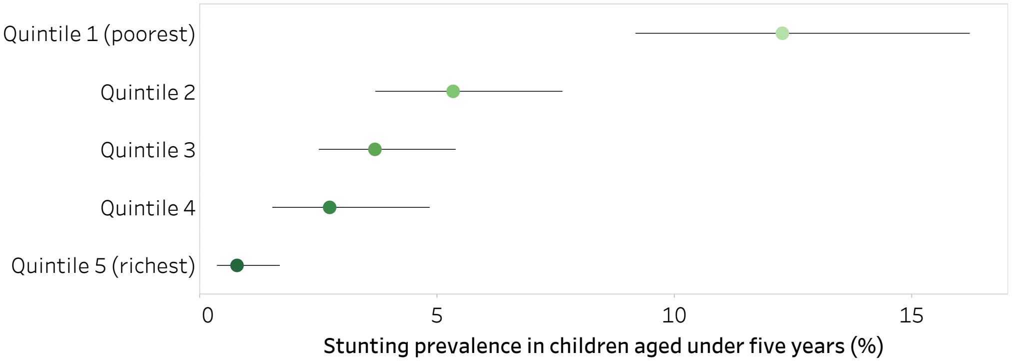
Measures of uncertainty for point estimates derived from surveys, such as 95% confidence intervals or standard errors, provide information about the reliability of the estimate. They can also be used to assess whether there are statistically significant differences between population subgroups and to help determine whether the results are meaningful. Figure 18.3, for example, shows 2016 estimates for stunting prevalence in children aged under five years in Paraguay disaggregated by wealth quintiles, with corresponding 95% confidence intervals (indicated by horizontal lines). Taking 95% confidence intervals into account, the data show a marginal exclusion pattern. The highest stunting prevalence was in the poorest quintile, with a large overlap in the 95% confidence intervals for the three middle quintiles (quintiles 2–4), and minimal overlap for the two richest quintiles (quintiles 4 and 5).

The mathematical calculation of measures of uncertainty takes survey sample size into account. Subgroup estimates based on smaller sample sizes tend to have more uncertainty, whereas estimates based on larger sample sizes tend to demonstrate lower uncertainty.

The level of uncertainty surrounding an estimate considers whether a comparison between two values is statistically significant (e.g. measured using a *P* value). Subgroup estimates based on larger sample sizes are more likely to yield statistically significant results. There may be cases where small differences in disaggregated estimates show statistical significance solely because they are based on a large sample size.

When inspecting and interpreting point estimates, a distinction can be made between statistical significance and public health significance. Estimates derived from large samples may prove to be statistically different mathematically, but in public health this difference may not be meaningful. For example, the 2020 DHS in India reported a statistical difference between demand for family planning satisfied (use of modern and traditional methods) in urban and rural areas. The coverage in urban areas was 89.2% (95% confidence interval (CI) 88.8–89.5%), and the coverage in rural areas was 86.9% (95% CI 86.7–87.1%) *(2)*. In terms of public

FIGURE 18.3. **Stunting prevalence in children aged under five years, by economic status, Paraguay**



Horizontal lines show 95% confidence intervals around the point estimates.
Source: derived from the WHO Health Inequality Data Repository Child Malnutrition dataset *(2)*, with data sourced from the 2016 Multiple Indicator Cluster Surveys.

health policies, programmes and practices, however, the difference of 2.3 percentage points likely bears little importance. Nevertheless, this does not mean that sample size and uncertainty measures should be ignored when reporting data. Rather, there is a need to ensure point estimates do not lead to false conclusions and misinformed policy. This includes considering whether the confidence intervals of the point estimates are narrow enough to allow for meaningful conclusions about inequality. In cases where no meaningful conclusions can be drawn, point estimates for indicators in population subgroups should be presented with the necessary caveats to avoid confusion and misinformation. See Chapter 23 for more discussion about reporting the results of health inequality monitoring.

Ecological fallacy

An ecological fallacy is a misinterpretation that occurs because the characteristics of a group are attributed to an individual. Health indicators and dimensions of inequality measured at an aggregate level, such as by district or household, do not necessarily reflect the situation for all individuals within the group. For instance, if richer districts are found to have a higher prevalence of road traffic injuries than poorer districts, it would be erroneous to use these data to draw the conclusion that road traffic injuries are more prevalent among richer individuals – although the data could be used to help inform targeted interventions in richer districts.

> An ecological fallacy refers to an erroneous inference that may occur because an association observed between variables on an aggregate level does not necessarily represent or reflect the association that exists at an individual level *(3)*.

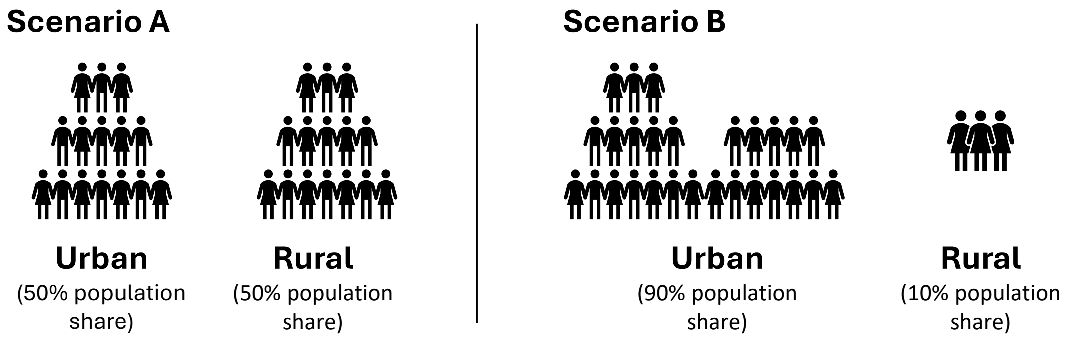
Household measures can mask inequalities within households. Care should be taken to avoid drawing conclusions that rely on the extrapolation of characteristics about individuals from household-level data. For example, for the purposes of health inequality monitoring, economic status is commonly measured as household wealth using asset-based indices. Household members, however, may not have equal access to assets and income due to their age, gender or other factors. An interpretation of data disaggregated by household wealth, therefore, would be more accurately expressed as “women from richer households are more likely to access health services” than “rich women are more likely to access health services”.

Population share and population shift

Population share refers to the percentage of the total affected population included in a given population subgroup. (The total affected population may not encompass the entire population in an area. For example, for certain indicators, it may consist of all women of reproductive age or all children aged under five years.) Population share can be expressed as the population size (i.e. the absolute number of affected people represented by each population subgroup), although the relative value (share) is often easier to interpret. Awareness of the population share (or size) associated with a disaggregated estimate lends greater understanding of the context of the situation and underlying population.

For example, consider a hypothetical population consisting of 50% urban residents and 50% rural residents (Figure 18.4, Scenario A). Disaggregated estimates for rural and urban areas each represent the situation for half the population. In a different

FIGURE 18.4. Illustration of two hypothetical population share scenarios



scenario where the population share is 90% urban and 10% rural (Figure 18.4, Scenario B), the disaggregated estimate for urban areas corresponds to a much higher proportion of the population than the estimate for rural areas. It is not necessarily the case that disadvantage reported by a subgroup with a smaller population share is less important: inequality monitoring is often concerned with situations of disadvantage that affect small subgroups. Instead, knowledge about population share helps in understanding more fully how the estimates represent the population and how to accurately contextualize the results.

Population shifts occur when the distribution of the population across subgroups (i.e. the population share of the subgroups) changes over time. This is a pertinent consideration when making comparisons over time, because population shifts can help to explain why disaggregated estimates may (or may not) have changed. In the hypothetical scenarios illustrated in Figure 18.4, Scenario A might represent an earlier time point before urbanization, and Scenario B might represent a later time point after large-scale migration from rural to urban settlements. In this example, suppose the disaggregated estimates for health service coverage were as follows:

- Pre-urbanization (Scenario A) coverage was 90% in urban areas and 20% in rural areas.

- Post-urbanization (Scenario B) coverage was 70% in urban areas and 30% in rural areas.

Without corresponding information about population share, it is apparent only that coverage in urban areas declined over time while coverage in rural areas increased. The patterns in the disaggregated estimates provide little indication of why these changes might have occurred. If information about the population share is provided, however, the complexity of the situation becomes apparent. The increase of the urban population share from 50% to 90% between the two time points (and corresponding decrease of the rural population share from 50% to 10%) is suggestive of urbanization. Given this information, it is clear that the composition of the subgroups has shifted over time, and the disaggregated estimates are capturing different subgroup populations in Scenario A versus Scenario B. More information is required about the migrant coverage levels to interpret the data accurately. For example, one possible explanation for the observed coverage decline in urban areas is that the rural populations that moved to urban areas may have lower levels of coverage than the pre-urbanization urban populations. For more discussion and examples regarding population shift and the use of weighted versus unweighted summary measures of health inequality, see Chapters 19 and 22. For more about urbanization and health inequality, see Annex 6.

Resolution issues

Resolution issues arise when interpreting and comparing between sets of disaggregated data based on variable numbers of subgroups. A larger number of groupings will usually capture more heterogeneity (i.e. variation), especially when comparing between subgroups that reflect the extreme ends of an ordered inequality dimension *(4, 5)*. Conversely, a smaller number of subgroups for a dimension of inequality will generally capture less heterogeneity between the subgroups.

To illustrate this issue, consider the case of economic status. This dimension of inequality is commonly categorized using deciles, quintiles or two subgroups:

- Deciles (10 subgroups) each contain about 10% of the population.
- Quintiles (five subgroups) each contain about 20% of the population.
- Two subgroups may be formed from the richest 60% and the poorest 40%, or the richest 10% and the poorest 40% (known as the Palma ratio).

For a given population, observing disaggregated data and making comparisons between the two subgroups at the extremes – the richest and the poorest – leads to different conclusions about inequality, depending on the number of subgroups. Dividing the population into deciles means the comparisons are made between the richest 10% and the poorest 10%. Having 10 subgroups of economic status captures more of the extreme wealth and extreme poverty than having five subgroups (quintiles, where comparisons capture the richest 20% and the poorest 20%) or two subgroups (where comparisons capture the richest 60% and the poorest 40%). Box 18.2 demonstrates the use of economic status deciles versus quintiles to show inequality in births attended by skilled health personnel in Bangladesh.

> The numbers of subgroup categories should be harmonized when comparing between situations of inequality.

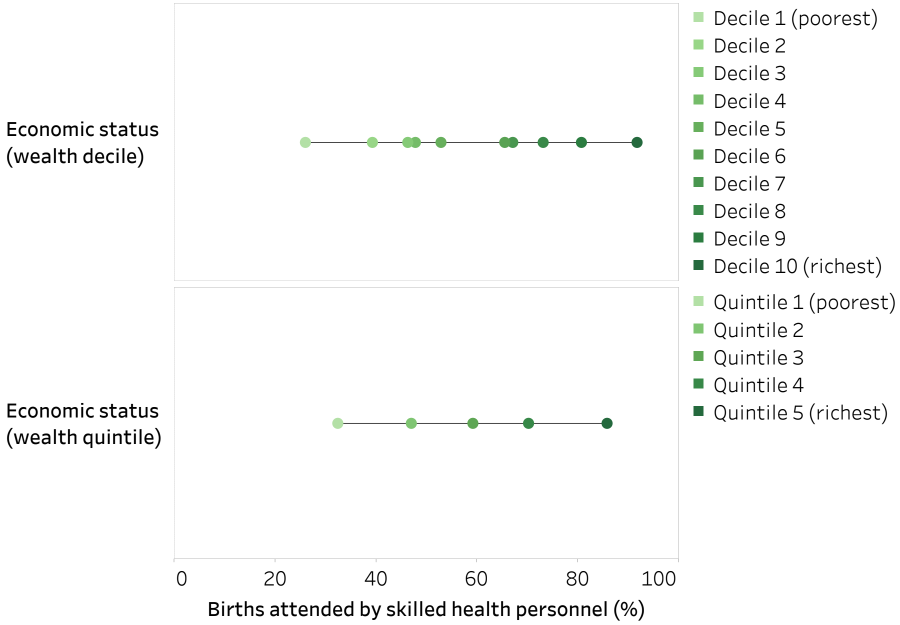
Due to resolution issues, comparisons between dimensions of inequality that are categorized based on variable numbers of subgroups can be misleading and generally should be avoided. Similarly, attention to resolution issues is required when comparing between different dimensions of inequality for a given indicator, comparing disaggregated estimates over time, and comparing between countries. It would not be valid to make comparisons of within-country inequality if economic status is categorized as quintiles in one country and as deciles in another country. When benchmarking across countries, it may be valid, however, to compare within-country wealth-related inequality if economic status is categorized consistently in all countries.

BOX 18.2. Applying economic status deciles versus quintiles

Figure 18.5 shows data from Bangladesh about the percentage of births attended by skilled health personnel, disaggregated by economic status. Each of the green dots represents one subgroup. On the top, economic status is categorized as deciles. The coverage is 26% in the poorest subgroup and 92% in the richest subgroup.

On the bottom, economic status is categorized as quintiles, each consisting of 20% of the population. Here, the range of coverage between the poorest and richest is smaller – 32% coverage in the poorest subgroup and 86% in the richest subgroup. The range of values, therefore, is larger when economic status is categorized as 10 rather than five subgroups.

FIGURE 18.5. **Births attended by skilled health personnel, by economic status, Bangladesh**



Horizontal lines show the range between the lowest and highest subgroup estimates.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(2)*, with data sourced from the 2019 Multiple Indicator Cluster Surveys. Data are based on two years prior to the survey.

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19

Assessing inequality using summary measures of health inequality

Overview

Summary measures of health inequality offer a concise way to express the magnitude of inequality in a given health indicator, using a single number. They enable comparisons across time points, health indicators and settings. There are several types of summary measure of inequality, with different applicability depending on the characteristics of the underlying data and the dimensions of inequality that are the focus of the analysis. For example, summary measures can be expressed on an absolute or relative scale. They can draw from two subgroups (pairwise comparisons) or more than two subgroups (complex measures), and they may be weighted or unweighted with regard to population size. Some summary measures rely on the selection of a reference point.

This chapter focuses on summary measures of health inequality related to social inequality (also termed bivariate inequality), whereby inequalities in a population are assessed in relation to subgroups defined by a dimension of inequality, such as age, economic status, education level, place of residence, sex or subnational region. Accordingly, the calculation of such summary measures of inequality requires disaggregated health data from two or more subgroups (see Chapters 20 and 21). Some summary measures, however, can also be calculated using individual-level data (see examples in Chapter 25).

The objective of this chapter is to build a theoretical understanding of the general applications, strengths and limitations of summary measures of health inequality as an extension of disaggregated data analysis. The chapter discusses why summary measures of health inequality are used and introduces their defining characteristics. Subsequent chapters provide a more detailed description of the calculation of pairwise summary measures of health inequality (Chapter 20) and selected complex summary measures of health inequality (Chapter 21). Chapters 22 and 23 address considerations for interpreting and reporting summary measures of inequality.

Why are summary measures of health inequality used?

Summary measures of health inequality provide a means of summarizing information about multiple data points using a single number to express inequality. These measures are calculated from disaggregated data (data broken down by population subgroups defined by a dimension of inequality – see Chapter 11). Accordingly, they represent health inequality associated with a specified demographic, socioeconomic or geographic characteristic, summarizing inequality across two or more subgroups.

Summary measures are used to monitor inequality across population subgroups and assess situations of health inequity (i.e. unfair differences in health). Summary measures provide insight into where differences between social groupings may require intervention or further study. Summary measures may be useful to track progress towards targets to reduce or eliminate inequalities. They can be applied to summarize the extent of progress made towards a target, and how much more progress is needed. The summary measures covered in Chapters 20–21 are descriptive and do not support assertions that, for example, poor health results in socioeconomic disadvantage, or that socioeconomic disadvantage is a cause of poor health.

Summary measures are especially useful when making comparisons of inequality between settings, over time and across health indicators. Although inspection of disaggregated data is important to understand the situation in all subgroups, the interpretation of disaggregated data across multiple countries and many subgroups, time points or indicators can become cumbersome. The use of a summary measure to assess inequality in a health indicator in multiple countries (e.g. between the richest and poorest wealth quintiles in each country) would allow countries to be sorted according to the level of within-country inequality – that is, a cross-country comparison of within-country inequality. Similarly, the use of summary measures for tracking inequality in health between the richest and poorest quintiles within a country each year over a 10-year period would provide information on whether inequalities have grown, narrowed or stayed the same over time. Within a given health topic, comparing the extent of the rich–poor inequality across a range of health indicators would help to indicate where inequalities are most pressing.

In addition to summarizing inequality across multiple subgroups, certain summary measures of inequality may incorporate other information related to the underlying data, such as the population size. Therefore, various summary measures offer unique insights into health inequalities.

Defining characteristics of summary measures

There are multiple summary measures of health inequality, with different applicability *(1–3)*. An understanding of their defining characteristics is necessary, both to inform the appropriate selection of summary measures for a given set of disaggregated data and to ensure an accurate interpretation of the results. The selection of summary measures reflects different aspects of inequality, such as absolute versus relative inequality, or inequality between two subgroups versus more than two subgroups. Some summary measures of inequality can be adapted for use with any set of disaggregated data, but other summary measures of inequality must be selected appropriately in accordance with the characteristics of the underlying data, such as whether the dimension of inequality is inherently ordered or non-ordered. Other distinctions include whether summary measures are weighted or unweighted and the selection of a reference point.

Absolute versus relative summary measures

Summary measures of health inequality can be divided broadly into absolute inequality measures and relative inequality measures. For a given health indicator, absolute inequality measures indicate the magnitude of difference in health between subgroups in absolute terms. Absolute measures remain constant when the health indicator values in all subgroups change by the same amount. They retain the same unit of measure as the health indicator (Box 19.1), which makes the result easy to understand. Absolute measures, however, should not be used to compare the situation across indicators with different units.

Relative inequality measures show proportional differences in health among subgroups and have no units. Relative measures remain constant when the health indicator values in all subgroups change by the same proportion. They can be used to compare findings across indicators with different units, but it can be difficult to get a sense of the magnitude of inequality.

Absolute and relative measures of inequality provide complementary perspectives to assess a situation of inequality and both should be calculated and considered when interpreting findings. For example, the coverage of a health intervention in Subgroup A (80%) compared with Subgroup B (40%) could be expressed in absolute terms as a gap of 40 percentage points between Subgroups A and B, or in relative terms as the coverage in Subgroup A being twice as high as in Subgroup B. Neither piece of information in isolation would give a complete sense of the situation of inequality. This is illustrated in Figure 19.1, which shows ratio values corresponding to differences of 40 percentage points and difference values corresponding to ratios of 2.0.

In general, relative measures suggest larger inequality when the denominator has smaller values relative to the value of the numerator (i.e. when the denominator is further away from the numerator). For example, 20/1 = 20, whereas 20/10 = 2. Absolute measures tend to be small at the lower and upper ends of a distribution (e.g. when overall disease prevalence is very low, or when overall coverage or health levels are very high). For example, if the overall prevalence is 1%, the maximum (unweighted) inequality between two subgroups is 2 percentage points (disaggregated data values of 2% and 0%). Similarly, if the overall prevalence is 99%, the maximum inequality between two subgroups is also 2 percentage points (disaggregated data values of 100% and 98%). For more discussion about mathematical considerations when interpreting summary measure results, including the use of absolute and relative measures to assess inequality trends, see Chapter 22.

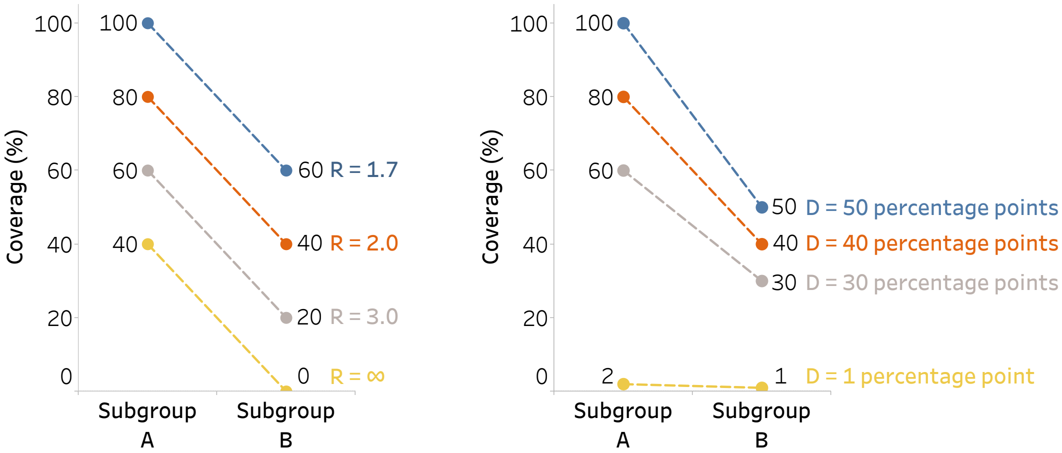
BOX 19.1. Percentages or percentage points?

There is a special consideration regarding units of measurement for expressing absolute inequality based on a health indicator measured as a percentage. Percentage is commonly understood to express relative differences (e.g. a 50% increase or a 50% decrease). When expressing absolute inequality based on a health indicator measured as a percentage, the difference between percentages is communicated using percentage points.

For example, if coverage in Subgroup A is 80% and coverage in Subgroup B is 40%, it is correct to state that "coverage in Subgroup A is 40 percentage points higher than coverage in Subgroup B". It is also correct to state that "coverage in Subgroup A is 100% higher than coverage in Subgroup B".

It is incorrect, however, to state that "coverage in Subgroup A is 40% higher than coverage in Subgroup B".

FIGURE 19.1. Illustration of difference and ratio values corresponding to different hypothetical levels of coverage



Ratio (R) values corresponding to differences of 40 percentage points between Subgroups A and B at various levels of coverage

Difference (D) values corresponding to a ratio of 2 between Subgroups A and B at various levels of coverage

Pairwise versus complex summary measures

Another major distinction can be made between pairwise (or simple) summary measures and complex summary measures. Pairwise measures make comparisons between two (and only two) subgroups. They can be calculated for any health indicator and dimension of inequality and tend to be intuitive and easy to understand, whether expressed on the absolute (difference) or relative (ratio) scale. Pairwise differences and ratios are especially relevant for dimensions of inequality that are binary – that is, consisting of exactly two subgroups, such as urban versus rural place of residence, or females versus males. For dimensions consisting of more than two subgroups, difference and ratio can still be calculated, but they can take only two of the subgroups into account; the situation in all other subgroups is overlooked or sometimes factored in by collapsing heterogeneous populations into two subgroups. Approaches for selecting subgroups for difference and ratio measures are outlined in Chapter 20, along with other considerations for the calculation of these measures.

Complex summary measures make use of data from all population subgroups to express the level of inequality. For example, a complex measure of inequality can express inequality across all five wealth quintiles, or across all districts in a country. Although complex measures usually apply to dimensions with more than two subgroups, there are a few exceptions. As described below, complex measures may apply to ordered or non-ordered dimensions of inequality and can be characterized further as weighted (accounting for the population size of each subgroup) or unweighted (treating each subgroup as equally sized). In some cases, selection of a reference point may be required, which may be one of the subgroups, the overall average, or another meaningful value such as a target. Chapter 21 covers the calculation of several different classes of complex summary measures, including regression-based measures, ordered disproportionality measures, mean difference measures, variance measures, non-ordered disproportionality measures and impact measures.

Summary measures based on ordered versus non-ordered inequality dimensions

Complex summary measures generally apply to either ordered or non-ordered dimensions of inequality. Subgroups within ordered dimensions of inequality have an inherent positioning and can be ranked. Complex summary measures of inequality that apply to ordered dimensions consider the ordering of the subgroups in their calculation. Age, economic status and education level are examples of ordered dimensions of inequality. In the case of economic status and education level, subgroups can be ordered from the most disadvantaged (poorest or least educated) to the most advantaged (richest or most educated), irrespective of the health status of the subgroup. Age can be ranked from youngest to oldest. The ordered nature of certain dimensions of inequality, however, may be less straightforward. For example, rankings of occupational or social classes are sometimes made, but this can be controversial because it requires a subjective assessment.

Economic status and education level are commonly used to explore variation in health status at varying levels of socioeconomic status – also known as the social gradient in health.

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Another set of summary measures is appropriate for use with non-ordered dimensions of inequality. Non-ordered dimensions of inequality are based on criteria that cannot be logically ranked, such as languages spoken, race or ethnicity, or subnational regions.

There may be situations where an ordered characteristic is attached to a non-ordered dimension of inequality. For example, subnational regions could be described according to the average income, population density or level of unemployment, and then ordered from the region with the lowest value to the region with the highest value. In this case, income, population density or unemployment levels (all ordered dimensions of inequality) would be the criteria upon which the regions are ranked, and summary measures of inequality for ordered dimensions would be appropriate.

Weighted versus unweighted summary measures

Summary measures of inequality can be described further as weighted or unweighted. Weighted measures take into account the population size of each subgroup. Unweighted measures treat each subgroup as equally sized. Complex measures may be weighted or unweighted, but pairwise difference and ratio measures are always unweighted. Note that this description of weighting is distinct from the use of sampling weights when preparing data from surveys, discussed in Annex 8.

Weighted summary measures require information about population size or population share. Population size refers to the number of people represented by each subgroup. Population share describes this information as a percentage (i.e. the percentage of the total population represented by each subgroup). For more information, see Chapter 18.

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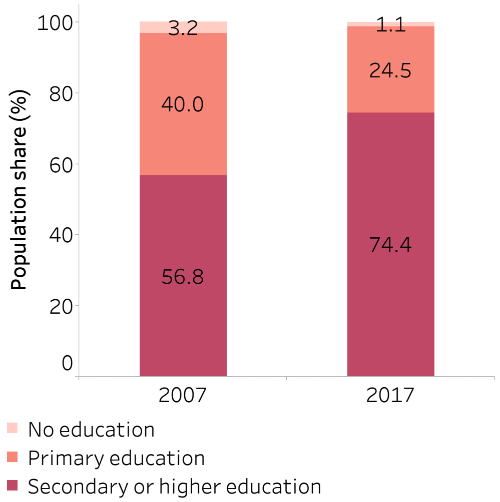
For example, Figure 19.2 shows the population share of women aged 15–49 years by education level in Indonesia in 2007 and 2017. In 2017, 74% of this population had secondary education or higher, 25% had primary education and 1% had no education. The use of a weighted measure of inequality, accounting for the lower percentage of the population in the “no education” subgroup, may suggest a different level of inequality than an unweighted measure, which treats all groups as equally sized. Moreover, population shift across education subgroups over the 10-year period between the surveys is evident. Compared with 2007, the share of the population with secondary or higher education was higher in 2017, and the share of the

FIGURE 19.2. **Proportion of women aged 15–49 years, by education level, Indonesia**



Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(4)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys for the indicator "births attended by skilled personnel".

population with primary or no education was lower. Weighted measures, if used to compare the level of inequality between the two time points, would account for this shift, whereas unweighted measures would not. See Chapter 21 for a corresponding analysis of education-related inequality in births attended by skilled health personnel, measured using weighted and unweighted summary measures.

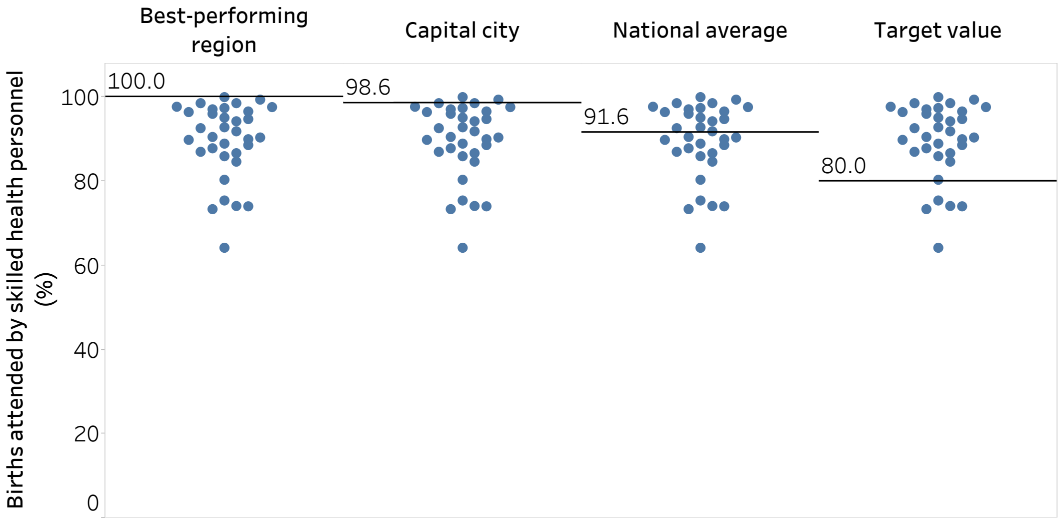
There are two main considerations for the selection of a weighted versus unweighted measure. First, there are methodological reasons. Weighted summary measures account for the distribution of the population across subgroups. If there is a very small subgroup, it is unlikely to have a strong impact on the summary measures if weighted. Weighted measures may, however, be methodologically warranted in some circumstances, such as monitoring health inequalities over time amid a situation of population shift. For example, tracking education-based inequality – as in Figure 19.2, where the population share in the "no education" and "primary education" subgroups decreased over time and the population share in the most educated subgroup increased – the use of a weighted measure would likely capture a reduction of health inequality over time.

A second reason relates to ethical and value judgements (see Chapter 22). Briefly, the use of weighted measures treats all individuals equally. Conversely, unweighted measures treat all subgroups equally. For example, the use of a weighted measure to show inequality between Indigenous versus non-Indigenous subgroups would not capture inequality if the number of individuals in the Indigenous subgroup was much smaller than the number in the non-Indigenous subgroup. In this case, the use of an unweighted measure, which reflects an equal normative status of the subgroups, would be more likely to capture inequality. The ethics and value judgements conveyed through the selection of weighted or unweighted measures are not "right or wrong" or "better or worse" but rather should be considered and acknowledged as an appropriate fit for the circumstances that surround a particular application of monitoring.

Reference points

Complex measures of inequality have specific reference points that serve as benchmarks or points of comparison. There are often several possible reference points that could be selected, depending on the specifics of what is being monitored. Commonly, a reference point is based on a chosen subgroup. For an ordered dimension of inequality, the reference group may be one of the subgroups at the extreme, such as the richest or most educated subgroup. For non-ordered dimensions, a subgroup may be selected for holding special significance, such as the dominant ethnicity or the region where the capital city is located. A reference subgroup may also be selected because it is the best-performing subgroup based on the assumption that its health status is achievable by other subgroups (usually the less advantaged or worse-performing subgroups). This concept is also known as "levelling up" and

FIGURE 19.3. **Illustrating the use of four distinct reference points: births attended by skilled health personnel, by subnational region, Indonesia**



Each subnational region is represented by one circle per column. Horizontal lines indicate the reference points across subnational regions. The best-performing region was Bali. The capital city is Jakarta.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(4)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

indicates improvement towards the elimination of inequalities. In some circumstances, reference points other than subgroup values may be specified, such as the overall average of the health indicator or a health indicator target.

To illustrate the use of different reference points, Figure 19.3 shows data about the coverage of births attended by skilled health personnel across 34 subnational regions of Indonesia. Across the four panes of the figure, four distinct reference points are identified. On the left, the selected reference point is the best-performing region (Bali), where the indicator coverage is 100%. Next, Jakarta is highlighted as a potential reference point. This subgroup holds special significance because it is the capital city. A few other regions had higher coverage than Jakarta, but most regions had lower coverage. Another possible reference point is national average, which was around 92% in this example. A defined target value, such as 80% coverage, is the fourth possible reference point highlighted in this example. The use of this reference point illustrates that only a few regions had coverage below the target.

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20

Pairwise summary measures of health inequality

Overview

Pairwise (or simple) summary measures of health inequality make comparisons between two population subgroups. There are two pairwise measures of inequality. Difference is an absolute measure of inequality that shows the gap between two subgroups. Ratio is a relative measure that shows proportional inequality (relative gap) between two subgroups. They are the most commonly used summary measures in inequality reporting.

A primary reason for using difference and ratio is to simplify patterns in disaggregated data in a manner that is easy to calculate and understand. A systematic approach to setting up the calculation of pairwise measures helps to ensure the results can be readily assessed and compared across settings, indicators and time. There are, however, a few initial considerations when setting up the calculations. Two subgroups must be selected for the calculation – this is straightforward for binary dimensions of inequality (e.g. rural and urban or female and male), but it is less straightforward for dimensions of inequality consisting of more than two subgroups (e.g. subnational regions or wealth quintiles). In this situation, how are the two subgroups selected? Attention must be paid to how advantaged and disadvantaged subgroups are positioned in the calculation, and navigating situations where subgroups cannot logically be assigned as advantaged or disadvantaged. Additionally, considerations arise when calculations are made for favourable or adverse health indicators.

This chapter provides in-depth descriptions of pairwise summary measures of health inequality (difference and ratio) calculations, with illustrative examples of their applications. The objectives are to use disaggregated data to calculate difference and ratio, to consider factors to promote a systematic approach to how they are calculated, and to understand the strengths and limitations of using these measures to assess health inequality.

Basic calculations

Difference and ratio are calculated from disaggregated data and can be used with ordered and non-ordered inequality dimensions. As they make pairwise comparisons, they can be used with binary dimensions of inequality (e.g. rural versus urban place of residence). They can be used with dimensions of inequality categorized as more than two subgroups, but they account for only two selected subgroups (e.g. richest and poorest wealth quintiles). Difference and ratio are typically unweighted, with both subgroups treated as equally sized. The key characteristics of difference and ratio, along with other summary measures of health inequality, are summarized in Annex 11.

Calculating difference

Difference shows the absolute gap between subgroups and is a measure of absolute inequality. To calculate difference, the health indicator estimate in one subgroup is subtracted from the indicator estimate in a second subgroup.

$$\text{Difference} = \text{Subgroup A estimate} - \text{Subgroup B estimate}$$

The difference value retains the same unit of measure as the health indicator. A difference of 0 indicates no inequality, meaning the two estimates are the same. A higher absolute value (i.e. negative or positive) indicates more inequality between the two subgroups. It is typically most intuitive to interpret a positive difference value, which is the result of calculating difference as the highest minus the lowest subgroup estimate.

Calculating ratio

Ratio is a measure of relative inequality. It is multiplicative, showing how much better or worse one subgroup is doing in relation to the other. To calculate ratio, the indicator estimate in one subgroup is divided by the estimate in a second subgroup, showing the proportional difference.

$$\text{Ratio} = \text{Subgroup A estimate} / \text{Subgroup B estimate}$$

Ratio values are unitless. A ratio of 1 is interpreted as no inequality. In most cases, ratio is calculated as the highest subgroup estimate divided by the lowest subgroup estimate. This convention ensures the resulting ratio value is greater than 1, which tends to be easier to interpret than a ratio value of less than 1 (Box 20.1). Because ratio is a multiplicative measure, graphical presentation of results should adopt a logarithmic rather than a linear scale. On a logarithmic scale, axis values larger than 1 hold the same magnitude as their reciprocal counterparts smaller than 1 (e.g. 2 is equivalent to 0.5) and a baseline of 1 indicates no inequality.

Beyond simple ratio, relative difference is another way to describe pairwise relative inequalities (Box 20.2).

Selection of two subgroups

When using pairwise measures of inequality with dimensions comprised of more than two subgroups, different approaches may be taken to decide which two subgroups should be included, depending on the research question. Approaches include calculations based on the highest and lowest subgroup estimates (range difference and ratio), extreme subgroups (in the case of ordered dimensions of inequality), and subgroups with special significance (in the case of non-ordered dimensions of inequality).

Range difference and ratio

In general, the most basic approach to calculating difference and ratio uses the subgroups with the lowest and highest indicator estimates, such that difference (highest − lowest) and ratio (highest / lowest) produce values that are positive and above 1, respectively. This approach, which yields the range difference and range ratio, can be applied regardless of the number of subgroups and regardless of whether they are ordered or non-ordered. Drawing on an example from Indonesia, a comparison may be made between the subnational region with the highest coverage of skilled birth attendants versus the region with the lowest coverage, expressing the maximum extent of inequality between two regions (Figure 20.1 and Table 20.2). This captures the range difference and range ratio across the 34 subnational regions.

BOX 20.1. Deriving equivalent ratio values

Ratio values are calculated by dividing one subgroup estimate by another. Depending on how the calculation is set up, a situation of inequality will yield a value greater than 1 (if the higher estimate is divided by the lower estimate) or between 0 and 1 (if the lower estimate is divided by the higher estimate).

Generally, ratios greater than 1 are easier to interpret. Considering different estimates for hypothetical Subgroups A and B, Table 20.1 shows equivalent ratio values for the two possible calculations. In the first row, where the estimate in Subgroup A is 90% and the estimate in Subgroup B is 50%, a ratio value can be calculated as the highest estimate divided by the lowest estimate, resulting in a ratio of 1.8 (Ratio calculation 1). This calculation supports the finding that "coverage in Subgroup A is 1.8 times higher than in Subgroup B". If, instead, ratio is calculated as the estimate in Subgroup B divided by the estimate in Subgroup A, the resulting ratio equals 0.56 (Ratio calculation 2). The finding that "coverage in Subgroup B is 0.56 times coverage in Subgroup A" tends to be less intuitive to understand.

TABLE 20.1. Examples of equivalent ratio values for two possible ratio calculations

Subgroup A	Subgroup B	Ratio calculation 1 [Subgroup A / Subgroup B]	Ratio calculation 2 [Subgroup B / Subgroup A]
90	50	1.8	0.56
100	50	2.0	0.50
50	50	1.0	1.0

BOX 20.2. Relative difference

Relative difference expresses the difference between two subgroups as a percentage of the overall average or of the best-performing subgroup estimate. For example, the relative difference between two subgroups reporting 15% and 10% may be expressed as:

$$\frac{\textit{Subgroup A estimate} - \textit{Subgroup B estimate}}{\textit{Overall average}} = \frac{15\% - 10\%}{12.5\%} = 0.4\ (\textit{or}\ 40\%)$$

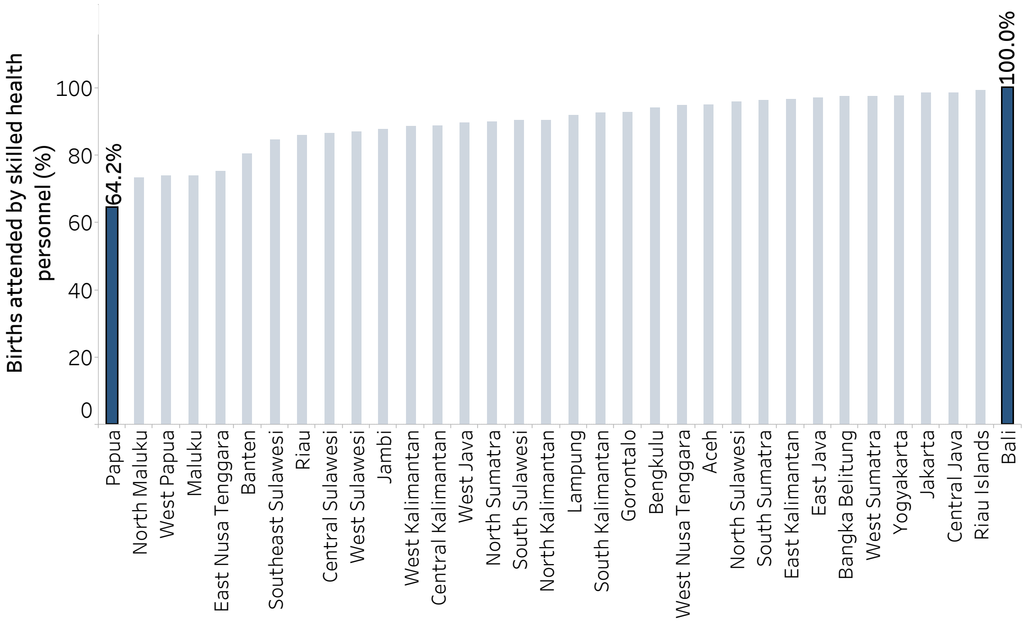
or

$$\frac{\textit{Subgroup A estimate} - \textit{Subgroup B estimate}}{\textit{Best-performing subgroup estimate}} = \frac{15\% - 10\%}{15\%} = 0.33\ (\textit{or}\ 33\%)$$

The interpretation of the first calculation is that the difference is 40% of the overall average. The interpretation of the second calculation is that the difference is 33% of the best-performing subgroup estimate.

For more on mathematical considerations for interpreting summary measures of inequality, see Chapter 22.

FIGURE 20.1. Births attended by skilled health personnel, by subnational region, Indonesia: subnational regions with highest and lowest indicator estimates



Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

TABLE 20.2. Calculation of range difference and range ratio: births attended by skilled health personnel, by subnational region, Indonesia

Highest estimate (%) [A]	Lowest estimate (%) [B]	Range difference [A – B]	Range ratio [A / B]
100.0	64.2	100.0 – 64.2 = 35.8 percentage points	100.0 / 64.2 = 1.56

The highest estimate was for Bali, and the lowest estimate was for Papua.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

There are several merits to the calculation of range difference and range ratio. The approach is easy to apply, and the calculations always provide results that are straightforward to interpret. It is an appropriate approach for research questions pertaining to the overall absolute or relative inequality between all subgroups. It is also fitting for preliminary comparisons across situations when it is not possible to identify two consistent subgroups (e.g. because the dimension is non-ordered or because subgroups are categorized differently between settings or over time).

There are, however, limitations for the use of range difference and ratio. The approach can make comparisons challenging, and it will not reflect the underlying directionality of inequality across situations. For example, when comparing inequalities between females and males, in one situation an indicator may be higher among males and in the other it may be higher among females – but using the range difference and range ratio would not differentiate this. Moreover, in cases of comparing inequality across dimensions with more than two subgroups (or over time in the same population), these measures may not always be based on the same two subgroups. Additionally, when there are multiple subgroups based on ordered dimensions of inequality, this approach does not necessarily include the subgroups that are at the top and bottom of the ordering. For example, in a scenario where health coverage is highest in the second-richest wealth quintile (quintile 4) and lowest in the second-poorest quintile (quintile 2), the calculation would not include the richest or poorest quintiles.

Ordered dimensions of inequality

For dimensions that have a natural ordering and have more than two subgroups, another approach is to compare between the subgroups at the extreme ends of a continuum. For example, wealth-related inequality would be calculated using the poorest and richest subgroups. In a case where education level is categorized as three subgroups, inequality would be calculated between the most and least educated (Table 20.3). This approach places importance on the social ordering, highlighting the situations in the most advantaged and most disadvantaged subgroups. When making comparisons, this approach ensures the same subgroups are used consistently, even if the estimates from the intermediate subgroups are higher or lower.

Non-ordered dimensions of inequality

For non-ordered dimensions of inequality, the calculation of range difference and range ratio is a common approach to selecting subgroups (see above). Alternatively, comparisons can be made between two subgroups that are of special interest. For example, pairwise comparisons could be made to show inequality between a subnational region of interest with the capital city. In Figure 20.2, the Indonesian capital city of Jakarta is highlighted as a possible reference point for a pairwise comparison. Difference and ratio could be calculated to show the inequality between Jakarta and a region of interest, such as Papua, the region with the lowest coverage (Table 20.4). For comparisons based on ethnicity, as another example, subgroups may be selected to calculate inequalities between the dominant ethnic group and minority groups of interest.

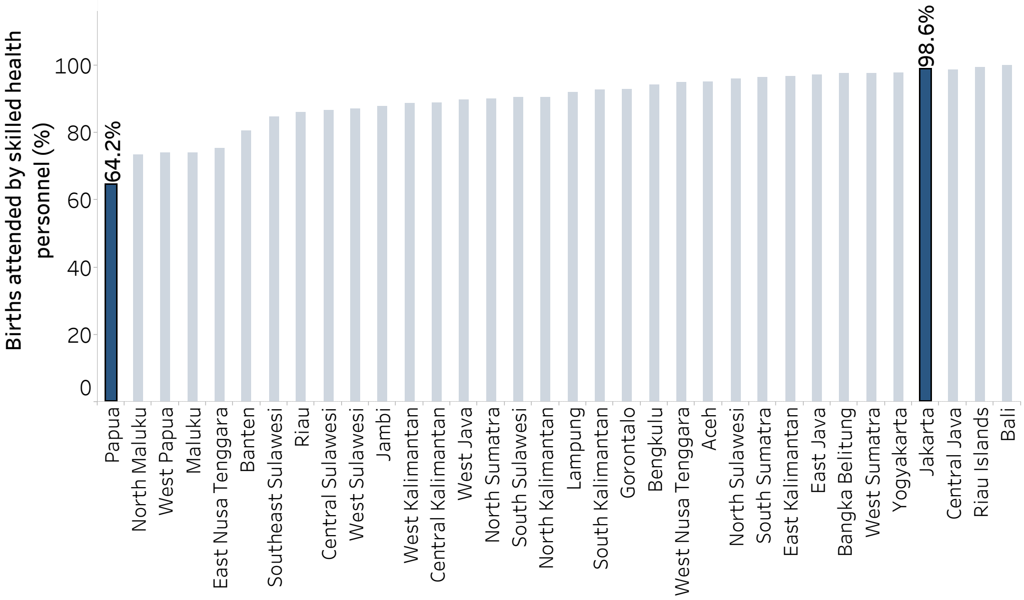
TABLE 20.3. Calculation of difference and ratio: births attended by skilled health personnel, by education level, Indonesia

Most educated subgroup estimate (%) [A]	Least educated subgroup estimate (%) [B]	Difference [A – B]	Ratio [A / B]
95.6	43.0	95.6 – 43.0 = 52.6 percentage points	95.6 / 43.0 = 2.22

Education is categorized as three subgroups: no education, primary education and secondary or higher education.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

FIGURE 20.2. **Births attended by skilled health personnel, by subnational region, Indonesia: subnational regions of special interest**



The capital city is Jakarta.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

TABLE 20.4. **Calculation of difference and ratio: births attended by skilled health personnel, by subnational region, Indonesia**

Capital city (Jakarta) estimate (%) [A]	Region of interest (Papua) estimate (%) [B]	Difference [A – B]	Ratio [A / B]
98.6	64.2	98.6 – 64.2 = 34.4 percentage points	98.6 / 64.2 = 1.54

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

Additional considerations

When using difference and ratio measures to make comparisons, a consistent configuration of the underlying calculations helps to identify outliers that have a different directionality of inequality. Accordingly, once the two subgroups are selected, there are two further considerations: the advantaged or disadvantaged nature of the subgroups, and the favourable or adverse nature of the health indicator.

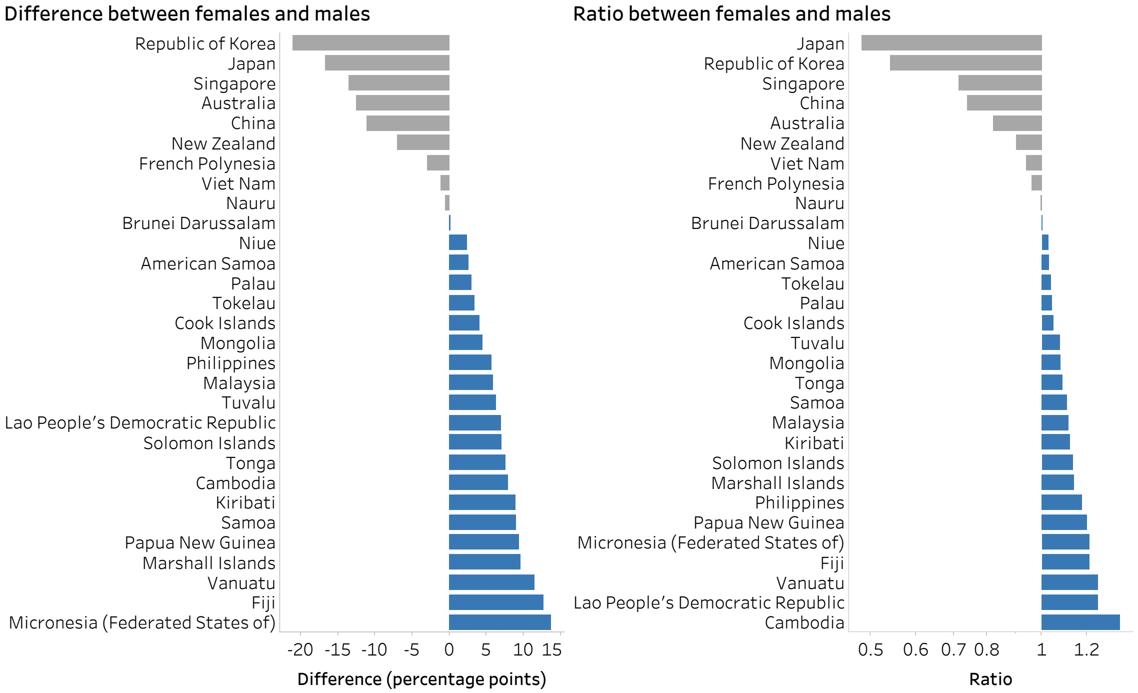
Why is it important to make these distinctions? As summary measures, difference and ratio each express inequality using a single number, and thus the directionality of inequality needs to be stated explicitly. The finding that one subgroup has a higher indicator estimate than another subgroup tells us nothing about whether the situation is better or worse in a particular subgroup. An understanding of whether subgroups are traditionally advantaged or disadvantaged and whether an indicator is favourable or adverse makes it possible to set up calculations that promote easier interpretation of results (i.e. most often yielding positive values for difference and ratio values greater than 1).

Advantaged versus disadvantaged subgroups

Where possible, subgroups should be identified on the basis of which are socially advantaged and which are socially disadvantaged (noting that this distinction is not always possible and may be context-specific). The determination of "advantaged" or "disadvantaged" can often be deduced from historic patterns of inequity that reflect how power and resources are distributed. For example, richer people tend to fare better than poorer people, more educated people tend to fare better than less educated people, and people in urban settings tend to fare better than people in rural settings. In other cases, the situation may be more variable and require consideration of the health topic or indicator.

In cases where it is not possible to logically assign subgroups as advantaged or disadvantaged, it is recommended to construct the calculations in a consistent manner. Figure 20.3 shows the sex-related inequality in overweight prevalence among adults in 30 countries and areas in the WHO Western

FIGURE 20.3. **Difference and ratio: overweight prevalence among adults (body mass index (BMI) ≥25, age-standardized), by sex, 30 countries and areas in the WHO Western Pacific Region**



Grey shading indicates higher prevalence among males. Blue shading indicates higher prevalence among females.

Source: derived from the WHO Health Inequality Data Repository Noncommunicable Diseases and Risk Factors dataset *(1)*, with data from 2022 sourced from the WHO Global Health Observatory.

Pacific Region. For all countries and areas, difference is calculated as the prevalence in females minus the prevalence in males, and ratio is calculated as the prevalence in females divided by the prevalence in males. From these figures, it is apparent that most countries and areas had higher overweight prevalence among females compared with males (positive difference values and ratio values above 1, highlighted in blue), although nine countries and areas had higher overweight prevalence among males (negative difference values and ratio values between 0 and 1, highlighted in grey).

Favourable versus adverse health indicators

Attention to the distinction between favourable versus adverse health indicators (sometimes termed the polarity of a health indicator) helps to ensure difference and ratio are calculated in a systematic manner that is intuitive to interpret. A favourable health indicator affirmatively measures a desired condition that is promoted through public health action, where the aim is to achieve a maximum level. An adverse (or unfavourable) indicator affirmatively measures an undesired condition that is detrimental to health. Public health actions aim to reduce or eliminate it. Although many health indicators can be broadly classified as favourable or adverse, certain indicators do not have an overriding positive or negative association with health and thus present a more nuanced situation. The interpretation of inequalities in such indicators is less straightforward and usually requires a benchmark or reference point. Box 20.3 illustrates examples of favourable, adverse and nuanced health indicators.

The distinction between favourable, adverse and nuanced health indicators is relevant to the calculation and interpretation of difference and ratio. Generally, for a given dimension of inequality, the calculation for favourable indicators is the opposite of the calculation for adverse indicators. Annex 12 details how difference and ratio calculations are constructed for favourable and adverse health indicators using different inequality dimensions and provides examples.

In some cases, disaggregated data may be expressed as either a favourable indicator (e.g. coverage) or an adverse indicator (e.g. non-coverage). For absolute

BOX 20.3. Examples of favourable, adverse and nuanced health indicators

Favourable health indicators have a positive relationship with health (i.e. higher values are generally regarded as better). For example, they may measure the use of essential services, healthy behaviours and attitudes, family and community connectedness, and positive health outcomes. Examples of favourable health indicators include births attended by skilled health personnel, HIV testing and receiving results, and life expectancy.

Adverse health indicators have an inverse relationship with health (i.e. lower values are generally regarded as better). These indicators include burden of disease, non-use of essential services, lack of knowledge, and unhealthy behaviours or attitudes. Examples of adverse indicators include mortality in children aged under five years, children with no doses of diphtheria, tetanus toxoid and pertussis (DTP) vaccine, and prevalence of tobacco use.

Nuanced health indicators do not have an overriding positive or negative association with health. The desired situation for those indicators is neither the maximum nor the minimum, but somewhere in between, depending on the context and population. Examples of nuanced indicators include fertility rate, births by caesarean section, and hospitalization rates.

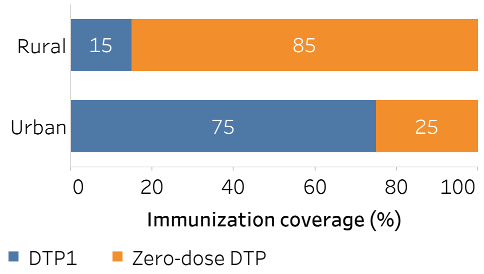
measures of inequality such as difference, the extent of inequality will remain consistent, regardless of whether the indicator is expressed as favourable or adverse, and thus the distinction is immaterial. For relative measures of inequality such as ratio, however, favourable and adverse indicators will yield different results (which are not simply a change of sign or inversion) (Box 20.4). Consequently, when calculating relative inequality, the distinction between favourable and adverse indicators matters, even for fundamentally the same health outcome *(2–4)*. For the sake of transparency, both adverse

BOX 20.4. Example of pairwise summary measure calculations based on equivalent favourable and adverse health indicators

To contrast pairwise measures based on the use of favourable and adverse indicators, an example was constructed using complementary indicators of immunization coverage and non-coverage among children aged one year in urban and rural areas. The indicator of immunization coverage is the receipt of (at least) one dose of DTP (DTP1), and the indicator of immunization non-coverage is the receipt of no doses of DTP (zero-dose DTP).

Figure 20.4 displays hypothetical indicator data, using the equivalent situations of coverage (a favourable indicator) and non-coverage (an adverse indicator).

FIGURE 20.4. **Immunization coverage with combined diphtheria, tetanus toxoid and pertussis vaccine (DTP1) and non-coverage (zero-dose DTP) in rural and urban areas**



The absolute difference remains constant (±60 percentage points) for both favourable and adverse indicators, regardless of how the calculation is constructed (Table 20.5).

TABLE 20.5. **Calculation of difference: immunization coverage with combined diphtheria, tetanus toxoid and pertussis vaccine (DTP1) and non-coverage (zero-dose DTP) in urban and rural areas**

Indicator	Calculation	Difference
DTP1	Urban – rural (75 – 15)	60 percentage points
	Rural – urban (15 – 75)	–60 percentage points
Zero-dose DTP	Rural – urban (85 – 25)	60 percentage points
	Urban – rural (25 – 85)	–60 percentage points

BOX 20.4. *continued*

The ratio values, however, are different based on the use of a favourable or adverse indicator (Table 20.6). Although these values are mathematically correlated, they may not be apparently distinct when communicating about inequalities.

TABLE 20.6. Calculation of ratio: immunization coverage with combined diphtheria, tetanus toxoid and pertussis vaccine (DTP1) and non-coverage (zero-dose DTP) in urban and rural areas

Indicator	Calculation	Ratio
DTP1	Urban – rural (75 / 15)	5.0
	Rural – urban (15 / 75)	0.20
Zero-dose DTP	Rural – urban (85 / 25)	3.4
	Urban – rural (25 / 85)	0.29

and favourable versions of indicators should be reported, if possible and when appropriate *(3)*. To facilitate comparisons of relative inequality across multiple health indicators, all indicators should be expressed consistently as either adverse or favourable indicators.

Strengths and limitations of pairwise summary measures

Difference and ratio tend to be straightforward to calculate, especially for binary dimensions of inequality. Although attention to the advantaged versus disadvantaged nature of the subgroups and favourable versus adverse nature of the health indicator is warranted, the interpretation of these measures is intuitive. The results can be communicated effectively through text, tables or graphs to a range of audiences with variable technical expertise.

There are two major limitations to pairwise summary measures of inequality. First, for dimensions of inequality categorized as more than two subgroups, difference and ratio ignore all but the two selected subgroups. For example, pairwise measures calculated using the most and least educated subgroups do not capture the situation in middle subgroups (Box 20.5). Similarly, pairwise measures calculated using the richest and poorest wealth quintiles do not account for quintiles 2, 3 and 4. For this reason, inspection of the underlying disaggregated data, including the middle or non-extreme subgroups, is important to get a sense of the overall patterns of inequality across all subgroups (see Chapter 18).

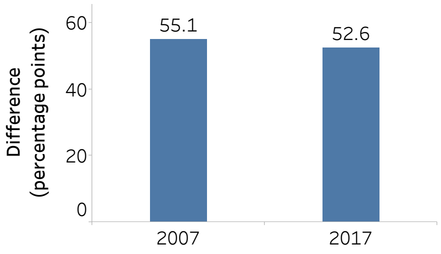
A second major limitation to difference and ratio is that the population size of the subgroups is not taken into account – that is, the measures are unweighted. As such, difference and ratio treat the subgroups as equivalent when conveying information about the extent and direction of inequality between them. There may, however, be cases where the size of one subgroup is considerably larger than the other, or where population shift occurs over time, whereby the respective population share of the two subgroups changes. Population size can be captured through the use of a weighted complex summary measure of inequality (see Chapter 21). For more information about the interpretation of summary measures, including a discussion of the interpretation of weighted versus unweighted measures, see Chapter 22.

BOX 20.5. Limitation of using difference to show education-related inequality across three subgroups

Figure 20.5 displays the difference in births attended by skilled health personnel, calculated as coverage in the most educated subgroup (secondary school or higher) minus coverage in the least educated subgroup (no education) for 2007 and 2017. Based on this calculation, we might conclude that inequality was almost unchanged, moving from 55.1 percentage points to 52.6 percentage points.

The calculation, however, ignores the situation in the subgroup with primary education. The accompanying disaggregated data demonstrate marked improvements in coverage in this subgroup, where coverage increased from 59.6% in 2007 to 81.5% in 2017 (Figure 20.6).

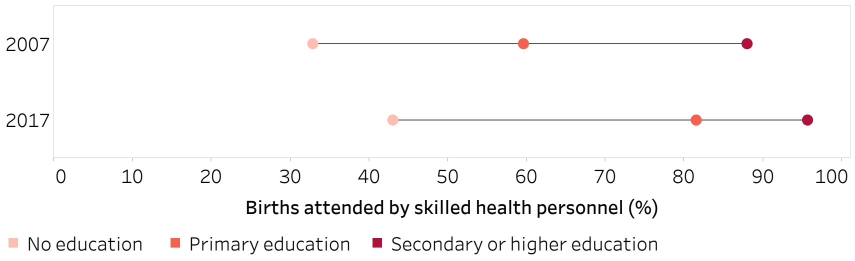
FIGURE 20.5. Difference: births attended by skilled health personnel, by education level, Indonesia



Education is categorized as three subgroups, and the difference is calculated as coverage in the most educated subgroup minus coverage in the least educated subgroup.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

FIGURE 20.6. Births attended by skilled health personnel, by education level, Indonesia



Horizontal lines show the range between the lowest and highest subgroup estimates.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

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21

Complex summary measures of health inequality

Overview

Complex summary measures of health inequality are calculated using information on all subgroups of a population. They are termed “complex” not because they are overly complicated but because, in contrast to pairwise measures, their calculation accounts for complexities in the underlying disaggregated data. They can be applied to dimensions of inequality comprised of more than two subgroups that are ordered or non-ordered; they may measure absolute or relative inequality; they may be weighted or unweighted; and they may incorporate reference points (see Chapter 19). Similarly to pairwise summary measures, the calculation and interpretation of some complex measures may vary depending on whether the health indicator is favourable or adverse (see Chapter 20).

Having a good understanding of the characteristics of different summary measures and the underlying data requirements is essential to select suitable measures for the inequality analysis and accurately interpret and present results. The objective of this chapter is to describe several complex summary measures and provide detailed information about the calculation and interpretation of selected measures. Where applicable, it features both absolute and relative versions of measures. In these cases, a key difference between the relative and absolute versions of summary measures is that the relative versions normalize the difference in health by the population mean (i.e. the mean is in the denominator), whereas the absolute versions do not.

The calculation of many of the summary measures discussed in this chapter involves the use of the setting average, which is defined as the overall indicator average for the setting of interest. If the disaggregated data are at the national level, then this is the national average; if the disaggregated data pertain to a specific subnational region, then this is the average for that region.

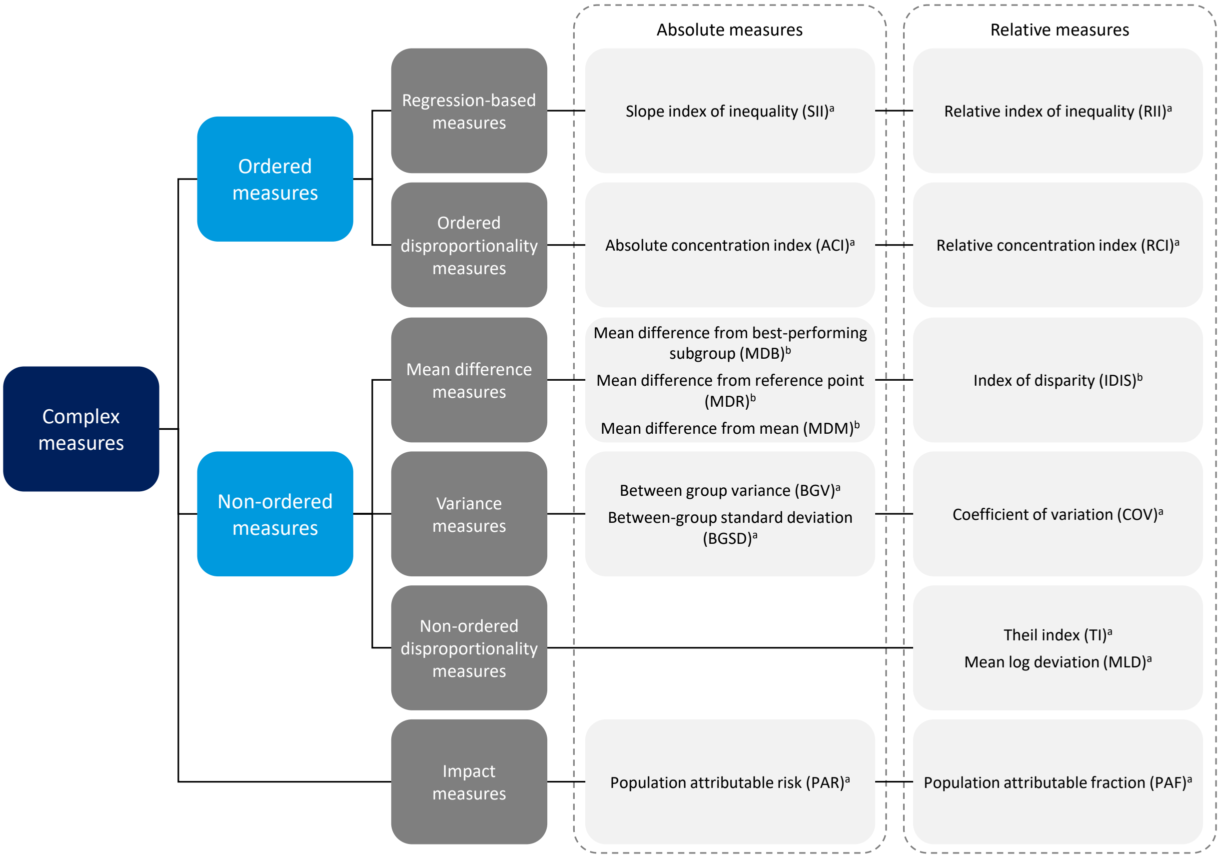
The summary measures discussed in this chapter are shown using disaggregated data for subgroups, although many can also be calculated using individual data. The calculation of inequality measures using individual data is addressed in Chapter 25.

Initial considerations

The two main types of complex measures are ordered measures (appropriate for use with ordered dimensions of inequality such as education) and non-ordered measures (appropriate for use with non-ordered dimensions such as subnational region). A third type – impact measures – can be calculated for both ordered and non-ordered dimensions, and for binary dimensions (e.g. rural or urban place of residence). Figure 21.1 provides an overview of the complex summary measures of inequality covered in this chapter, noting that pairwise measures are addressed in Chapter 20. Key characteristics of summary measures are summarized in Annex 11. Software applications, statistical codes and additional readings are available to facilitate the calculation of complex summary measures (Box 21.1).

The following sections detail several complex summary measures, accompanied by examples pertaining to maternal and child health in Indonesia. The main text of the chapter highlights education- and subnational-related inequality because this demonstrates how certain complex summary measures can be applied to account for the population share of each subgroup. Annex 13 contains a comprehensive example of the application of summary measures in an expanded selection of maternal and child health indicators and dimensions of inequality in Indonesia.

FIGURE 21.1. Overview of complex summary measures of health inequality



[a] Weighted measure.
[b] Weighted or unweighted measure.
Pairwise measures of inequality (see Chapter 20) are not included in this figure.

BOX 21.1. Tools and resources to facilitate calculation of complex summary measures of health inequality

The WHO Health Equity Assessment Toolkit (HEAT and HEAT Plus) is a specialized software application that facilitates the assessment of health inequalities and calculates a range of summary measures based on disaggregated data *(1, 2)*. HEAT, Built-in Database Edition, comes with preinstalled datasets consisting of all disaggregated data in the WHO Health Inequality Data Repository *(1)*. HEAT Plus, Upload Database Edition, enables users to upload and work with their own databases of disaggregated data. Both HEAT and HEAT Plus automatically calculate suitable summary measures based on the underlying disaggregated data. The software also uses data visualizations to show summary measures, enabling users to assess the change in inequality over time and compare inequality across indicators and settings.

Statistical codes for the calculation of summary measures (and their 95% confidence intervals, where possible) using Excel, Stata and R are available via the WHO Health Inequality Monitor *(3)*. Two Excel resources are available: a step-by-step workbook that takes users through the calculation of summary measures, and an automated workbook that calculates these measures for a user-inputted dataset. (Note that the automated workbook is designed to support small datasets. For datasets containing more than 200 rows of data, R or Stata is recommended.) Stata resources include do-files for each summary measure, a step-by-step guide, and an ado command "healthequal" that calculates measures using a disaggregated dataset. An R package, "healthequal", also calculates summary measures using a disaggregated dataset and is accompanied by supporting documentation.

A review article overviews existing summary measures of health inequality, including their definition, calculation, interpretation and application. It also discusses their respective strengths and weaknesses *(4)*.

An article demonstrates the application of statistical codes in R and Stata to assess the state of inequality in childhood immunization indicators in low- and middle-income countries *(5)*.

The HEAT and HEAT Plus technical notes provide information about the data presented in the software, including a general introduction to the summary measures calculated in HEAT and HEAT Plus *(1)*.

Additional guidance for the calculation of concentration index and slope index of inequality is available from the International Center for Equity in Health *(6)*.

Summary measures based on ordered inequality dimensions

Ordered summary measures, which are calculated for inequality dimensions where subgroups have an inherent ordering, such as economic status or education, include regression-based measures (slope index of inequality (SII) and relative index of inequality (RII)) and disproportionality measures (absolute concentration index (ACI) and relative concentration index (RCI)) (Box 21.2). These measures are weighted by population size and have absolute and relative versions. Regression-based measures consider the situation in all population subgroups using an appropriate regression model. Disproportionality measures indicate the extent to which the distribution of health differs from a hypothetical line of equality – that is, the extent to which an indicator is concentrated among disadvantaged or advantaged subgroups.

Regression-based measures

Regression-based complex summary measures of inequality include SII (an absolute measure) and RII (a relative measure). These measures are based on the association between the subgroup's relative position and their corresponding health indicator

BOX 21.2. Relationship between regression-based indices of inequality and concentration indices

Sometimes different disciplines apply similar methods using different names to describe variations in measures. This is the case for regression-based indices and concentration indices measuring inequality because there is a close mathematical correspondence between the two sets of measures. Public health scientists tend to favour regression-based indices of inequality because they have a more intuitive measurement unit and interpretation for public health purposes, but economists often prefer concentration indices.

For example, ACI and SII are both measured using the unit of the health indicator, such as percentage points. SII may have a more intuitive interpretation because it is the percentage point difference between the most advantaged and most disadvantaged subgroups. The value of ACI indicates the degree of concentration away from the mean, and therefore the unit of measurement is less important.

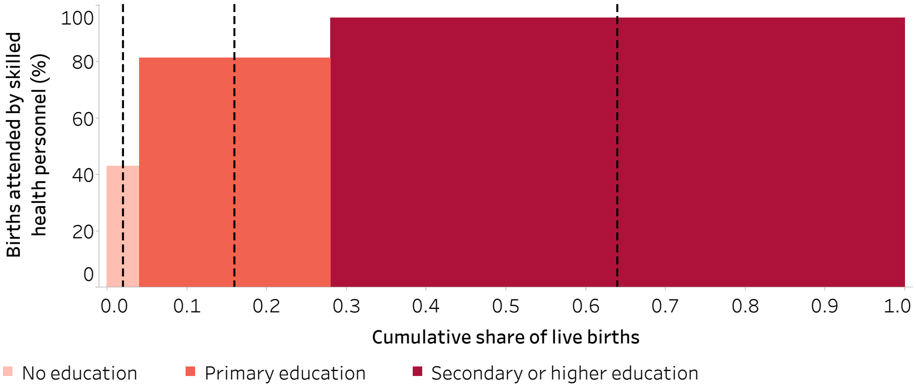
status: each step up with regard to the ordered dimension of inequality results in a gain or loss in terms of the health indicator *(7)*.

For both measures, a weighted sample of the whole population is ranked from the most disadvantaged subgroup (at rank 0) to the most advantaged subgroup (at rank 1). This ranking is weighted, accounting for the proportional distribution of the population within each subgroup. The population of each subgroup is then considered in terms of its range in the cumulative population distribution, and the midpoint of this range, also known as the relative or fractional rank. The relative rank is calculated as:

$$X_j = \sum_{i=1}^{j} p_i - 0.5(p_j)$$

The relative rank is visualized in Figure 21.2. The value of the indicator of interest is regressed against this midpoint value for each subgroup using an appropriate regression model (Box 21.3), and the predicted values of the indicator are calculated for the two extremes (rank 1 and rank 0).

FIGURE 21.2. Cumulative share of live births (relative rank) across subgroups: births attended by skilled health personnel, by education level, Indonesia



The dashed black vertical lines indicate the midpoint of the range of the cumulative population share (relative rank) for each education subgroup.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

BOX 21.3. Selection of regression models

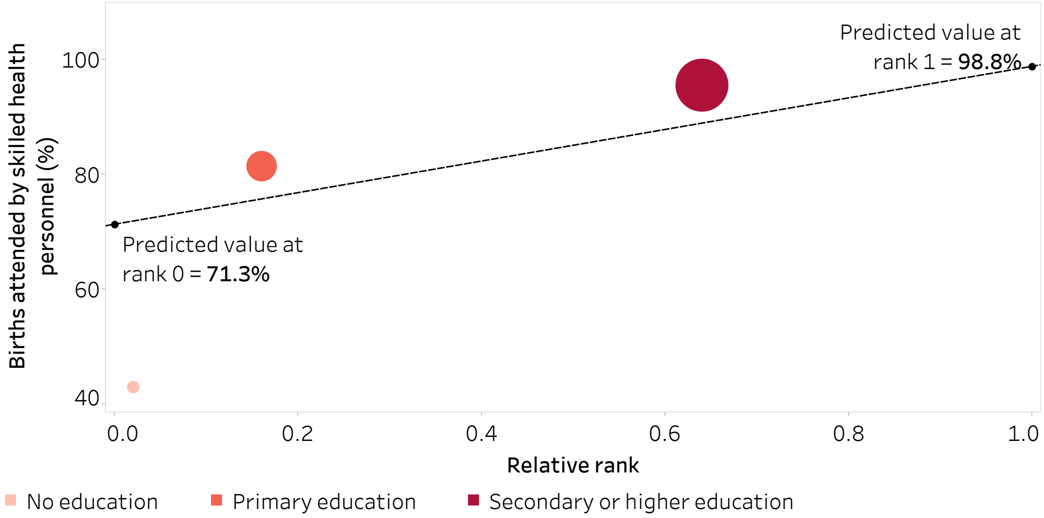
Regression-based summary measures of health inequality make use of an appropriate regression model. The indicator value for each subgroup is regressed against the subgroup's relative (or fractional) rank. Because the data are grouped (by subgroup), each observation needs to be weighted by the subgroup's population size. The indicator values can be scaled to a 0–1 scale (i.e. all values falling between 0 and 1). A linear regression model could be used, but this has the limitation that it assumes a linear relationship between the health indicator and the subgroup relative rank (which is not always the case) and can result in estimated values outside of a 0–1 or 0–100% interval since there are no lower and upper limits (which is inaccurate for some indicators, particularly those measured as percentages). Using logistic regression can sometimes solve these problems. In logistic regression, the relationship between the health indicator and the subgroup rank is not assumed to be linear and, due to a logit transformation of the health indicator (i.e. a logit link), the estimated values from the regression model will be bounded between 0 and 1.

Figure 21.3 visualizes the calculation of regression-based measures to assess education-related inequality in births attended by skilled health personnel in Indonesia in 2017. Table 21.1 illustrates the steps for arriving at the *x*-axis and *y*-axis values for the three education subgroups shown in Figure 21.3 (shaded in the table).

Slope index of inequality

SII is an absolute measure of inequality that represents the difference in predicted values of an indicator between the most advantaged and most disadvantaged subgroups, obtained by fitting a regression model (see above). It is calculated as the difference between the predicted values

FIGURE 21.3. **Calculation of regression-based measures: births attended by skilled health personnel, by education level, Indonesia**



The size of the data points on the graph reflects the population share of live births of the education subgroups. The graph represents a simplified use of a linear regression model, while a log transformation is used in the calculations in the text.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

at rank 1 ($\hat{v}_1$) and rank 0 ($\hat{v}_0$) (covering the entire distribution):

$$SII = \hat{v}_1 - \hat{v}_0$$

In the example in Figure 21.3, SII is calculated as:

98.8 – 71.3 = 27.5 percentage points

There was a difference of 27.5 percentage points in the proportion of births attended by skilled health personnel between the most and least educated subgroups.

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If there is no inequality, SII takes the value of 0. Greater absolute values indicate higher levels of inequality. Positive values indicate that the level of the indicator is higher among advantaged subgroups, while negative values indicate that the level of the indicator is higher among disadvantaged subgroups (Figure 21.4). Note that this results in different interpretations for favourable and adverse indicators.

Relative index of inequality

RII uses similar logic as SII, but on a relative scale. RII represents the ratio between the predicted values of an indicator between the most advantaged and most disadvantaged subgroups derived from the regression model. It is calculated as the ratio of the predicted values at rank 1 ($\hat{v}_1$) and rank 0 ($\hat{v}_0$):

$$RII = \hat{v}_1 / \hat{v}_0$$

In the example in Figure 21.3, RII is calculated as:

98.8 / 71.3 = 1.4

The proportion of births attended by skilled health personnel was 1.4 times higher in the most educated subgroup compared with the least educated subgroup.

• • • • • • •

The approach to calculating RII presented here is sometimes called the Kunst–Mackenbach relative index. There are also other approaches to calculating this measure *(8, 9)*.

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RII takes only positive values. If there is no inequality, RII has the value of 1. Values larger than 1 indicate the level of the indicator is higher among advantaged subgroups, and values lower than 1 indicate the level of the indicator is higher among disadvantaged subgroups (Figure 21.5). Like SII, interpretation differs

TABLE 21.1. Preliminary steps to calculate regression-based measures: births attended by skilled health personnel, by education level, Indonesia

	Live births					Proportion of births attended by skilled health personnel
Education level	Number [A]	Population share [C = A / B]	Cumulative population share [D]	Range of cumulative population share	Midpoint of range (relative rank) [X = D – (0.5 × C)]	Estimate (%) [Y]
No education	111	0.011	0.011	0.000–0.011	0.006	43.0
Primary education	2479	0.245	0.256	0.011–0.256	0.134	81.5
Secondary or higher education	7515	0.744	1.000	0.256–1.000	0.628	95.6
Total	*10 105 [B]*	*1.000*				

The shaded columns indicate the data points plotted on Figure 21.3.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

for favourable and adverse indicators. Regardless of the indicator type, the further the value of RII from 1, the higher the level of inequality.

RII is a multiplicative measure and therefore results should be displayed on a logarithmic scale. Values larger than 1 are equivalent in magnitude to their reciprocal values smaller than 1 (e.g. a value of 2 is equivalent in magnitude to a value of 0.5). See Chapter 23 for more about reporting summary measures of inequality.

FIGURE 21.4. Interpreting the results of the slope index of inequality

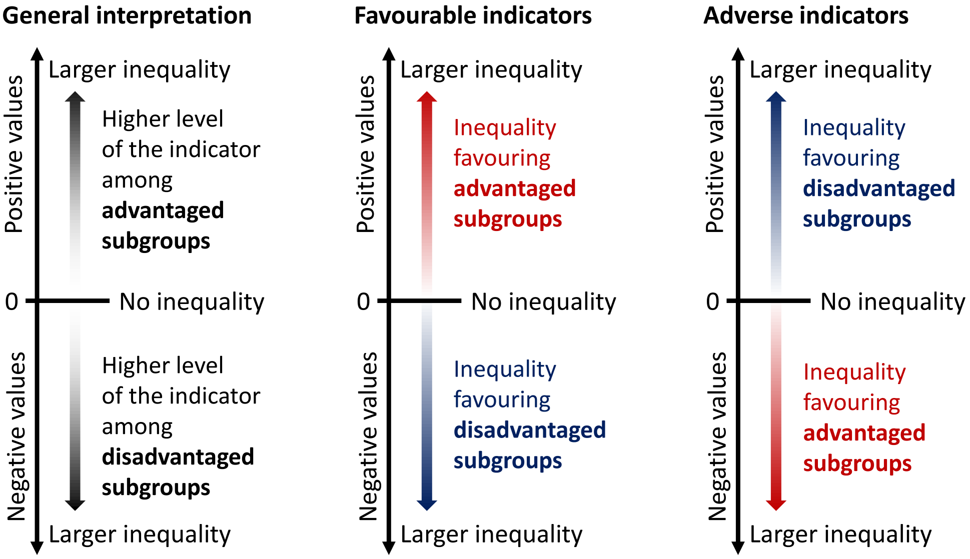
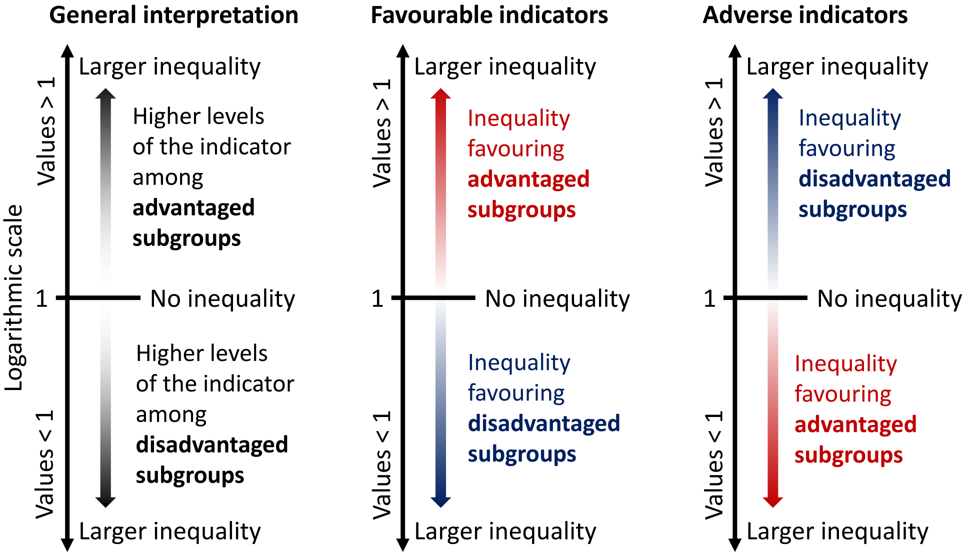


FIGURE 21.5. Interpreting the results of the relative index of inequality



Ordered disproportionality measures

Ordered disproportionality measures include ACI and RCI. These measures have an implied reference group of the general population because they express the burden or excess level of health indicator in subgroups relative to a reference equal distribution across the population *(7, 10)*.

This section presents a general approach to calculating ACI and RCI. Box 21.4 describes an alternative method of calculating ACI and RCI using a regression model, as well as additional technical issues that warrant consideration.

The calculation of the concentration indices can be shown using a concentration curve. To plot the

BOX 21.4. Alternative approaches and additional considerations for calculating concentration indices

The ACI and RCI can also be calculated as the covariance between the health indicator and the relative rank. For example, the calculation of RCI can be expressed as:

$$RCI = \frac{2cov(y_j, X_j)}{\mu}$$

where y_j is the health estimate for Subgroup j, X_j is the relative rank of Subgroup j, μ is the setting average, and *cov* is the covariance between the health estimate and the relative rank.

Since the slope coefficient of a simple least squares regression is the covariance divided by the variance of the regressor, ACI and RCI can also be obtained from a regression of the health indicator estimates against the relative rank.

Technical issues related to concentration indices

Several issues related to the calculation of concentration indices have been highlighted in academic literature and technical papers. These include considerations related to the measurement scale of outcomes, bounded outcomes, and weights across the relative ranking variable. Such factors affect the magnitude of the index, with implications for comparisons across countries or over time. When health variables are not on a fixed scale (i.e. a measurement scale that has 0 corresponding to a situation of complete absence), or when variables are bounded and have a finite upper limit (e.g. years in school, health utility index or any binary indicator), modified versions of ACI and RCI may be needed.

The following resources contain detailed discussions of these issues:

Erreygers G. Correcting the concentration index. J Health Econ. 2009;28(2):504–515. doi:10.1016/j.jhealeco.2008.02.003.

Erreygers G, Van Ourti T. Measuring socioeconomic inequality in health, health care and health financing by means of rank-dependent indices: a recipe for good practice. J Health Econ. 2011;30(4):685–694. doi:10.1016/j.jhealeco.2011.04.004.

Kjellsson G, Gerdtham U. On correcting the concentration index for binary variables. J Health Econ. 2013;32(3):659–670. doi:10.1016/j.jhealeco.2012.10.012.

O'Donnell O, Van Doorslaer DE, Wagstaff A, Lindelow M. Analyzing health equity using household survey data: a guide to techniques and their implementation. Washington, DC: World Bank; 2008 (https://openknowledge.worldbank.org/entities/publication/8c581d2b-ea86-56f4-8e9d-fbde5419bc2a, accessed 9 August 2024).

Wagstaff A. The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality. Health Econ. 2005;14(4):429–432. doi:10.1002/hec.953.

Wagstaff A. The concentration index of a binary outcome revisited. Health Econ. 2011;20(10):1155–1160. doi:10.1002/hec.1752.

concentration curve, the cumulative proportion of the population ranked by the ordered social category (the cumulative population share) is plotted on the *x*-axis and the cumulative proportion of the health indicator (the cumulative health share) is plotted on the *y*-axis. In a situation where there is no systematic difference in health according to the inequality dimension, the concentration curve would run along the 45-degree diagonal line. The further away from the line, the greater the inequality in health.

Returning to the example from Indonesia, Table 21.2 illustrates the step-by-step calculations that yield the two components (shaded in the table) required for the visual display of the concentration curve (Figure 21.6). An additional example is provided in Figure 21.7 to visualize concentration curves using wealth deciles (which tend to yield a smoother concentration curve than inequality dimensions categorized as fewer subgroups) and both adverse and favourable indicators (to show the concentration curve in different directions).

The interpretation of ordered disproportionality measures reflects the distribution of health according to the inherent ordering of the inequality dimension (e.g. a queuing pattern across wealth quintiles, as described in Chapter 18). As a result, if the level of health does not follow the subgroup ordering, the measures might suggest minimal or low inequality.

Absolute concentration index

ACI is calculated as twice the area between the hypothetical line of equality and the concentration curve. ACI can be calculated as:

$$ACI = \sum_j p_j (2X_j - 1)\, y_j$$

where y_j indicates the health estimate for Subgroup j, p_j is the population share of Subgroup j, and X_j is the relative rank of Subgroup j (see *Regression-based measures* above for the definition and calculation of the relative rank).

In the example in Table 21.2, ACI is calculated as the total of the values in the right-most column = 3.1 percentage points.

This result indicates a concentration of skilled birth attendance among mothers with higher education.

If there is no inequality, ACI takes the value of 0. Positive values indicate a concentration of the indicator among advantaged subgroups, and negative values indicate a concentration of the indicator among disadvantaged subgroups (Figure 21.8). Greater absolute values of ACI describe higher levels of inequality.

Relative concentration index

RCI is the relative counterpart to ACI, showing the gradient across population subgroups on a relative scale. RCI is calculated by dividing ACI by the setting average μ. For the sake of interpretability, it can then be multiplied by 100:

$$RCI = \frac{ACI}{\mu} \times 100$$

In the example in Table 21.2, RCI is calculated as ACI divided by the national average and multiplied by 100:

$$3.1 / 91.6 \times 100 = 3.4$$

This result indicates a concentration of skilled birth attendance among mothers with higher education.

RCI is bounded between −1 and +1 (note, however, that if multiplied by 100 in the calculation, the range is −100 to +100). If there is no inequality, RCI equals 0. Larger absolute values of RCI indicate higher levels of inequality. Positive values indicate a concentration of the indicator among advantaged subgroups, and negative values indicate a concentration of the indicator among disadvantaged subgroups (Figure 21.9).

TABLE 21.2. Steps to visualize the concentration curve and calculate the concentration indices: births attended by skilled health personnel, by education level, Indonesia

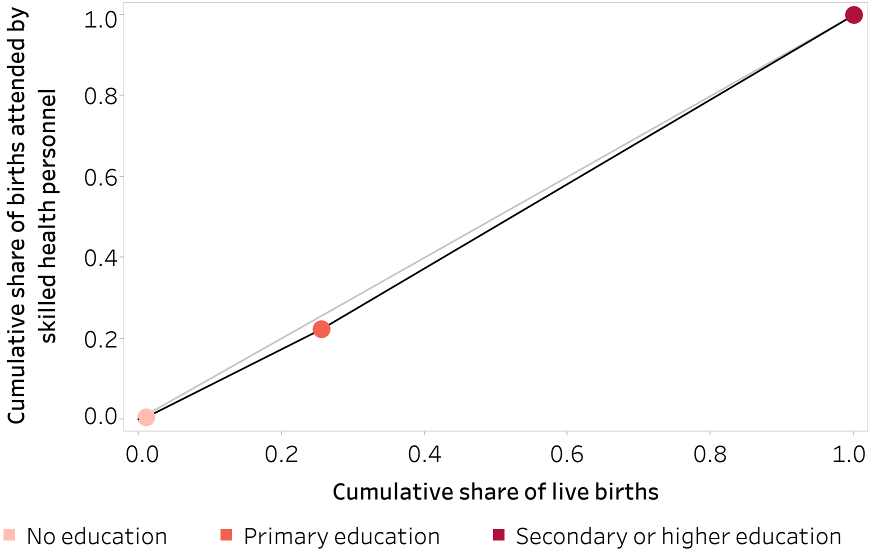
	Live births					Births attended by skilled health personnel			Proportion of births attended by skilled health personnel	Concentration indices calculations
Education level	Number [A]	Population share [C = A / B]	Cumulative population share [D]	Range of cumulative population share	Midpoint of range (relative rank) [X = D − (0.5 × C)]	Number [E]	Health indicator share [G = E / F]	Cumulative health share [Y]	Estimate (%) [H]	[J = C × (2 × X − 1) × H]
No education	111	0.011	0.011	0.000–0.011	0.006	48	0.005	0.005	43.0	−0.5
Primary education	2479	0.245	0.256	0.011–0.256	0.134	2020	0.218	0.223	81.5	−14.6
Secondary or higher education	7515	0.744	1.000	0.256–1.000	0.628	7187	0.777	1.000	95.6	18.2
Total	*10 105 [B]*	*1.000*				*9255 [F]*	*1.000*			*ACI = 3.1 percentage points*
									National average = 91.6 [I]	RCI = [ACI / I × 100] = 3.4

ACI, absolute concentration index; RCI, relative concentration index.

The shaded columns indicate the data points plotted on the concentration curve in Figure 21.6.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

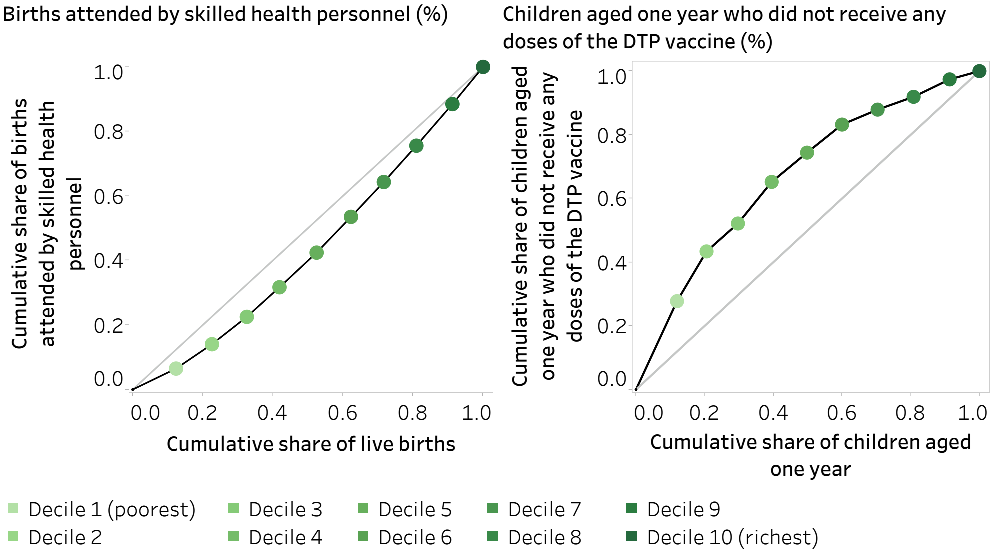
FIGURE 21.6. Concentration curve visualizing the calculation of disproportionality measures: births attended by skilled health personnel, by education level, Indonesia



The grey lines shows the hypothetical line of equality. The black line is the concentration curve.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

FIGURE 21.7. Concentration curves visualizing the calculation of disproportionality measures: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by economic status, Indonesia



The grey lines show the hypothetical lines of equality. The black lines are the concentration curves.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 Demographic and Health Surveys. Data are based on three years prior to the survey.

FIGURE 21.8. Interpreting the results of the absolute concentration index

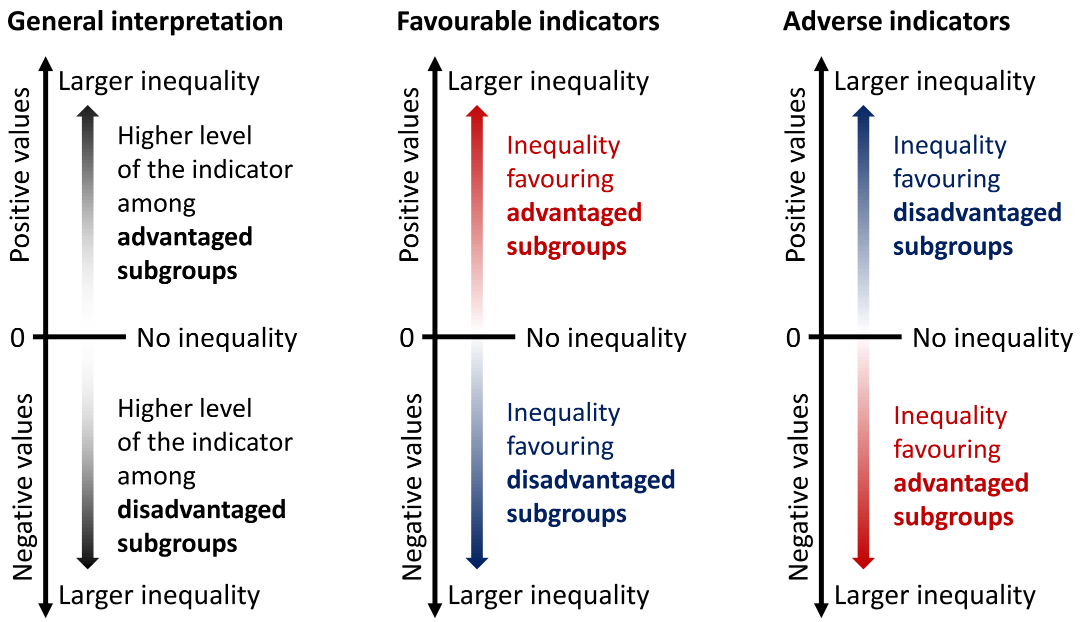
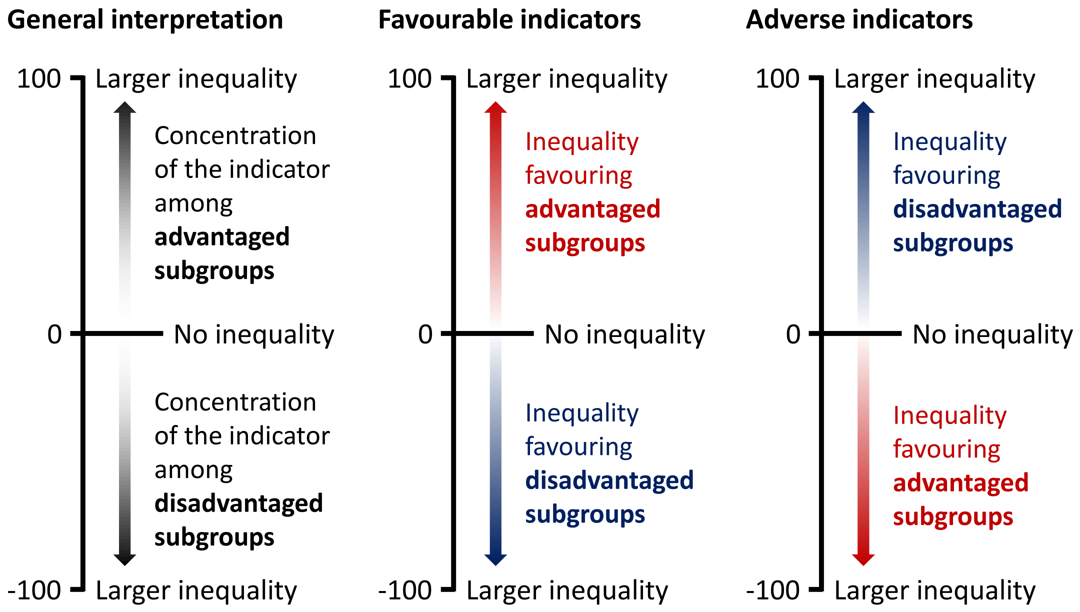


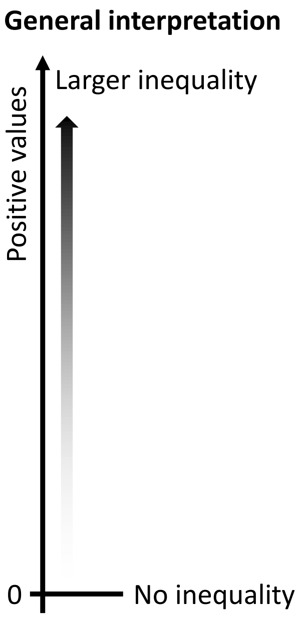
FIGURE 21.9. Interpreting the results of the relative concentration index



Summary measures based on non-ordered inequality dimensions

Non-ordered summary measures can be calculated for dimensions with subgroups that do not have a natural ordering, such as subnational regions. There are two main groups of non-ordered measures: mean difference and variance measures, and disproportionality measures. The interpretation is the same for all measures (Figure 21.10). Non-ordered summary measures take only positive values, with larger values indicating higher levels of inequality. The measures equal 0 if there is no inequality.

FIGURE 21.10. Interpreting the results of non-ordered summary measures



Mean difference and variance measures

Mean difference and variance measures quantify how much subgroup values tend to spread out (or deviate) from the overall average or another reference point. Mean difference measures answer questions such as the following:

- Mean difference from best-performing subgroup (MDB): how much, on average, does the level of the health indicator in the subgroups fall short of the best-performing subgroup?
- Mean difference from reference point (MDR): how much, on average, does the level of the health indicator in the subgroups differ from a defined reference subgroup or target?
- Mean difference from mean (MDM): how much, on average, does the level of the health indicator in the subgroups differ from the population average?
- Index of disparity (IDIS): by what proportion does the level of health indicator in the subgroups differ from the population average?

If making comparisons between mean difference measures over time, the stability of the reference group value may be a consideration. A best-performing subgroup may change over time (especially if it is one of several subnational regions, for example), but the use of the population average, the best 5–10% performing subgroups or a predefined target would likely provide a more stable reference point over time.

Variance measures summarize the squared differences of each subgroup estimate from the setting average (such as the national average). Variance measures include between-group variance (BGV), between-group standard deviation (BGSD) and the coefficient of variation (COV). Compared with mean difference measures, variance measures are more sensitive to outlier estimates because they give more influence to estimates that are further from the setting average.

Mean difference measures

Table 21.3 contains an example dataset used to illustrate the calculation of mean difference measures. All mean difference measures can be calculated as unweighted or weighted measures. For the unweighted version, all subgroups are weighted equally. For the weighted version, subgroups are weighted according to their population share. For comparisons over time, consider that the reference points (i.e. the value of the best-performing subgroup, the reference subgroup, or the population average) are subject to shift. In the case of MDB, the subgroup that performs best may also fluctuate. MDM and IDIS are calculated using the absolute differences between the subgroup estimate and overall average, and therefore they provide more insight into the extent of inequality than its directionality (noting that the directionality of MDB is necessarily constant). The calculations are detailed in the following text.

Mean difference from best-performing subgroup

MDB is an absolute measure of inequality that shows the mean difference between each population subgroup and the best performing subgroup (i.e. the subgroup with the highest value in the case of favourable health indicators and the subgroup with the lowest value in the case of adverse health indicators). MDB can be calculated as an unweighted or weighted measure.

The unweighted version (MDBU) is calculated as the sum of absolute differences between the subgroup estimates y_j and the estimate for the best-performing subgroup y_{best}, divided by the number of subgroups n:

$$MDBU = \frac{1}{n} \times \sum_j |y_j - y_{best}|$$

In the example in Table 21.3, MDBU is calculated as the sum of the unweighted differences (I) divided by the number of regions (n):

351.1 / 34 = 10.3 percentage points

On average, the proportion of births attended by skilled health personnel in regions differed from the best-performing subgroup (Bali) by 10.3 percentage points (when unweighted).

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The weighted version (MDBW) is calculated as the weighted sum of absolute differences between the subgroup estimates y_j and the estimate for the best-performing subgroup y_{best}. Absolute differences are weighted by each subgroup's population share p_j:

$$MDBW = \sum_j p_j |y_j - y_{best}|$$

where y_{best} is the subgroup with the highest estimate in the case of favourable indicators and the subgroup with the lowest estimate in the case of adverse indicators.

In the example in Table 21.3, MDBW is calculated as the sum of weighted differences (total of column J) = 8.4 percentage points.

On average, the proportion of births attended by skilled health personnel in regions differed from the best performing subgroup (Bali) by 8.4 percentage points (when weighted).

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Mean difference from reference point

MDR is an absolute measure of inequality that shows the mean difference between each population subgroup and a defined reference subgroup (e.g. the capital city or region for data disaggregated by subnational regions) or target. MDR can be calculated as an unweighted or weighted measure.

The unweighted version (MDRU) is calculated as the sum of absolute differences between the subgroup estimates y_j and the estimate for the reference point y_{ref}, divided by the number of subgroups n:

$$MDRU = \frac{1}{n} \times \sum_j |y_j - y_{ref}|$$

In the example in Table 21.3, MDRU is calculated as the sum of the unweighted differences (L) divided by the number of regions (n):

306.6 / 34 = 9.0 percentage points

On average, the proportion of births attended by skilled health personnel in regions differed from the reference subgroup (Jakarta) by 9.0 percentage points (when unweighted).

* * *

The weighted version (MDRW) is calculated as the weighted average of absolute differences between the subgroup estimates y_j and the estimate for the reference point y_{ref}. Absolute differences are weighted by each subgroup's population share p_j:

$$MDRW = \sum_j p_j |y_j - y_{ref}|$$

In the example in Table 21.3, MDRW is calculated as the sum of weighted differences (total of column M) = 7.0 percentage points.

On average, the proportion of births attended by skilled health personnel in regions differed from the reference subgroup (Jakarta) by 7.0 percentage points (when weighted).

* * *

Mean difference from mean

MDM is an absolute measure of inequality that shows the mean difference between each subgroup and the mean (e.g. the national average). MDM can be calculated as an unweighted or weighted measure.

The unweighted version (MDMU) is calculated as the sum of the absolute differences between the subgroup estimates y_j and the setting average μ, divided by the number of subgroups n:

$$MDMU = \frac{1}{n} \times \sum_j |y_j - \mu|$$

In the example in Table 21.3, MDMU is calculated as the sum of unweighted differences (O) divided by the number of regions (n):

224.9 / 34 = 6.6 percentage points

On average, the proportion of births attended by skilled health personnel in regions differed from the national average by 6.6 percentage points (when unweighted).

* * *

The weighted version (MDMW) is calculated as the weighted average of absolute differences between the subgroup estimates y_j and the setting average μ. Absolute differences are weighted by each subgroup's population share p_j:

$$MDMW = \sum_j p_j |y_j - \mu|$$

In the example in Table 21.3, MDMW is calculated as the sum of the weighted differences (total of Column P) = 5.3 percentage points.

On average, the proportion of births attended by skilled health personnel in regions differed from the national average by 5.3 percentage points (when weighted).

* * *

Index of disparity

IDIS is the relative version of MDM, showing the mean difference between each subgroup and the setting average, on a relative scale. IDIS can be calculated as an unweighted or weighted measure.

The unweighted version (IDISU) is calculated by dividing MDMU by the setting average μ and multiplying the fraction by 100:

$$IDISU = \frac{MDMU}{\mu} \times 100$$

In the example in Table 21.3, IDISU is calculated as MDMU divided by the national average (D) multiplied by 100:

$6.6 / 91.6 \times 100 = 7.2\%$

On average, the proportion of births attended by skilled health personnel in regions differed from the national average by 7.2% (when unweighted).

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The weighted version (IDISW) is calculated by dividing MDMW by the setting average μ and multiplying the fraction by 100:

$$IDISW = \frac{MDMW}{\mu} \times 100$$

In the example in Table 21.3, IDISW is calculated as MDMW divided by the national average multiplied by 100:

$5.3 / 91.6 \times 100 = 5.8\%$

On average, the proportion of births attended by skilled health personnel in regions differed from the national average by 5.8% (when weighted).

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Variance measures

Variance measures are indicative of uncertainty of an estimate produced from a dataset. More specifically, they capture the level of dispersion of a distribution, meaning the extent to which observation values (or data points) are likely to vary from an average value, and thus from every other observation value in the data set. Table 21.4 contains an example dataset used to illustrate the calculation of variance measures. The calculations are detailed in the following text.

Between-group variance

BGV is an absolute measure of inequality that considers all population subgroups. Subgroups are weighted according to their population share. BGV is reported as the squared unit of the health indicator. BGV is calculated as the weighted average of squared differences between the subgroup estimates y_j and the setting average μ. Squared differences are weighted by each subgroup's population share p_j:

$$BGV = \sum_j p_j \, (y_j - \mu)^2$$

In the example in Table 21.4, BGV is calculated as the sum of weighted squared differences (total of Column G) = 50.4 squared percentage points.

On average, the proportion of births attended by skilled health personnel in regions differed from the national average by 50.4 squared percentage points.

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Between-group standard deviation

Like BGV, BGSD is an absolute measure of inequality that considers all population subgroups. Subgroups are weighted according to their population share. BGSD is calculated as the square root of BGV:

$$BGSD = \sqrt{BGV}$$

Since BGSD is the square root of BGV, it is reported in the unit of the health indicator, which may be more easily interpretable than BGV and will not be as sensitive to outliers.

In the example in Table 21.4, BGSD is calculated as the square root of BGV:

$\sqrt{50.4} = 7.1$ percentage points

On average, the proportion of births attended by skilled health personnel in regions differed from the national average by 7.1 percentage points.

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Coefficient of variation

COV is a relative measure of inequality that considers all population subgroups. Subgroups are weighted according to their population share. COV is calculated by dividing BGSD by the setting average μ and multiplying the fraction by 100:

$$COV = \frac{BGSD}{\mu} \times 100$$

In the example in Table 21.4, COV is calculated as BGSD divided by the national average multiplied by 100:

$$7.1 / 91.6 \times 100 = 7.8\%$$

The standard deviation of the proportion of births attended by skilled health personnel in regions is 7.8% of the national average.

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Non-ordered disproportionality measures

Non-ordered disproportionality measures express inequality as a function of how the share of the health indicator compares with the share of the population. They include the two relative measures, Theil index (TI) and mean log deviation (MLD). These measures were originally developed for measuring economic inequality, where the resource in question (wealth) is subject to redistribution.

To promote easier interpretation of the results, TI and MLD values are multiplied by 1000. This aligns with how these measures are calculated in WHO health inequality monitoring resources, including the Health Equity Assessment Toolkit *(2)* and statistical codes *(3)*.

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Table 21.5 contains an example dataset used to illustrate the calculation of non-ordered disproportionality measures. The calculations are detailed in the corresponding subsections below.

Theil index

TI is a relative measure of inequality that considers all population subgroups. Subgroups are weighted according to their population share. TI is calculated as the sum of products of the natural logarithm of the share of the indicator of each subgroup (ln (y_j/μ)), the share of the indicator of each subgroup (y_j/μ), and the population share of each subgroup (p_j). TI may be more easily interpreted when multiplied by 1000:

$$TI = \sum_j p_j \frac{y_j}{\mu} \ln\left(\frac{y_j}{\mu}\right) \times 1000$$

where y_j indicates the estimate for Subgroup j, p_j is the population share of Subgroup j, and μ is the setting average.

In the example in Table 21.5, TI is calculated as the total of Column G (H) multiplied by 1000:

$$0.0031 \times 1000 = 3.1$$

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Mean log deviation

MLD is a relative measure of inequality that considers all population subgroups. Subgroups are weighted according to their population share. MLD is calculated as the sum of products between the negative natural logarithm of the share of the indicator of each subgroup $(-\ln (y_j/\mu))$ and the population share of each subgroup (p_j). MLD may be more easily interpreted when multiplied by 1000:

$$MLD = \sum_j p_j \left(-\ln\left(\frac{y_j}{\mu}\right)\right) \times 1000$$

where y_j indicates the estimate for Subgroup j, p_j is the population share of Subgroup j, and μ is the setting average.

In the example in Table 21.5, MLD is calculated as the total of Column I (J) multiplied by 1000:

$$0.0033 \times 1000 = 3.3$$

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TABLE 21.3. Steps to calculate mean difference measures: births attended by skilled health personnel, by subnational region, Indonesia

	Proportion of births attended by skilled health personnel	**Live births**		**Mean difference measures**					
Subnational region ($n = 34$)	Estimate (%) [A]	Number [E]	Population share [$G = E / F$]	Unweighted absolute difference from best-performing subgroup [$H = \lvert A - B \rvert$]	Weighted absolute difference from best-performing subgroup [$J = H \times G$]	Unweighted absolute difference from reference point [$K = \lvert A - C \rvert$]	Weighted absolute difference from reference point [$M = K \times G$]	Unweighted absolute difference from mean [$N = \lvert A - D \rvert$]	Weighted absolute difference from mean [$P = N \times G$]
Aceh	95.1	230	0.023	4.9	0.11	3.4	0.08	3.5	0.08
Bali[a]	100.0 [B]	149	0.015	0.0	0.00	1.4	0.02	8.4	0.12
Bangka Belitung	97.4	56	0.006	2.6	0.01	1.1	0.01	5.8	0.03
Banten	80.4	451	0.045	19.6	0.88	18.2	0.81	11.2	0.50
Bengkulu	94.3	70	0.007	5.7	0.04	4.3	0.03	2.7	0.02
Central Java	98.6	1222	0.121	1.4	0.17	0.0	0.00	7.0	0.84
Central Kalimantan	88.9	92	0.009	11.1	0.10	9.6	0.09	2.6	0.02
Central Sulawesi	86.7	125	0.012	13.3	0.16	11.9	0.15	4.9	0.06
East Java	97.1	1257	0.124	2.9	0.36	1.5	0.18	5.5	0.68
East Kalimantan	96.6	138	0.014	3.4	0.05	2.0	0.03	5.0	0.07
East Nusa Tenggara	75.4	252	0.025	24.6	0.61	23.1	0.58	16.2	0.40
Gorontalo	92.8	47	0.005	7.2	0.03	5.7	0.03	1.2	0.01
Jakarta[b]	98.6 [C]	365	0.036	1.4	0.05	0.0	0.00	7.0	0.25
Jambi	87.8	136	0.013	12.2	0.16	10.7	0.14	3.8	0.05
Lampung	91.9	304	0.030	8.1	0.24	6.7	0.20	0.3	0.01
Maluku	74.1	85	0.008	25.9	0.22	24.4	0.21	17.5	0.15
North Kalimantan	90.5	26	0.003	9.5	0.02	8.0	0.02	1.1	0.00
North Maluku	73.4	52	0.005	26.6	0.14	25.2	0.13	18.2	0.09

TABLE 21.3. *continued*

	Proportion of births attended by skilled health personnel	**Live births**		**Mean difference measures**					
Subnational region (*n* = 34)	Estimate (%) [A]	Number [E]	Population share [G = E / F]	Unweighted absolute difference from best-performing subgroup [H = |A – B|]	Weighted absolute difference from best-performing subgroup [J = H × G]	Unweighted absolute difference from reference point [K = |A – C|]	Weighted absolute difference from reference point [M = K × G]	Unweighted absolute difference from mean [N = |A – D|]	Weighted absolute difference from mean [P = N × G]
North Sulawesi	96.0	75	0.007	4.0	0.03	2.5	0.02	4.4	0.03
North Sumatra	90.0	617	0.061	10.0	0.61	8.6	0.52	1.6	0.10
Papua	64.2	180	0.018	35.8	0.64	34.4	0.61	27.4	0.49
Riau	86.0	308	0.031	14.0	0.43	12.6	0.38	5.6	0.17
Riau Islands	99.4	77	0.008	0.6	0.00	0.8	0.01	7.8	0.06
South Kalimantan	92.6	164	0.016	7.4	0.12	5.9	0.10	1.0	0.02
South Sulawesi	90.4	309	0.031	9.6	0.29	8.2	0.25	1.2	0.04
South Sumatra	96.4	355	0.035	3.6	0.13	2.1	0.07	4.8	0.17
Southeast Sulawesi	84.7	120	0.012	15.3	0.18	13.9	0.16	6.9	0.08
West Java	89.8	1980	0.196	10.2	1.99	8.7	1.71	1.8	0.34
West Kalimantan	88.6	212	0.021	11.4	0.24	10.0	0.21	3.0	0.06
West Nusa Tenggara	94.8	224	0.022	5.2	0.12	3.8	0.08	3.2	0.07
West Papua	74.0	39	0.004	26.0	0.10	24.5	0.09	17.5	0.07
West Sulawesi	87.0	56	0.006	13.0	0.07	11.6	0.06	4.6	0.03

TABLE 21.3. *continued*

	Proportion of births attended by skilled health personnel	**Live births**		**Mean difference measures**					
Subnational region (*n* = 34)	Estimate (%) [A]	Number [E]	Population share [G = E / F]	Unweighted absolute difference from best-performing subgroup [H = $\lvert A − B\rvert$]	Weighted absolute difference from best-performing subgroup [J = H × G]	Unweighted absolute difference from reference point [K = $\lvert A − C\rvert$]	Weighted absolute difference from reference point [M = K × G]	Unweighted absolute difference from mean [N = $\lvert A − D\rvert$]	Weighted absolute difference from mean [P = N × G]
West Sumatra	97.6	195	0.019	2.4	0.05	0.9	0.02	6.0	0.12
Yogyakarta	97.7	133	0.013	2.3	0.03	0.8	0.01	6.1	0.08
Total		*10 105 [F]*	*1.000*	*351.1 [I]*	*MDBW = 8.4 percentage points*	*306.6 [L]*	*MDRW = 7.0 percentage points*	*224.9 [O]*	*MDMW = 5.3 percentage points*
	National average = 91.6 [D]			MDBU [I / *n*] = 10.3 percentage points		MDRU [L / *n*] = 9.0 percentage points		MDMU [O / *n*] = 6.6 percentage points	

IDISU, index of disparity (unweighted); IDISW, index of disparity (weighted); MDBU, mean difference from best-performing subgroup (unweighted); MDBW, mean difference from best-performing subgroup (weighted); MDMU, mean difference from mean (unweighted); MDMW, mean difference from mean (weighted); MDRU, mean difference from reference point (unweighted); MDRW, mean difference from reference point (weighted).

[a] Best-performing region (Bali).

[b] Reference point (Jakarta).

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

TABLE 21.4. Steps to calculate variance measures: births attended by skilled health personnel, by subnational region, Indonesia

	Proportion of births attended by skilled health personnel	Live births		Variance measures	
Subnational region (*n* = 34)	Estimate (%) [A]	Number [C]	Population share [E = C / D]	Squared difference from mean $[F = (A - B)^2]$	Weighted squared difference from mean [G = F × E]
Aceh	95.1	230	0.023	12.4	0.28
Bali	100.0	149	0.015	70.6	1.04
Bangka Belitung	97.4	56	0.006	33.8	0.19
Banten	80.4	451	0.045	126.3	5.64
Bengkulu	94.3	70	0.007	7.1	0.05
Central Java	98.6	1222	0.121	48.5	5.87
Central Kalimantan	88.9	92	0.009	7.0	0.06
Central Sulawesi	86.7	125	0.012	24.3	0.30
East Java	97.1	1257	0.124	30.3	3.77
East Kalimantan	96.6	138	0.014	25.0	0.34
East Nusa Tenggara	75.4	252	0.025	261.3	6.52
Gorontalo	92.8	47	0.005	1.5	0.01
Jakarta	98.6	365	0.036	48.5	1.75
Jambi	87.8	136	0.013	14.1	0.19
Lampung	91.9	304	0.030	0.1	0.00
Maluku	74.1	85	0.008	305.3	2.57
North Kalimantan	90.5	26	0.003	1.1	0.00
North Maluku	73.4	52	0.005	332.0	1.71
North Sulawesi	96.0	75	0.007	19.6	0.14
North Sumatra	90.0	617	0.061	2.6	0.16
Papua	64.2	180	0.018	750.8	13.41
Riau	86.0	308	0.031	31.8	0.97
Riau Islands	99.4	77	0.008	60.9	0.47
South Kalimantan	92.6	164	0.016	1.0	0.02
South Sulawesi	90.4	309	0.031	1.4	0.04
South Sumatra	96.4	355	0.035	23.5	0.83
Southeast Sulawesi	84.7	120	0.012	48.1	0.57
West Java	89.8	1980	0.196	3.1	0.61
West Kalimantan	88.6	212	0.021	9.0	0.19
West Nusa Tenggara	94.8	224	0.022	10.1	0.22

TABLE 21.4. *continued*

	Proportion of births attended by skilled health personnel	Live births		Variance measures	
Subnational region ($n = 34$)	Estimate (%) [A]	Number [C]	Population share [E = C / D]	Squared difference from mean $[F = (A - B)^2]$	Weighted squared difference from mean [G = F × E]
West Papua	74.0	39	0.004	307.9	1.19
West Sulawesi	87.0	56	0.006	21.1	0.12
West Sumatra	97.6	195	0.019	36.4	0.70
Yogyakarta	97.7	133	0.013	37.4	0.49
Total		*10 105 [D]*	*1.000*		*BGV = 50.4 squared percentage points*
	National average = 91.6 [B]				BGSD $[\sqrt{BGV}]$ = 7.1 percentage points
					COV [BGSD / B × 100] = 7.8%

BGSD, between-group standard deviation; BGV, between-group variance; COV, coefficient of variation.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

TABLE 21.5. **Steps to calculate non-ordered disproportionality measures: births attended by skilled health personnel, by subnational region, Indonesia**

	Proportion of births attended by skilled health personnel	Live births		Non-ordered disproportionality measures		
Subnational region ($n = 34$)	Estimate (%) [A]	Number [C]	Population share [E = C / D]	Indicator share [F = A / B]	Product of indicator share, natural logarithm of indicator share and population share [G = F × ln(F) × E]	Product of negative natural logarithm of indicator share and population share [I = −ln(F) × E]
Aceh	95.1	230	0.023	1.04	0.0009	−0.0009
Bali	100.0	149	0.015	1.09	0.0014	−0.0013
Bangka Belitung	97.4	56	0.006	1.06	0.0004	−0.0003
Banten	80.4	451	0.045	0.88	−0.0051	0.0058
Bengkulu	94.3	70	0.007	1.03	0.0002	−0.0002
Central Java	98.6	1222	0.121	1.08	0.0095	−0.0089
Central Kalimantan	88.9	92	0.009	0.97	−0.0003	0.0003
Central Sulawesi	86.7	125	0.012	0.95	−0.0006	0.0007
East Java	97.1	1257	0.124	1.06	0.0077	−0.0073

TABLE 21.5. *continued*

	Proportion of births attended by skilled health personnel	**Live births**		**Non-ordered disproportionality measures**		
Subnational region (*n* = 34)	Estimate (%) [A]	Number [C]	Population share [E = C / D]	Indicator share [F = A / B]	Product of indicator share, natural logarithm of indicator share and population share [G = F × ln(F) × E]	Product of negative natural logarithm of indicator share and population share [I = −ln(F) × E]
East Kalimantan	96.6	138	0.014	1.05	0.0008	−0.0007
East Nusa Tenggara	75.4	252	0.025	0.82	−0.0040	0.0048
Gorontalo	92.8	47	0.005	1.01	0.0001	−0.0001
Jakarta	98.6	365	0.036	1.08	0.0028	−0.0026
Jambi	87.8	136	0.013	0.96	−0.0005	0.0006
Lampung	91.9	304	0.030	1.00	0.0001	−0.0001
Maluku	74.1	85	0.008	0.81	−0.0014	0.0018
North Kalimantan	90.5	26	0.003	0.99	0.0000	0.0000
North Maluku	73.4	52	0.005	0.80	−0.0009	0.0011
North Sulawesi	96.0	75	0.007	1.05	0.0004	−0.0003
North Sumatra	90.0	617	0.061	0.98	−0.0011	0.0011
Papua	64.2	180	0.018	0.70	−0.0045	0.0063
Riau	86.0	308	0.031	0.94	−0.0018	0.0019
Riau Islands	99.4	77	0.008	1.09	0.0007	−0.0006
South Kalimantan	92.6	164	0.016	1.01	0.0002	−0.0002
South Sulawesi	90.4	309	0.031	0.99	−0.0004	0.0004
South Sumatra	96.4	355	0.035	1.05	0.0019	−0.0018
Southeast Sulawesi	84.7	120	0.012	0.92	−0.0009	0.0009
West Java	89.8	1980	0.196	0.98	−0.0037	0.0038
West Kalimantan	88.6	212	0.021	0.97	−0.0007	0.0007
West Nusa Tenggara	94.8	224	0.022	1.03	0.0008	−0.0008
West Papua	74.0	39	0.004	0.81	−0.0007	0.0008
West Sulawesi	87.0	56	0.006	0.95	−0.0003	0.0003
West Sumatra	97.6	195	0.019	1.07	0.0013	−0.0012
Yogyakarta	97.7	133	0.013	1.07	0.0009	−0.0009
Total		*10 105 [D]*	*1.000*		*0.0031 [H]*	*0.0033 [J]*
	National average = 91.6 [B]				TI [H × 1000] = 3.1	MLD [J × 1000] = 3.3

MLD, mean log deviation; TI, Theil index.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

Impact measures

Impact measures show the improvement in the health of the total population that would be achieved if all subgroups had the same level of health indicator as the selected reference group. Impact measures, including population attributable risk (PAR) and its equivalent relative measure, population attributable fraction (PAF), reflect the differences between each subgroup's level of health and the health of the reference group. The population impact number (PIN) is another absolute impact measure (Box 21.5). Impact measures can serve as "an empirical expression of a common argument for reducing health inequalities" and may be used to quantify the population impact of inequalities with the goal of informing population-level policy actions *(7)*. Given that they are based on a hypothetical scenario and tend to be presented with a causal interpretation, care is required to ensure results are adequately contextualized.

BOX 21.5. Population impact number

The PIN is an impact measure that expresses the potential improvement in health using absolute counts. Applied to disease cases, for example, the PIN yields the reduction in the number of cases across the whole population, if everyone had the same rate as the reference group *(11, 12)*. For more on how the PIN has been used to report health inequalities in Canada, see *Key health inequalities in Canada: a national portrait (13)* and *Trends in income-related health in Canada (14)*.

These measures can be used with all types of dimensions of inequality, including ordered and non-ordered dimensions and binary dimensions. They consider all population subgroups and are weighted by population share. The interpretation of these measures tends to be straightforward, expressing the potential improvement by eliminating inequality. For these reasons, they may be particularly resonant with decision-makers.

Impact measures take positive values for favourable indicators and negative values for adverse indicators (Figure 21.11). The larger the absolute value of the measure, the higher the level of inequality. Impact measures equal 0 if no further improvement can be achieved – that is, if all subgroups have reached the same level of the indicator as the reference point or surpassed that level.

FIGURE 21.11. Interpreting the results of impact measures

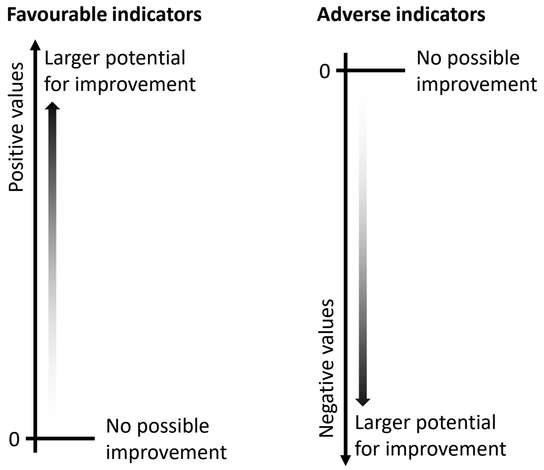

Table 21.6 contains an example dataset used to illustrate the calculation of PAR and PAF for three dimensions of inequality. The calculations are detailed in the following text.

Population attributable risk

PAR shows the absolute improvement in a setting average (such as national average) that could be achieved if all population subgroups had the same level of health as a reference point. PAR is calculated

TABLE 21.6. **Steps to calculate impact measures: births attended by skilled health personnel, by education level, place of residence and subnational region, Indonesia**

Dimension of inequality	Reference subgroup	Reference subgroup estimate (%) [A]	Setting average (%) [B]	PAR (percentage points) [C = A – B]	PAF (%) [D = C / B × 100]
Place of residence	Urban	96.2	91.6	4.6	5.0
Education level	Secondary or higher education	95.6	91.6	4.0	4.4
Subnational region	Bali	100.0	91.6	8.4	9.2

PAF, population attributable fraction; PAR, population attributable risk.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

as the difference between the reference point y_{ref} and the setting average μ:

$$PAR = y_{ref} - \mu$$

where y_{ref} refers to the most advantaged subgroup or, if it is not possible to identify an advantaged subgroup, the best-performing subgroup (i.e. the subgroup with the highest estimate in the case of favourable indicators and the subgroup with the lowest estimate in the case of adverse indicators).

In the example in Table 21.6, PAR is calculated as:

96.2 – 91.6 = 4.6 percentage points for place of residence

95.6 – 91.6 = 4.0 percentage points for education

100.0 – 91.6 = 8.4 percentage points for subnational region

These results suggest that if all subgroups had the same level of coverage as the most advantaged subgroup, the national average coverage would improve by 4.6 percentage points (eliminating place of residence-related inequality), by 4.0 percentage points (eliminating education-related inequality), or by 8.4 percentage points (eliminating inequality between subnational regions).

• • • • • • •

Population attributable fraction

PAF expresses the same information as PAR in relative terms – that is, the relative improvement in a setting average (such as national average) that could be achieved if all population subgroups had the same level of health as a reference point. PAF is calculated by dividing PAR by the setting average μ and multiplying the fraction by 100:

$$PAF = \frac{PAR}{\mu} \times 100$$

In the example in Table 21.6, PAF is calculated as:

4.6 / 91.6 × 100 = 5.0% for place of residence

4.0 / 91.6 × 100 = 4.4% for education

8.4 / 91.6 × 100 = 9.2% for subnational region

These results suggest that if all subgroups had the same level of coverage as the most advantaged subgroup, the national average coverage would increase by 5.0% (eliminating place of residence-related inequality), by 4.4% (eliminating education-related inequality), or by 9.2% (eliminating inequality between subnational regions).

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Strengths and limitations of complex summary measures

The complex summary measures presented in this chapter have different strengths and limitations. When considered together, multiple summary measures can promote a well-rounded perspective on the state of inequality. Compared with pairwise summary measures, they consider the situation in all population subgroups and may account for the population share of each subgroup. They are inherently more challenging to calculate and interpret, although the evolution of user-friendly analysis and reporting software has reduced this barrier. Selecting appropriate complex measures for analysis and reporting requires a thorough understanding of the characteristics of the underlying data and the application and limitations of the complex measures. It also requires consideration of value judgements inherent to the characteristics of the measure. Communicating the results of complex summary measures may be challenging and not appropriate for all audiences. Further information about the interpretation of summary measures is provided in Chapter 22. Chapter 23 focuses on reporting and communication of results.

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22

Interpreting summary measures of health inequality

Overview

Summary measures of health inequality provide a concise way to express inequality in a single number. A comprehensive understanding of inequalities, however, often entails assessing the results derived from multiple summary measures. Furthermore, different classes of complex summary measures (pairwise measures, regression-based measures, ordered disproportionality measures, mean difference and variance measures, non-ordered disproportionality measures and impact measures) convey different types of information.

Interpreting summary measures of health inequality requires familiarity with the nuances in the underlying disaggregated data (see Chapter 18) and a basic understanding of how summary measures are calculated (see Chapters 19–21). As with any measurement, the results obtained from summary measures of health inequality are only as good as the quality and validity of the underlying data. When assessing the results of summary measures, one should consider the overall situation in the affected population (national or overall average) and the patterns evident from the underlying disaggregated data. This information, together with an awareness of any key factors in the surrounding context, promotes a more holistic understanding of the findings and their importance.

Drawing on empirical and hypothetical examples, this chapter covers some of the assumptions and considerations inherent in understanding results derived from summary measures of inequality, especially when results are compared across populations and datasets. After covering general limitations and mathematical considerations, the chapter discusses basic value judgements associated with various summary measure characteristics. This insight is a prerequisite for making decisions about reporting (see Chapter 23) and reaching conclusions and recommendations for further action (see Chapter 24).

General limitations

There are a few general limitations when interpreting the results of the summary measures of health inequality described in Chapters 20 and 21. All of these measures are descriptive – that is, they quantify the magnitude of associations between health indicators and dimensions of inequality. They are not estimates of causal effects. Summary measures cannot, per se, confirm that belonging to a subgroup with a disadvantaged socioeconomic position causes poorer health or, conversely, that poorer health is a cause of socioeconomic disadvantage. Although the associations derived from summary measures may point towards possible causal relationships between variables, other forms of evidence are required to support such assertions (see Chapter 24).

Relatedly, when assessing measures of health inequality over time, the measures covered in Chapters 20 and 21 do not imply that improving (or worsening) socioeconomic conditions are the cause of improved (or worse) health indicators. For example, moving out of poverty or achieving a higher level of education does not necessarily translate into improved health or narrowed health inequality. In particular, the use of unweighted summary measures to compare changes in inequality over time can yield confusing results because they do not capture population shifts (i.e. when the proportion of the population belonging to each subgroup changes over time). For example, if the healthiest individuals in rural areas move to urban areas, the mean level of health in rural areas may get worse, although there may be no changes in health (or even slight improvements) among individuals who remained in rural areas. Similarly, a programme oriented to improve educational attainment among individuals with poor health might result in a worse mean level of health among individuals in the more educated subgroup.

Other notable limitations have been raised in previous chapters. Briefly, the summary measures of inequality described in this book do not permit comparisons between dimensions of inequality categorized based on different numbers of subgroups due to resolution issues (see Chapter 18). For dimensions categorized as more than two subgroups, the use of pairwise measures ignores the situation in the other groups and does not account for population size (see Chapter 20). Impact measures are based on counterfactual scenarios and should be interpreted as hypothetical changes in population-level averages (see Chapter 21). Therefore, inspection of disaggregated data and calculation of multiple complex summary measures are recommended to gain a more comprehensive understanding of the state of inequality.

Mathematical considerations

Certain mathematical considerations arise in the calculation of summary measures of health inequality that should be considered in their interpretation. Insights into such issues serve as necessary background to understand the results because they relate to the value judgements inherent in selecting and reporting different measures (see below). The following sections address how summary measures are affected by the underlying disaggregated data values and the overall level of the indicator in the population (the national or overall average), and how absolute and relative measures can lead to conflicting conclusions about inequality trends. Pairwise measures of inequality (difference and ratio) are used to demonstrate these effects.

Disaggregated data values

The magnitude of absolute and relative measures of inequality is correlated with the mathematical values of the underlying disaggregated data. Generally, larger disaggregated data values will yield a lower ratio than smaller disaggregated data values. Conversely, difference will be larger when disaggregated values are larger, and smaller when values are smaller. As a simple illustration of this effect, consider the calculation of difference and ratio for different hypothetical Subgroup A and Subgroup B estimates (Table 22.1). A difference of 10 percentage points results in a lower ratio when the difference falls between larger values than smaller values (see Row 1 versus Row 2, respectively). A ratio of 1.1 corresponds to a larger difference when the disaggregated data values are larger than when the disaggregated data values are smaller (see Row 1 versus Row 3, respectively).

TABLE 22.1. Examples of difference and ratio calculations corresponding to larger and smaller disaggregated data values

	Subgroup A (%)	Subgroup B (%)	Difference (percentage points)[a]	Ratio[b]
Larger disaggregated data values				
Row 1	100	90	10	1.1
Smaller disaggregated data values				
Row 2	20	10	10	2.0
Row 3	20	18	2	1.1

[a] Difference is calculated as Subgroup A – Subgroup B.
[b] Ratio is calculated as Subgroup A / Subgroup B.

Overall level of health

Subsequent to the above, the overall level of the health indicator in the population often (but not always) shows characteristic associations with the calculated magnitude of inequality. Although relative inequality measures tend to be larger at lower levels of health, absolute inequality measures tend to be low at both very low and very high overall levels (although this may not always be the case – see Box 22.1). For example, in an empirical exploration of absolute and relative summary measures applied to maternal and child health indicators, a tendency for relative inequalities in mortality rates among children aged under five years to be higher in countries with lower overall mortality rates was observed (with some exceptions of countries having low mortality rates and low relative inequality). It was noted that low levels of relative inequality alongside high mortality rates are “a necessity, not an accomplishment” because disaggregated estimates are necessarily high across all subgroups *(1)*.

Using absolute and relative measures to assess trends

In some cases, the results derived from absolute versus relative measures of inequality can lead to conflicting conclusions about inequality trends. For example, inequality may appear to increase over time when measured using a relative measure and to decrease over time when using an absolute measure (or vice versa). The reason relates to the mathematical considerations described above, where the magnitude of absolute and relative inequality measures is associated with disaggregated data and the overall level of the indicator. This underscores that absolute and relative inequality measures are complementary, not inconsistent. When benchmarking several settings, the use of a scatterplot to display trends in absolute and relative inequality measures may provide a useful initial assessment of results (Box 22.2).

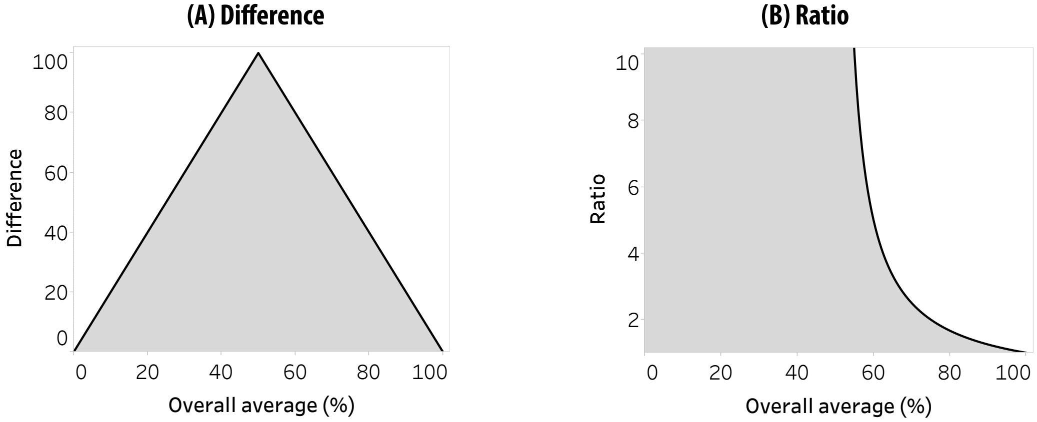
The interpretation of opposing absolute and relative inequality trends requires a close inspection of the underlying data, including national averages and disaggregated data, to assess the situation in more detail. Figure 22.2 provides examples of scenarios where conflicting trends may be observed over three time periods. In the case of pairwise measures of inequality, equal absolute decreases across both subgroup estimates yield an increased ratio but unchanged absolute inequality (Example A). Proportionally equal decreases across both subgroups will yield a decrease in absolute inequality and unchanged relative inequality (Example B). In the context of decreasing values

BOX 22.1. Mathematical ceilings for difference and ratio measures

Figure 22.1 provides a simplified illustration of the maximum possible values of difference and ratio for a health indicator measured as a percentage (i.e. bounded between 0 and 100), such as use of health care. In this example, the overall average is predicated on a population comprised of two subgroups of equal size or weight (whereby the overall average is calculated as the sum of the two disaggregated data values, divided by two). The mathematical ceilings for the pairwise measures are plotted against the overall level of the indicator. The space below the inverted V shape in Panel A and to the left of the curve in Panel B contain all possible difference and ratio values, respectively, for the corresponding overall level of health.

In Panels A and B, the maximum possible values are realized when the overall average is 50%. The underlying disaggregated data values are provided in Table 22.2. For difference, the maximum possible value when the overall average is 50% is 100 percentage points. At an overall average of 0% or 100%, the only possible difference value is 0 percentage points. For ratio, the maximum possible value (infinite) may be derived at any overall average of 50% or below. As the overall level of health increases above 50%, the possible ratio values are restricted, reaching a minimum value of 1.0 when the overall average is 100%.

FIGURE 22.1. Mathematical ceilings for pairwise measures of inequality in relation to overall level of use of health care



Source: derived from Houweling et al. *(1)*.

TABLE 22.2. Data corresponding to mathematical ceilings for pairwise measures of inequality

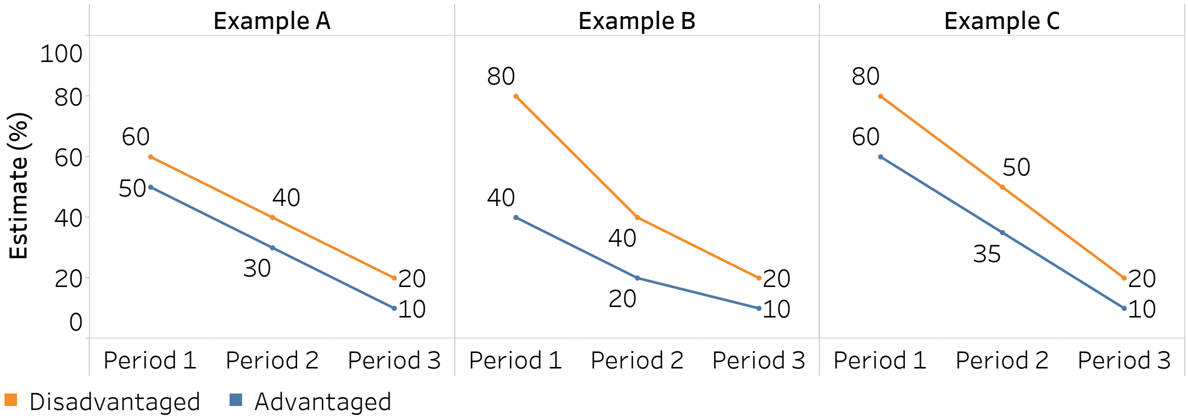
Overall average (%)	Subgroup A (%)	Subgroup B (%)	Difference (percentage points)[a]	Ratio[b]
0	0	0	0	(Infinite)
50	100	0	100	(Infinite)
100	100	100	0	1.0

[a] Difference is calculated as Subgroup A – Subgroup B.
[b] Ratio is calculated as Subgroup A / Subgroup B.

BOX 22.2. Use of scatterplots for benchmarking trends in absolute and relative inequality measures

If comparing across multiple settings, plotting the change in absolute versus relative inequality measures over time using a scatterplot can provide an initial visual representation of results. The use of a scatterplot creates four quadrants that correspond with the four possible scenarios: increased absolute and relative inequality; decreased absolute and relative inequality; increased absolute and decreased relative inequality; and decreased absolute and increased relative inequality. The use of scatterplots to assess trends in absolute and relative inequality measures has been applied, for example, to show inequality trends in maternal, newborn and child health topics *(2, 3)*.

FIGURE 22.2. **Conflicting trends in absolute and relative inequality alongside increasing disaggregated data values**



for both subgroups, a trend of decreasing absolute inequality alongside increasing relative inequality may occur when the absolute rate of decrease is faster among the subgroup with an initially higher value (Example C). For more information about the typology of possible scenarios related to increasing, decreasing or unchanged absolute inequality, relative inequality and overall average, and their graphical presentation, see Annex 14.

Value judgements

The measurement of health inequalities is laden with value judgements, from the initial selection of health topics, indicators and dimensions of inequality to the selection of summary measures and their subsequent calculation and reporting *(4–6)*. This section introduces some of the value judgements inherent in the characteristics of summary measures of inequality. An understanding of these distinctions promotes a more rigorous evaluation of findings and is important for deciding which dimensions of inequality are more (or less) urgent to address. It also enables more transparent and nuanced reporting on the state of inequality because the conclusions derived from particular summary measures can be explained on normative grounds.

Absolute and relative measures of inequality

Absolute and relative measures of health inequality provide distinct information about a situation of inequality, reflecting different ways of perceiving and prioritizing the nature of inequality *(5, 7)*. The consideration of absolute versus relative inequality raises questions surrounding the normative importance of seeking to address the absolute gap in the health indicator per se or relative to the overall population health.

Showing the magnitude of the gap between subgroups, absolute inequality focuses on the actual "performance" of the subgroups and the differences between them. An emphasis on monitoring and reducing absolute inequality prioritizes faster absolute improvements among disadvantaged subgroups. The scenario of decreasing absolute inequality alongside improved overall average (regardless of whether relative inequality decreases, remains the same or increases) is usually considered desirable because it signals improvements across disadvantaged population subgroups.

Relative measures are based on proportional comparisons, emphasizing the situation of inequality in relation to other subgroups or reference points. Strictly speaking, relative measures – and the drive to reduce relative inequality – implicitly reflect an egalitarian position, pointing to the normative significance of equality (and less on the overall performance). Because the mathematical ceiling for relative measures declines as the overall level of health increases (see above), decreasing relative measures of health inequality may imply a faster relative (but not necessarily absolute) rate of health improvement among disadvantaged groups than advantaged groups.

It is generally recommended that both absolute and relative measures are consulted and reported to provide a more comprehensive and balanced understanding of inequality than either type of measure in isolation. There are situations, however, where targets or indicators – and their reporting mechanisms – may reflect absolute or relative inequality, and different contexts and policy objectives may call for different types of measures. Box 22.3 highlights an example of the use of absolute versus relative summary measures to understand economic-related inequality in adolescent fertility in Rwanda.

Weighted and unweighted measures of inequality

A key question when selecting between and evaluating weighted and unweighted measures of inequality is whether the subgroups have importance as entities in themselves (regardless of their size) or whether their relative size matters.

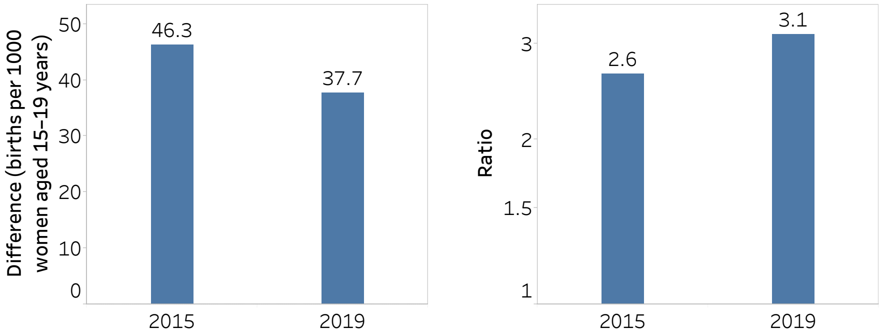
BOX 22.3. Example of using absolute and relative measures to understand economic-related inequality in adolescent fertility in Rwanda

In Rwanda, the national adolescent fertility rate declined between 2015 and 2019, from 43.7 to 35.2 births per 1000 women aged 15–19 years. During this period, absolute inequality, measured as the difference between the poorest and richest quintiles, also declined (Figure 22.3). In the context of a policy aiming to lower adolescent fertility, this might suggest a desirable situation because there were decreases in both the richest and poorest subgroups, but the decrease was larger (in absolute terms) among the poorest. This is evident from an inspection of the underlying disaggregated data (Figure 22.4).

Relative inequality measured using ratio, however, increased (Figure 22.3). This indicates that the proportional decrease in adolescent fertility was slower among the poorest, and therefore the relative gap between the groups grew wider. If population-level policy actions had been targeted specifically to have an accelerated impact among people in the poorest quintile, the findings would indicate a need for further efforts.

BOX 22.3. *continued*

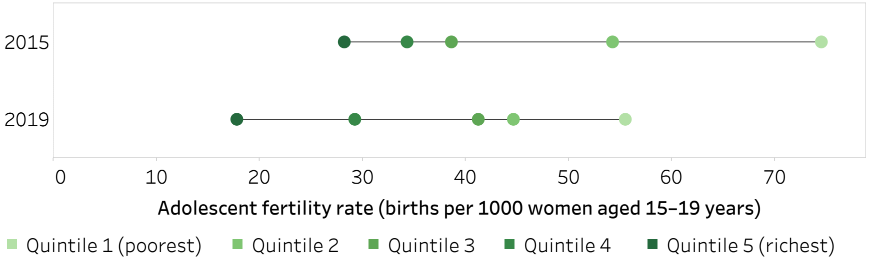
FIGURE 22.3. Difference and ratio: adolescent fertility rate, by economic status, Rwanda



Economic status is categorized as five subgroups (quintiles), and the difference is calculated as the poorest minus the richest. Ratio is calculated as the poorest divided by the richest.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(8)*, with data sourced from the 2015 and 2019 Demographic and Health Surveys.

FIGURE 22.4. Adolescent fertility rate, by economic status, Rwanda



Horizontal lines show the range between the lowest and highest subgroup estimates.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(8)*, with data sourced from the 2015 and 2019 Demographic and Health Surveys.

Unweighted measures treat all subgroups equally. They inherently convey that the importance of the subgroup as a unit is constant because small groups are given the same emphasis as larger groups. Consider a situation where the health of a particular subgroup, such as people experiencing homelessness, is of special interest. It may be worthwhile to compare the outcomes of the population of people experiencing homelessness with the population not experiencing homelessness, even though the size of the population experiencing homelessness may be much smaller. The use of an unweighted measure avoids masking the experience of a small minority group. There are considerations when using unweighted measures to track inequalities over time, however, because they do not account for situations where the size of the subgroup changes (population shift). For example, if the size of the population experiencing homelessness doubles between two times points, this would not be captured in an unweighted summary measure. Likewise, a substantial decrease in the number of people experiencing homelessness would not be captured.

Weighted measures give greater emphasis to larger subgroups and weight all individuals equally. This approach endorses the position that disadvantage affecting larger populations is more significant than disadvantage affecting smaller populations. Weighted measures, however, capture population shift over time. They can be useful to account for upstream social policy factors that may, for example, increase people's level of education or help people move out of poverty (and thereby decrease the population share of the associated disadvantaged subgroups). Weighted measures also capture situations where the share of certain population subgroups increases, such as migration influxes or increased unemployment. Box 22.4 provides an example of the interpretation of weighted versus unweighted measures of subnational inequality in childhood immunization in Ethiopia.

Choice of reference point

For some summary measures, the reference point is implicit. Others require the explicit selection of a reference point as a benchmark for comparison, with several possible choices. Common reference points include the best-performing subgroup, a subgroup with special significance (e.g. a capital city), the overall average and a target level (see Chapter 19). The selection of a reference point has implications for how the calculation of these measures is done, but moreover for how the results derived from the measure are applied.

The best-performing subgroup, subgroups with special significance and overall average are all dynamic reference points because their values may fluctuate over time or across populations. This emphasizes the importance of lowered inequality per se. The choice of the best-performing subgroup puts importance on levelling up among all other subgroups. The implication of this selection is that all subgroups aim to reach the level of the best-performing subgroup. The selection of the overall average as a reference point signals a tolerance for a certain amount of levelling down among the subgroups that are above average; the same may be the case in the selection of a subgroup with special significance. In these cases, a redistribution may be plausible when proposing remedial actions such as resource allocation.

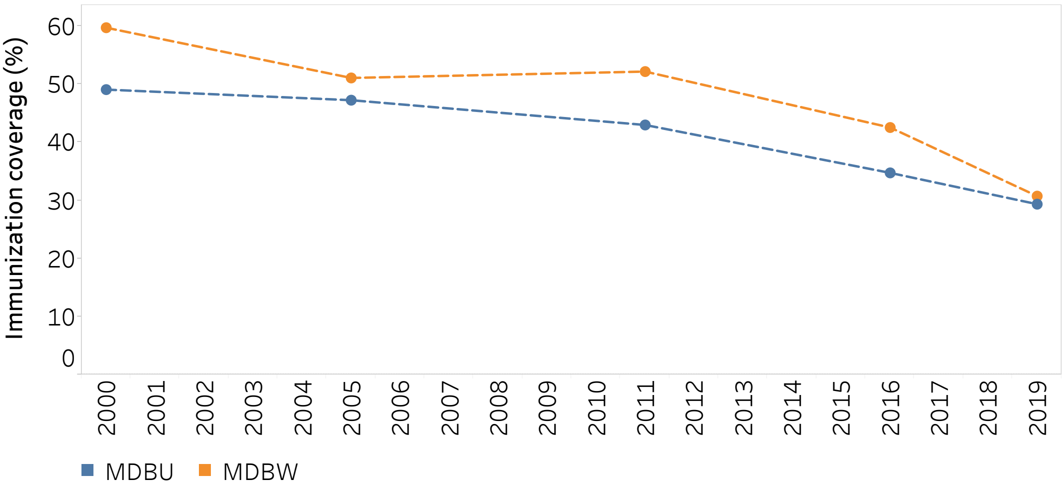
The use of a target as a reference point provides a fixed value that may remain constant over time and across populations (provided the target remains unchanged). This places emphasis on all subgroups achieving a stated reference value and

BOX 22.4. Example of using weighted versus unweighted measures to understand subnational inequality in childhood immunization in Ethiopia

Figure 22.5 shows subnational inequality in immunization coverage with a third dose of the diphtheria, tetanus toxoid and pertussis vaccine (DTP3) in Ethiopia measured using mean difference from best-performing subgroup. The weighted mean difference from the best-performing subgroup (MDBW) reflects the population distribution across regions, while the unweighted mean difference from the best-performing subgroup (MDBU) treats each region equally. In all survey years, the capital city Addis Ababa was the best-performing region.

BOX 22.4. *continued*

FIGURE 22.5. Weighted and unweighted mean difference from best-performing subgroup: immunization coverage with a third dose of the diphtheria, tetanus toxoid and pertussis vaccine among children aged one year, by subnational region, Ethiopia



MDBU, mean difference from best-performing subgroup, unweighted; MDBW, mean difference from best-performing subgroup, weighted.

The best-performing subgroup is Addis Ababa.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(8)*, with data sourced from the 2000, 2005, 2011, 2016 and 2019 Demographic and Health Surveys.

Both measures are valid and correct, but they reflect different priorities and values for assessing inequality. The weighted measure (MDBW) demonstrates larger absolute inequality compared with the unweighted measure (MDBU), except in 2019, when the two measures show the same level of inequality.

The explanations and messaging behind these differing results can be understood by investigating the disaggregated data and population share across regions (Table 22.3). The weighted measure largely reflects the trends associated with the three most populated regions (Amhara, Oromia and Southern Nations, Nationalities, and Peoples' Region), which together comprise 80–90% of the population (89% in 2000 and 80% in 2019). In 2000, for example, these regions had coverage of 21% or lower, compared with 81% in Addis Ababa, which is why a large gap between the weighted and unweighted measures can be observed. By 2019, coverage had increased in these regions to at least 54% (with 82% coverage in Amhara), compared with 93% in Addis Ababa, leading to a decrease in MDBW. The unweighted measure, by comparison, gives greater emphasis to the level of coverage in less populated regions. In 2000, 2005 and 2011, the majority of regions that accounted for less than 20% of the population share reported higher levels of immunization coverage than the three most populated regions.

BOX 22.4. *continued*

TABLE 22.3. Immunization coverage with a third dose of the diphtheria, tetanus toxoid and pertussis vaccine among children aged one year and population share, by subnational region, Ethiopia

	DHS 2000		DHS 2005		DHS 2011		DHS 2016		DHS 2019	
Region	Estimate (%)	Population share (%)	Estimate (%)	Population share (%)	Estimate (%)	Population share (%)	Estimate (%)	Population share (%)	Estimate (%)	Population share (%)
Addis Ababa	80.9	1.5	83.8	1.7	89.2	2.2	95.7	2.6	93.1	3.3
Affar	1.1	0.9	4.6	1.0	11.6	0.9	20.1	1.0	27.0	1.5
Amhara	20.6	26.3	32.1	25.7	39.4	23.1	63.8	18.2	82.2	21.2
Benishangul-Gumuz	16.7	0.9	30.7	0.9	42.9	1.2	76.2	1.0	80.5	1.0
Dire Dawa	52.4	0.3	62.5	0.4	76.1	0.4	84.9	0.5	74.5	0.6
Gambela	12.7	0.2	20.3	0.3	29.4	0.4	54.8	0.3	69.0	0.4
Harari	50.7	0.2	45.8	0.2	54.4	0.3	58.7	0.2	54.9	0.2
Oromia	16.6	42.2	28.8	36.8	27.1	42.0	39.9	44.0	53.6	39.4
Somali	24.4	1.1	5.6	4.2	25.8	2.6	36.3	3.8	26.2	5.4
Southern Nations, Nationalities, and Peoples' Region	16.9	20.6	35.6	21.7	38.5	20.2	59.0	20.9	56.3	19.4
Tigray	56.8	5.7	52.1	7.2	74.3	6.7	81.4	7.6	84.4	7.5

DHS, Demographic and Health Surveys.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(8)*, with data sourced from the 2000, 2005, 2011, 2016 and 2019 DHS.

may be particularly resonant, for example, when multiple countries are reporting on their progress towards high-level goals. A drawback of using a fixed target as a reference point, however, is that it is less responsive to the actual situation in a monitoring context, and the level at which the target is set must be justified. If all subgroups are far from the target – or, conversely, if all subgroups have already surpassed a target – the results may be less meaningful. Box 22.5 provides an example of the calculation of measures of subnational inequality in mortality among children aged under five years in Nepal using different reference points.

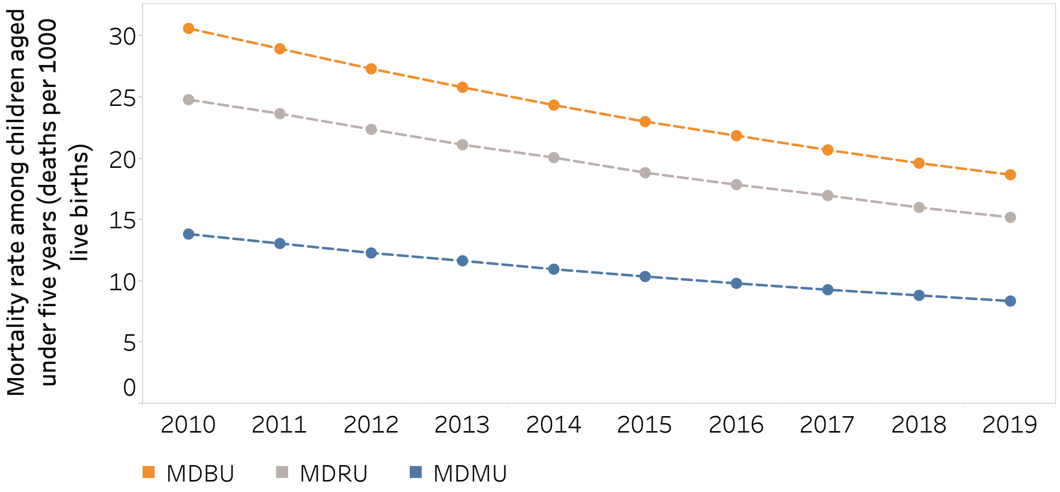
Distributional sensitivity

Distributional sensitivity, in the context of measuring inequality, refers to the responsiveness of an inequality measure to changes in the distribution of a health indicator among a population. Such sensitivity might be warranted if improving a

BOX 22.5. Example of measuring inequality using different reference points

Figure 22.6 demonstrates the use of different reference points to assess subnational inequality in mortality rates among children aged under five years in Nepal between 2010 and 2019. The unweighted version of the mean difference from the best-performing district (MDBU) uses the best-performing district as a point of reference (this was the district of Bhaktapur in the region of Bagmati in all years – although given the nature of the reference point, it could have been a different district in each year). The unweighted mean difference from a reference point (MDRU) measure uses the top 5% of district estimates as the reference point. The unweighted mean difference from the mean measure (MDMU) uses the national average as the reference point.

FIGURE 22.6. Mean difference measures: mortality rate among children aged under five years, by subnational region, Nepal



MDBU, unweighted mean difference from best-performing subgroup; MDMU, unweighted mean difference from mean; MDRU, unweighted mean difference from reference point.

The subnational regions were 77 districts (second administrative level). For MDBU, the best performing subgroup was the district of Bhaktapur in the region of Bagmati in all years. The top 5% of district estimates were used as the reference point for MDRU.

Source: derived from the WHO Health Inequality Data Repository Under-five Mortality dataset *(8)*, with data from 2010–2019 sourced from the United Nations Inter-agency Group for Child Mortality Estimation.

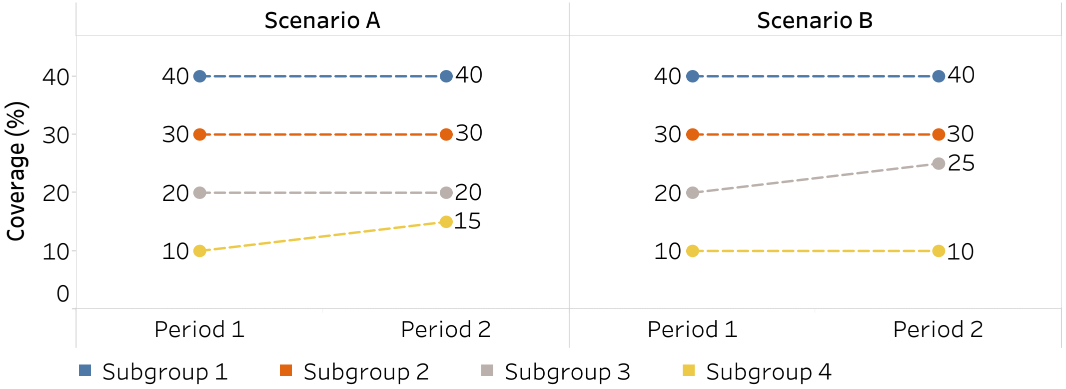
MDBU indicates a consistently higher level of absolute inequality than MDMU and MDRU. The selection of the best-performing district as the reference point implies that every other district has the potential to achieve the same level of mortality among children aged under five years, and therefore encourages a focus on lowering mortality in all districts to the level of mortality in that district. Selecting the top 5% of districts as the reference point results in a slightly lower magnitude of inequality (since a group of districts will already have mortality rates similar to that point of reference) and emphasizes the reduction of mortality in the other 95% of districts. On the other hand, selecting the mean as the reference point means that inequality could be reduced in several ways, including decreasing mortality in some districts, and maintaining low levels of mortality in others.

health indicator within a particular disadvantaged group (e.g. the poorest, least educated, homeless, unemployed or refugee populations) is of higher concern than improving it in others. Under this principle, if a single "healthier" subgroup becomes less healthy and the health of a previously "less healthy" subgroup improves, but the health of all other groups remains the same, the extent of inequality should decrease. Distributional sensitivity may also be important to help policy-makers understand whether interventions targeted to specific groups had the intended impact. Not all inequality measures, however, are able to reflect this. Some measures are more able than others to reflect a nuanced assessment of distributional shifts (Box 22.6).

BOX 22.6. Comparison of distributional sensitivity of various summary measures

This example uses two hypothetical scenarios of coverage increases to demonstrate the distributional sensitivity of four summary measures. In Scenario A, coverage increases by five percentage points in the most disadvantaged Subgroup 4. In Scenario B, coverage increases by five percentage points in Subgroup 3 (Figure 22.7). All subgroups are assumed to have the same population size.

FIGURE 22.7. Distributional sensitivity: two scenarios of coverage increase between two periods



Inequality is assessed and compared using four summary measures of inequality, which all show narrowing inequality between the two periods, with variable distributional sensitivity (Table 22.4). The first two measures are the mean difference from mean (MDM), which measures absolute inequality, and the index of disparity (IDIS), which measures relative inequality. For both measures, the extent of the decline in inequality in Scenario A and Scenario B is identical: MDM reduces by 1.3 in both scenarios, and IDIS reduces by 6.7 in both scenarios. They do not differentiate between an improvement in Subgroup 3 and Subgroup 4. This is because the weighted mean and the absolute difference between estimates and the weighted mean, which are key inputs into the calculation of MDM and IDIS, are the same.

BOX 22.6. *continued*

The use of the Theil index (TI) and mean log deviation (MLD), however, yield different results for Scenarios A and B. They each suggest a greater reduction in inequality in Scenario A than in Scenario B. This is because TI and MLD take into account the proportion of each subgroup, or their share, of the coverage indicator; therefore, a change in the coverage of any subgroup is reflected in TI and MLD.

TABLE 22.4. **Complex summary measure calculations corresponding to illustration of distributional sensitivity**

		Scenario A			**Scenario B**		
Measure	**Absolute or relative**	Period 1	Period 2	Difference (Period 2 – Period 1)	Period 1	Period 2	Difference (Period 2 – Period 1)
Mean difference from mean	Absolute	10.0	8.7	–1.3	10.0	8.7	–1.3
Index of disparity	Relative	40.0	33.3	–6.7	40.0	33.3	–6.7
Theil index	Relative	106.4	66.9	–39.6	106.4	95.1	–11.4
Mean log deviation	Relative	121.8	69.2	–52.6	121.8	114.8	–7.0

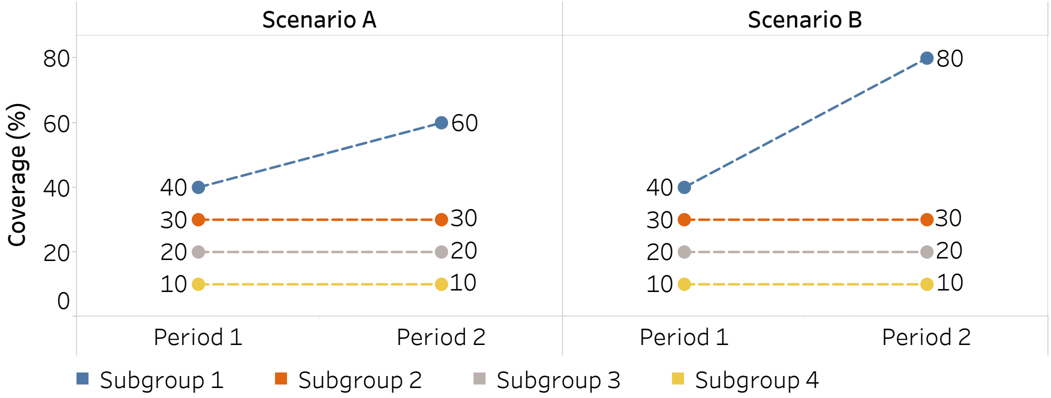
Sensitivity to outliers

Outliers are subgroups with health indicator values at the extreme high or low ends of a distribution. Depending on the monitoring purpose, sensitivity to outliers may be an advantage. An inequality measure that is highly sensitive to outliers will overemphasize the impact of extreme values, which might be useful if the aim of monitoring is to highlight subgroups being left behind or subgroups that are unfairly disadvantaged. If the monitoring purpose is to achieve a general understanding of the state of inequality, sensitivity to outliers can distract from the situation in the majority of the population – particularly if the population sizes of the outlier subgroups are small. Understanding how certain summary measures account for outlier estimates provides a stronger basis for meaningfully evaluating their findings. Box 22.7 compares sensitivity to outliers of selected variance and mean difference summary measures.

BOX 22.7. Assessing sensitivity to outlier estimates among variance and mean difference summary measures

Scenarios A and B show hypothetical situations where a health indicator increases in one subgroup while remaining the same in others (Figure 22.8). All subgroups are assumed to have the same population size. The extent of the increase is greater in Scenario B than in Scenario A, such that the outlier in Scenario B is more extreme.

FIGURE 22.8. Sensitivity to outliers: two scenarios of coverage increase between two periods



Two summary measures were calculated to demonstrate sensitivity to outlier estimates: between-group variance (BGV) and MDM. BGV is sensitive to the outlier estimate because it gives more weight to estimates that are further away from the overall average (by squaring the differences between each estimate and the setting average). In Scenario A, where there is an outlier with the value of 60, inequality measured using BGV in Period 2 is 2.8 times higher than in Period 1, while inequality measured using MDM was 1.5 times higher (Table 22.5). In Scenario B, which features a more extreme outlier with the value of 80, inequality measured by BGV increased 5.8 times, while it increased 2.3 times using MDM. Therefore, MDM is less sensitive to the outlier effect than BGV.

TABLE 22.5. Comparison of between-group variance (BGV) and mean difference from mean (MDM) in terms of sensitivity to outliers

	Scenario A			Scenario B		
	Period 1	Period 2	Ratio (Period 2 / Period 1)	Period 1	Period 2	Ratio (Period 2 / Period 1)
BGV	125.0 squared percentage points	350.0 squared percentage points	2.8	125.0 squared percentage points	725.0 squared percentage points	5.8
MDM	10.0 percentage points	15.0 percentage points	1.5	10.0 percentage points	22.5 percentage points	2.3

Ratios are compared because BGV and MDM have different units.

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23

Reporting disaggregated data and summary measures of health inequality

Overview

Disaggregated data and summary measures of health inequality can yield an abundance of information about the state of inequality in a given iteration of monitoring. This can include disaggregated data for multiple health indicators and dimensions of inequality, across multiple time periods and settings, and as numerous corresponding summary measures of health inequality that capture absolute and relative inequality. Calculating and comparing the results of inequality analyses allows a thorough assessment of this information. Reporting usually features a curated selection of these results, with adequate accompanying information to aid understanding of their interpretation and limitations. Reporting should aim to convey sufficient data to portray the state of inequality and support recommendations and conclusions, but it should avoid presenting redundant or irrelevant information that is not matched to the needs and interests of the intended audience.

Reporting disaggregated data and summary measures of health inequality requires familiarity with data sources, analysis approaches and inequality measures. The selection of information for inclusion in inequality reporting entails technical considerations such as the scope of reporting (i.e. latest status, time trend or benchmarking) that can be supported, given the available results; details about the background context and data that should be included to ensure reporting is complete and transparent; how results can be conveyed most effectively using text, tables, graphs, maps and interactive data visuals; and reporting checklists and tools that can be used to promote completeness in reporting. These issues are addressed in this chapter.

The aim of this chapter is to enable technically rigorous, complete and visually impactful reporting of health inequality data and measurements. The chapter focuses primarily on the technical considerations for reporting the results of inequality analysis (acknowledging that strong examples of inequality reporting also attend to characteristics of the context and affected population, and the intended purpose and audience for a given reporting activity, which are addressed further in Chapter 7). The chapter begins with a discussion about the scope of monitoring, followed by an overview of components of complete reporting. Techniques for presenting inequality data are discussed, including text, tables, graphs, maps and interactive visualizations. It concludes by outlining examples of reporting checklists and tools.

Scope of reporting

The scope of reporting reflects the decisions about the relevant aspects of inequality analyses, considering the purpose of reporting and the characteristics of the intended audience (see Chapter 7). The scope of reporting generally refers to latest status, change over time and benchmarking. A running example of HIV testing in Liberia is used in this chapter to illustrate these components.

Latest status

As a minimum, reporting should include the latest status of inequality. Reporting the latest status of inequality uses the most current available disaggregated data and/or summary measures to address issues such as the current level of the health indicator across population subgroups; where inequalities are more and less pronounced, and for which subgroups; how the health of population subgroups compares with targets and policy priorities; and the priority areas for further action. Box 23.1 contains an example from Liberia, showing the latest status of inequality in HIV testing in females and males.

Change over time

Changes in inequality over time can be reported if data are available from more than one time point. This compares the latest status of inequality with data from a single previous period or trends across multiple periods. This is often included in reporting because it gives a sense of how inequalities have changed and whether the situation is improving, staying the same or getting worse. Summary measures of health inequality may be useful when reporting change over time, especially if data are presented for several time points and span multiple indicators, inequality dimensions and settings.

Alongside other evidence, data about change over time can provide initial insight into whether actions to address inequalities have been accompanied by reductions in inequality. It can also act as a warning system because situations of increasing inequality may warrant further investigation. When reporting change over time, any discrepancies in measurements between time points should be noted, such as differences in data collection methods, differences in how health indicators or dimensions of inequality are defined and prepared, or differences related to the affected population. Box 23.2 demonstrates change over time reporting for HIV testing among females and males in Liberia.

Benchmarking

Benchmarking compares the level of inequality across similar settings. Often, benchmarking is conducted between countries, showing how the level of inequality varies for a given health indicator and dimension of inequality. It can also be conducted between subnational regions of a country – for example, to compare the level of socioeconomic-related inequality in mortality among children aged under five years across provinces of a country. Like change over time, benchmarking may involve the use of summary measures of inequality, especially if capturing more than one time point or variable (such as showing inequality alongside national average).

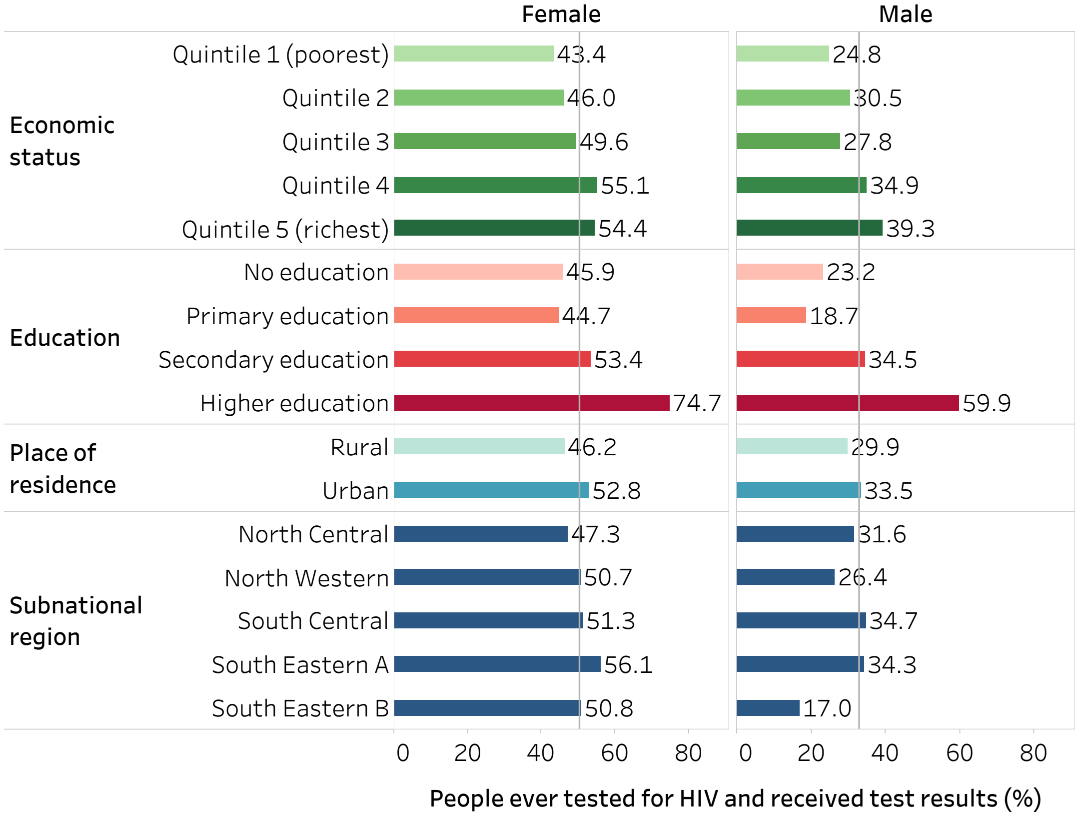
Benchmarking between settings requires that the underlying data are reasonably comparable – that is, collected around the same time and using similar methods. When reporting benchmarking, the criteria used to determine what constitutes “reasonably comparable” should be included in accompanying methods documentation to justify the selection of comparator settings. Box 23.3 shows benchmarking for the example of HIV testing in Liberia.

BOX 23.1. Example of latest status of inequality in HIV testing among females and males in Liberia

The indicator of HIV testing measures the percentage of people who have ever tested for HIV and received test results. The most recent data available are from the 2019 Demographic and Health Surveys (DHS). Figure 23.1 shows disaggregated data estimates for economic status (five subgroups), education level (four subgroups), place of residence (two subgroups) and subnational regions (five subgroups).

The use of bar graphs permits simple comparison of disaggregated data across the population subgroups for each inequality dimension, with the national average displayed as a vertical line. The choice of a horizontal bar graph to display subnational regions allows for the region labels to be displayed in a readable orientation. In both sexes, testing tends to be higher among subgroups that are richer, subgroups with higher education, and subgroups in urban compared with rural areas. The variation across subnational regions is larger in males (ranging from 17% in South Eastern B to above 34% in South Central and South Eastern A) than in females (ranging from about 47% in North Central to 56% in South Eastern A).

FIGURE 23.1. People ever tested for HIV and received test results, females and males, by economic status, education level, place of residence and subnational region, Liberia



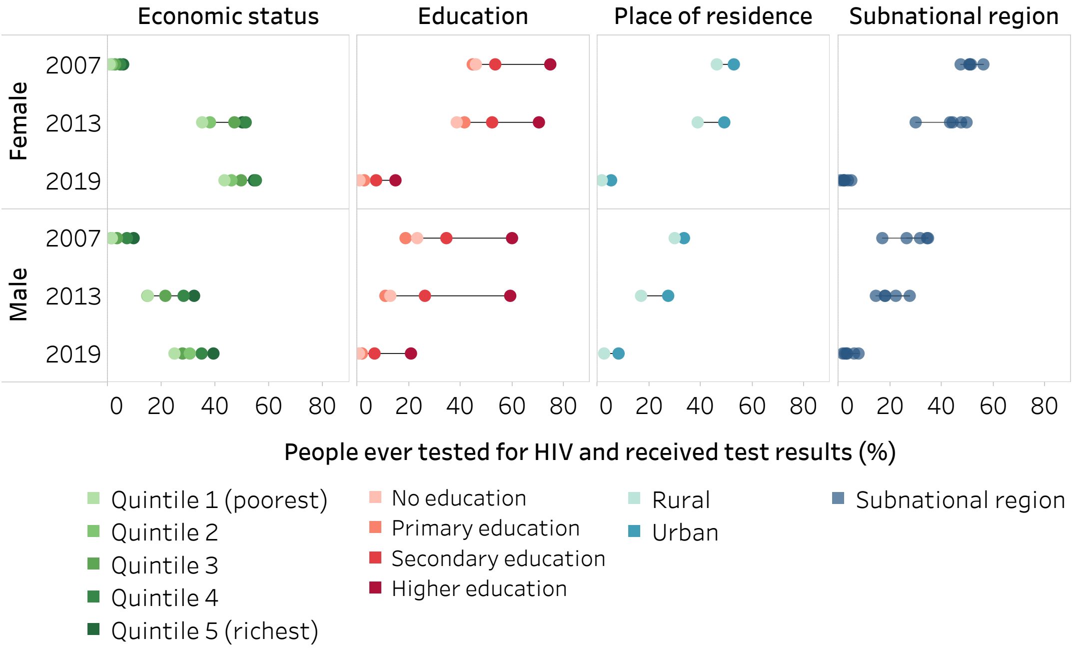
The vertical lines show the overall averages for females and males. The names for subnational regions recorded in Demographic and Health Survey datasets were retained.

Source: derived from the WHO Health Inequality Data Repository HIV/AIDS dataset *(1)*, with data sourced from the 2019 Demographic and Health Survey.

BOX 23.2. Example of change in inequality over time in HIV testing among females and males in Liberia

Continuing the example of HIV testing in Liberia from Box 23.1, change over time results show trends in inequality using comparable data from the 2007, 2013 and 2019 DHS. Using equiplots, Figure 23.2 displays data for females and males disaggregated by four inequality dimensions, for each point in time. Alongside increases in the national level of HIV testing in females and males over the three time points, there were increases in all the subgroups, especially between 2007 and 2013.

FIGURE 23.2. People ever tested for HIV and received test results, by economic status, education, place of residence and subnational region, females and males, Liberia

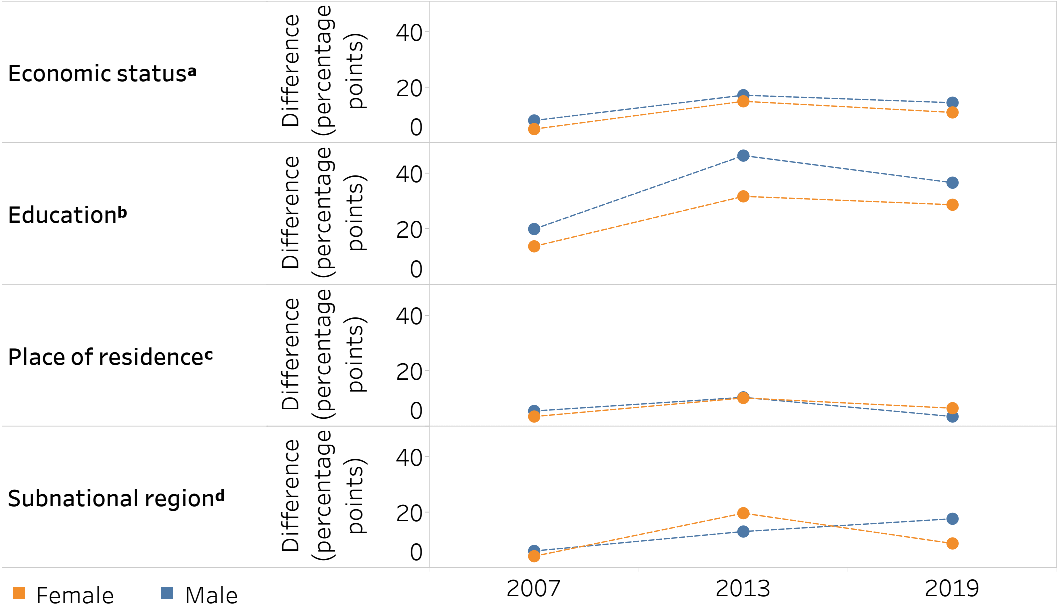


Source: derived from the WHO Health Inequality Data Repository HIV/AIDS dataset *(1)*, with data sourced from the 2007, 2013 and 2019 Demographic and Health Surveys.

BOX 23.2. *continued*

Line charts can be used to illustrate trends of how difference and ratio have changed over time for each of the four inequality dimensions. Absolute inequality related to education measured using difference tended to be higher in males than females; in both sexes, it was higher in 2013 compared with 2007 and 2019 (Figure 23.3). Absolute inequality related to economic status and place of residence was similar in females and males. Subnational regional inequality showed mixed patterns across the three time points.

FIGURE 23.3. Difference: people ever tested for HIV and received test results, by economic status, education, place of residence and subnational region, females and males, Liberia



[a] Economic status is categorized as five subgroups (quintiles), and the difference is calculated as the richest minus the poorest.

[b] Education level is categorized as four subgroups, and the difference is calculated as the most educated (higher education) minus the least educated (no education).

[c] The difference for place of residence is calculated as urban minus rural.

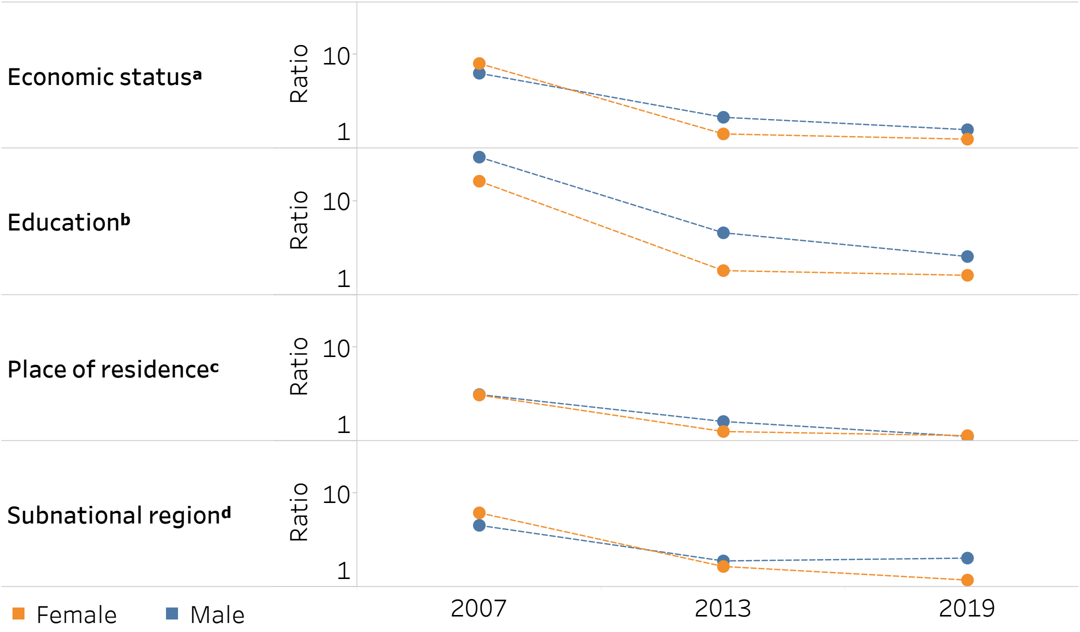
[d] Subnational region is categorized as five subgroups, and the difference is calculated based on the subgroup with the highest estimate minus the subgroup with the lowest estimate.

Source: derived from the WHO Health Inequality Data Repository HIV/AIDS dataset *(1)*, with data sourced from the 2007, 2013 and 2019 Demographic and Health Surveys.

BOX 23.2. *continued*

Relative inequality, measured using ratio, decreased between 2007 and 2013 for all four inequality dimensions in both sexes (Figure 23.4). Between 2013 and 2019, relative inequality tended to remain about the same or narrow slightly.

FIGURE 23.4. Ratio: people ever tested for HIV and received test results, by economic status, education, place of residence and subnational region, females and males, Liberia



[a] Economic status is categorized as five subgroups (quintiles), and the ratio is calculated as the richest divided by the poorest.
[b] Education level is categorized as four subgroups, and the ratio is calculated as the most educated (higher education) divided by the least educated (no education).
[c] The ratio for place of residence is calculated as urban divided by rural.
[d] Subnational region is categorized as five subgroups, and the ratio is calculated as the subgroup with the highest estimate divided by the subgroup with the lowest estimate.

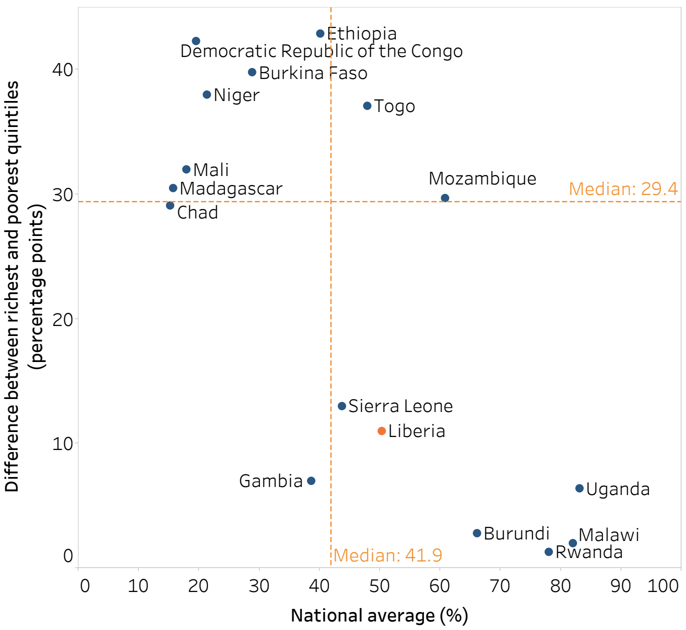
Source: derived from the WHO Health Inequality Data Repository HIV/AIDS dataset *(1)*, with data sourced from the 2007, 2013 and 2019 Demographic and Health Surveys.

BOX 23.3. Example of benchmarking HIV testing among females in Liberia

This example demonstrates benchmarking of economic-related inequality in HIV testing and receiving test results among females in Liberia. The situation in Liberia is benchmarked with 15 other low-income countries in the WHO African Region whose most recent available data were from 2010 or later.

The use of a scatterplot presents economic-related inequality, measured as difference, alongside national average (Figure 23.5). Countries in the lower right quadrant have the highest national average alongside the lowest difference. In this group of countries, Liberia (highlighted in orange) reported a national average above the median and was one of seven countries that reported a rich–poor difference below 15 percentage points. The best-performing countries in this group, with national averages above 75% and absolute economic-related inequality below 2 percentage points, were Malawi and Rwanda.

FIGURE 23.5. Difference and national average: people ever tested for HIV and received test results, by economic status, females, Liberia and 15 other low-income African countries



Source: derived from the WHO Health Inequality Data Repository HIV/AIDS dataset *(1)*, with data sourced from the most recent AIDS Indicator Survey or Demographic and Health Survey conducted between 2010 and 2021.

Components of complete reporting

Within the established scope of reporting, the content, including technical content, can be determined. Health inequality monitoring reporting should contain sufficient information for audiences to understand the main messages, recommendations and conclusions. In general, reporting includes information about the background and context, the methods for assessing data, the analysis results or main findings, and the implications of the findings (see Chapter 24). Depending on the audience and reporting output, these components may be featured with varying degrees of detail and emphasis.

> Maintaining detailed notes across all steps of the inequality monitoring cycle can make reporting easier by compiling relevant information and considerations.

Background information

Background information about the setting and population of interest and findings from qualitative sources provide context for reporting and help to set the scene. Background information situates the purpose of monitoring – that is, why monitoring was undertaken and what it is setting out to accomplish. The specific type of background information may vary, depending on the reporting output and audience. In some cases, the inclusion of photos or personal stories can make the report context more relatable and compelling and enhance its impact. See Box 23.4 for descriptions of the type of background information included in the WHO State of Inequality reports *(1–4)*.

Technical content

The technical content refers to the results of the inequality analysis that are reported to support the major findings and conclusions. Technical content includes results of analyses derived from disaggregated data and summary measures of health inequality. It also includes other details related to the analysis, such as overall average, population size or share, and uncertainty measures (Box 23.5), and metadata describing specifics about the data source, variables and calculation methods.

As with all reporting decisions, technical content should be selected with the intended reporting purpose and audience in mind. In particular, the needs, interests and technical abilities of the audience should guide decisions about the technical information so the content is appropriately transparent, accurate and easy to understand.

> Reporting requires that data and results are curated and interpreted. It is not simply a comprehensive collection of all underlying data and analysis results.

Although there are many possible reporting outputs from health inequality monitoring (see Chapter 7), the presentation of technical content in reports often shares common components. These include a summary of results, main content, appendices of detailed results, and technical appendices. These may be made available in different ways, such as printed reports, downloadable PDFs and web content, or

BOX 23.4. Examples of background information presented in WHO State of Inequality reports

- The background section of the WHO *State of inequality: reproductive, maternal, newborn and child health* report describes key issues related to health inequality in the topic area. It includes an overview of the major global policies and initiatives related to the topic since the year 2000, and how they address equity *(1)*.
- The first chapter of the WHO *State of health inequality: Indonesia* report provides information about demographic and health trends in the country, the political landscape and development process, and an overview of relevant aspects of the health sector *(2)*.
- The WHO *State of inequality: childhood immunization* report gives an overview of the global context for advancing equity in childhood immunization, highlighting past, current and emerging immunization-related milestones and initiates *(3)*.
- The WHO *State of inequality: HIV, tuberculosis and malaria* report presents data about the epidemiological profile of each disease, global commitments, information about key and underserved populations, and a literature review about current state of knowledge pertaining to inequalities *(4)*.

BOX 23.5. Descriptive statistics to report alongside inequality analysis results

- Overall average: the level of the health indicator in the population, such as the national average, gives a sense of the overall situation. For example, the national average may be presented alongside disaggregated data using a horizontal line across a vertical bar chart or alongside a summary measure of inequality (e.g. using a scatterplot).

- Population size or share: the population size (number of affected people represented by each population subgroup) and population share (percentage of the total affected population represented by each population subgroup) are key pieces of information to report alongside the findings. Population size or share statistics are particularly important to report if there is a large variation across population subgroups or a major shift over time.

- Subgroup sample size: if using data from household surveys, results based on small sample sizes should be flagged or suppressed. See Chapter 17 for a discussion of sample size considerations.

- Uncertainty measures: reporting uncertainty measures for disaggregated estimates, such as 95% confidence intervals or standard errors, is an important part of transparency in reporting. This can help audiences understand the extent of sampling errors when comparing estimates between population subgroups, and guide assessments about how conclusions can be drawn from the data. This level of detail, however, may not always be suitable for the intended audience. See Chapter 18 for more on measures of uncertainty and significance.

platforms such as GitHub. Increasingly, there is a trend for greater transparency and sharing of information, such as datasets, source codes and detailed results, as supplementary materials to the main content. Reporting this information facilitates its availability for inclusion in subsequent systematic reviews and meta-analyses.

Disaggregated data

Disaggregated data are a good starting point for reporting results because they present information in a straightforward and intuitive manner that is appropriate for diverse audiences with variable levels of technical expertise. In particular, describing patterns across ordered population subgroups can be a powerful way to report disaggregated data (see Chapter 18). In some cases, reporting disaggregated data may be sufficient to present inequality analysis, especially if the scope of reporting is confined to the latest status of inequality in a limited number of indicators.

Summary measures of health inequality

In many reporting applications, summary measures of health inequality are useful, keeping in mind their interpretation and limitations (see Chapters 19–22). Summary measures can concisely convey information about the level of inequality in a single number, facilitating comparisons over time and across settings and indicators. Pairwise summary measures of health inequality (i.e. difference and ratio measures) tend to be easier to comprehend than complex summary measures. Therefore, if pairwise and complex measures of inequality support the same conclusions, it is generally preferable to report pairwise measures, especially for audiences with less technical knowledge. If pairwise and complex measures do not support the same conclusions, a closer look at the data is needed to determine the reason for the discrepancy. The reporting of complex measures may be warranted to present a more nuanced depiction of the situation, if appropriate for the audience and the purpose of reporting. For example, it may be appropriate to include several complex measures of inequality in reporting targeted to academic audiences with high levels of technical expertise. This may be the case for an output such as a peer-reviewed journal article. If complex summary measures of inequality are reported, the underlying methods and their interpretation should be explained as clearly as possible.

If reporting summary measures (whether pairwise or complex), both absolute and relative measures should be included. This helps to ensure the reporting provides a balanced perspective on the state of inequality, capturing both the absolute magnitude of inequality and the relative inequality between subgroups. In addition, to facilitate a more complete understanding of the results of summary measures, the underlying disaggregated data and national (or overall) average should be reported, along with other pertinent information. For more on interpreting summary measures of health inequality, see Chapter 22.

Methods and metadata

Information about the methods and approaches used for health inequality analyses should be provided in an upfront and accurate manner. This includes descriptions of the data sources, health indicators and inequality dimensions, analysis methods and interpretation approaches. Reporting may also provide information about the selection of settings, populations and variables. If appropriate, the reason behind the choice of methods should be explained, and any pertinent limitations should be acknowledged. This information is important to establish the parameters of monitoring and add clarity to how the data support or do not support certain conclusions. In some cases, it may be appropriate to provide links to resources such as data repositories, software code or background methods papers. Box 23.6 describes how methods were reported in the WHO State of inequality reports *(1–4)*.

BOX 23.6. Example of methods reporting in WHO State of inequality reports

The WHO State of inequality reports contain an overview of the methods in the main report *(1–4)*. This includes information about the data, such as data sources, definitions and country selection, and information about the analysis, such as data disaggregation and summary measures of health inequality. More detailed information is provided in technical appendices and indicator compendiums. The data featured in these reports are available through the Health Inequality Data Repository *(5)*. The level of detail about the methods is sufficient such that the analysis approach could be replicated.

Metadata are data that describe and give information about other data. In the context of inequality monitoring, metadata often include detailed information related to data collection protocols, data sources, and definitions and calculation of indicators and dimensions of inequality. When reporting metadata for multiple variables, adopting a standard format to present the data enables audiences to readily access information of interest. Box 23.7 demonstrates the fields of metadata reported for all indicators included in the WHO *State of inequality: HIV, tuberculosis and malaria* report *(4)*.

Although it is important to have a sound justification for the conclusions derived from inequality analyses, the level of detail about methods and metadata that is reported should reflect the intended purpose and audience of reporting. In cases where reporting is of a less technical nature, much of the relevant metadata and methods may be made available as supplementary material or annexes. In cases where reporting is targeted to an audience with high levels of expertise, it may be relevant to put more emphasis on such details, and to discuss their merits and limitations in detail.

BOX 23.7. Metadata fields reported for indicators featured in the WHO *State of inequality: HIV, tuberculosis and malaria* report

The WHO *State of inequality: HIV, tuberculosis and malaria* report included 32 health indicators across the three diseases *(4)*. In the report annex, indicator metadata for each indicator were reported in tables, according to the following fields: indicator name, data unit, data source, definition, numerator, denominator, method of estimation, disaggregation and comments (e.g. links to where estimates were obtained or caveats in the data). A snapshot of the metadata entry for HIV incidence (new infections per 1000 population) is provided as an example in Figure 23.6.

FIGURE 23.6. Snapshot of metadata entry

	HIV
Indicator name	**HIV incidence (new infections per 1000 population)**
Data unit	Rate
Data source	UNAIDS/UNICEF/WHO
Definition	Number of new HIV infections per 1000 uninfected population Incidence rate is number of new cases per population at risk in a given time period
Numerator	Number of new HIV infections
Denominator	Uninfected population (total population minus people living with HIV)
Method of estimation	Modelling is often used to obtain an estimate of new infections using prevalence data as the main input data. Most countries rely on modelled estimates using Spectrum, a UNAIDS-supported software tool. To calculate the uninfected population per 1000, the estimate of the number of people living with HIV is subtracted from the previous year's population estimates produced by UNDP https://www.unaids.org/en/resources/documents/2016/methods-for-deriving-UNAIDS-estimates
Disaggregation	Sex
Comments	Estimates obtained through AIDSinfo (UNAIDS/UNICEF/WHO) https://aidsinfo.unaids.org/

Source: WHO *State of inequality: HIV, tuberculosis and malaria* report *(4)*.

Presenting inequality data

The presentation of inequality data should aim to clearly and accurately show the analysis results that support key findings. Ideally, it also incites the audience's interest in and engagement with the data. Therefore, decisions about how to present inequality data require a close understanding of the technical content underlying the major messages, the reporting context and the intended audience. To the extent possible, consulting members of the intended audience to get feedback on data presentation can help to further refine reporting approaches and enhance their impact.

The main approaches for presenting inequality data include text (or narration), tables, graphs and maps. Interactive data visualization through a digital format enables tailored engagement with the data. Text and tables are commonly used in inequality reports to provide a description of findings using words and numbers. Text is useful to explain nuances and patterns in results narratively, and to describe their significance. Tables are useful to present a set of data values in a consistent, precise and comprehensive way.

Graphs and maps show data in a manner that conveys meaning through visual presentation, relying on graphics to illustrate patterns in the underlying dataset. When designed well, they support rapid comparisons among values and make outliers visible. Graphs can be effective in simplifying complex messages and associations in the data and facilitating interpretation of large datasets. Several graph types are useful when presenting inequality data. Maps are useful for showing data with a geographical component.

Interactive visualization technology offers possibilities for audiences to explore data digitally and dynamically.

These approaches are not mutually exclusive. For example, tables, graphs and maps often contain text, or their interpretation may be facilitated by accompanying text. Tables may contain visual elements typical of graphs (e.g. colour-coding). Graphs and maps sometimes integrate tabular presentations of data. Many applications of interactive data visualization rely on several of these approaches.

Text

The text featured in inequality reporting typically presents information about the context, data, analysis methods, findings and implications. It is better to avoid writing out all information presented in tables or graphs, and instead to provide a summary of what is described, highlighting the most salient findings. Effective text is descriptive, concise and targeted at a reading level at or below that of the intended audience (acknowledging there may be a range of abilities within an audience). Jargon and technical terms should be limited and used only when writing for audiences with advanced levels of expertise, where such terms are required for precision and technical clarity. Text should be written and formatted in a deliberate and logical way, avoiding common pitfalls in inequality reporting (Box 23.8). Text may be sufficient as a standalone approach to present data when the key messages contain few numerical values or when the patterns in the data do not require visualization.

Tables

Tables often provide the most efficient and effective way for many variables and a mixture of both disaggregated data and summary measures of inequality to be presented together. For example, tables can present summary measure values alongside disaggregated data estimates and overall averages and confidence intervals. In this way, tables may serve as a reference with more comprehensive and detailed information across multiple settings, health indicators and inequality dimensions. With the purpose of the table in mind, the design of tables should facilitate simple navigation by the intended audience (Box 23.9).

Tables tend to demand effort from the reader to interpret and derive conclusions because patterns in the data may not be immediately apparent. Some tables may facilitate quicker interpretation by, for example, containing only key information, rounding to whole values, and incorporating the use of colour-coding of cells (see Box 23.10 for an example). Formatting tables as heatmaps or introducing other such modifications may facilitate visual interpretation of results, but this may sacrifice the precision of more detailed tables.

Data visualization using graphs and maps

The following sections describe graphs and maps that are frequently used when reporting inequality (acknowledging that this chapter does not comprehensively cover all types of graphs and maps that may have applicability to health inequality monitoring). Annex 15 contains descriptions of additional types of graphs and maps, guidance on selecting an appropriate graph or map for different uses, and tips for preparing them.

Graphs and maps can be created using software applications, including the WHO Health Equity Assessment Toolkit (HEAT and HEAT Plus) *(7)*.

BOX 23.8. Common issues in inequality texts

Reporting text should ensure terminology is clearly defined and used consistently throughout the text. Some of the common issues encountered in inequality texts include the following:

- Health inequality and health inequity are commonly understood as a measurable difference in health (in the case of inequality) or an unfair, avoidable or remediable difference in health (in the case of inequity). Related terms such as health disparity have variable meanings, depending on the context (see Chapter 1). Reports should aim for clarity and consistency in the use of language.

- Wealth inequality measures, such as the Gini coefficient, are common economic measures that compare the extent of the difference or variation in economic status across a population. Wealth-related inequality in health describes and compares how subgroups with different economic status experience health. Health inequality reporting as described in this book typically focuses on wealth-related inequality in health, although wealth inequality may be included as part of the background context. In some cases, data analysis may explore wealth inequality as a determinant of health (see Annex 1).

- The median represents the middle value in a dataset. The mean is the average, calculated from adding all values and dividing by the number of values.

- Per cent expresses a rate out of 100. Percentage points are used when comparing percentages. For example, an increase from 50% to 55% represents a gain of 10%

  $$(55\% - 50\%) / 50\% = 0.1 \times 100 = 10\%$$

  or a gain of 5 percentage points

  $$55\% - 50\% = 5 \text{ percentage points}$$

- Statistical and public health significance provide different ways of assessing whether a result is meaningful. Statistical significance is a mathematical calculation, but public health significance is a determination that accounts for the importance of the result from a public health perspective (see Chapter 18).

- Sex and gender are distinct but related concepts. Sex refers to the different biological and physiological characteristics of females and males. Gender reflects the norms, behaviours and roles associated with a particular identity *(6)*.

- Causation versus correlation: texts should avoid making claims of causation unless they are supported by the underlying data.

- Determinants of health are factors that combine together to affect the health of individuals and communities. Dimensions of inequality refer to the criteria upon which population subgroups are categorized for monitoring (see Chapter 3). An understanding of relevant determinants of health in a population can inform the selection of dimensions of inequality for monitoring.

BOX 23.9. Effective table design

Although tables may be designed to serve different purposes, there are certain general recommendations that promote greater usability by the intended audience:

- Tables should have descriptive titles and headers that are easy to read.
- The use of gridlines should be limited to those that are essential to facilitate reading and interpreting the table.
- The alignment of the column headers should be consistent with the contents of the cells below.
- Where applicable, the numbers in a column should be aligned at the decimal point position so they can be compared easily.
- Numbers should be rounded in a consistent way – for example, rounding to one decimal point for percentages tends to ensure readability.
- If using colour-coding, colours should be selected that conform to general perceptions, such as green/blue for desirable and red for undesirable. The selection of colour combinations should be made in consideration of individuals having varying abilities to see certain colours (in particular, green–red colour combinations should be avoided).
- Notes and footnotes can be used to indicate additional information about the data, such as cases of small sample size, or to explain the special use of symbols or dashes. Abbreviations should be spelled out in full in the footnotes, and data sources should be specified (where applicable).
- If multiple tables are used in a single report, the design should be consistent throughout.

BOX 23.10. Heatmaps and use of sequential and diverging colour scales

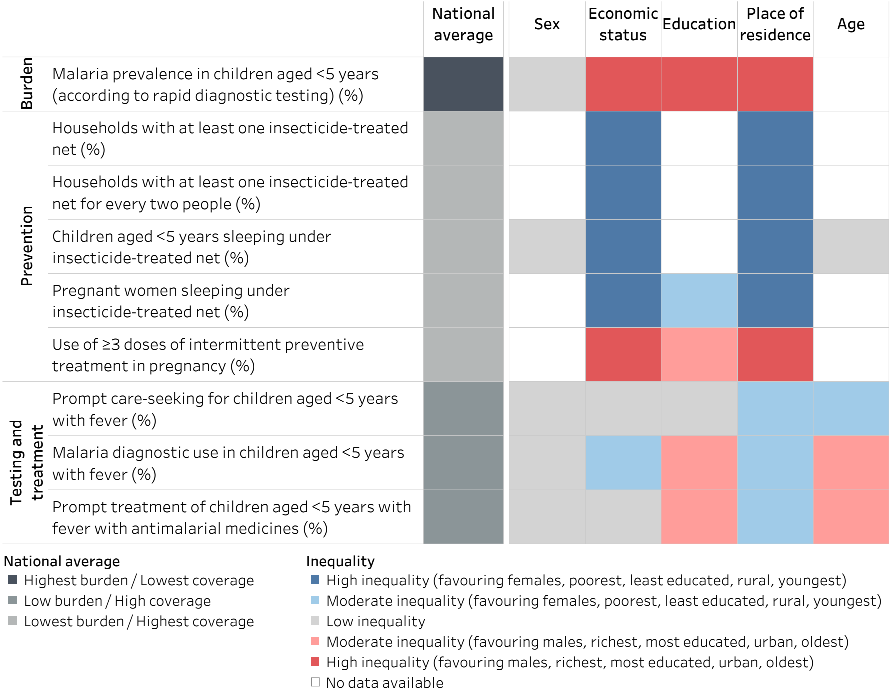
Heatmaps may be formatted as tables, applying colour-coding that corresponds to data values. They enable rapid approximate comparisons. Figure 23.7 shows an example of a heatmap with data for nine malaria indicators in Togo. This heatmap applies two types of colour scales: sequential (ranging from light to dark grey for national average) and diverging (ranging from light to dark across red and blue above and below a centre grey value for inequality). Thresholds in the data were established to define each colour assignment.

The sequential scale applied in the national average column uses dark grey to indicate the least desirable scenario – high malaria burden or low intervention coverage – and light grey to indicate more desirable situations. Sequential scales tend to be intuitive to interpret and are appropriate when the data values have no defined middle point. In addition to the example shown in Figure 23.7, sequential scales can also be useful to present disaggregated data about health service coverage, expressed as percentages.

BOX 23.10. *continued*

On the right, a diverging colour scale is applied to show the level of inequality according to five dimensions of inequality. Diverging colour scales are appropriate when there is a meaningful middle point and values at opposing sides of the middle are to be emphasized. Here, the colour of each cell corresponds to a particular threshold of inequality (high, moderate or low) and directionality of inequality, as indicated in the legend. After becoming familiar with the colour legend, the trends from this data are evident from a quick inspection of the table. The red cells indicate inequality favouring groups that are traditionally considered to be advantaged (or in the case of sex, in the context of this report, males), whereas blue cells indicate inequality in the opposite direction. Darker shading indicates higher inequality. Low inequality – the middle point – is evident by the grey shading.

FIGURE 23.7. Country heatmap of selected malaria indicators and dimensions of inequality in Togo



Source: derived from the WHO *State of inequality: HIV, tuberculosis and malaria* report *(4)*, with data sourced from the 2017 Malaria Indicator Surveys.

Graphs

Many graph types can be used to show inequality data. In general, it is recommended to choose the type of graph that is the least cognitively demanding – that is, easy to understand and uncluttered. Depending on the intended audience and the level of technical detail that is appropriate, graphs may incorporate elements that show the level of uncertainty around estimates. Some of the most common graphs, which are featured in the WHO HEAT and HEAT Plus *(7)* and State of Inequality reports *(1–4)*, include bar graphs, equiplots, dot plots, scatter plots and line graphs. As described below, these graphs are suitable for different applications within inequality reporting. Technical practices for creating graphs that are accurate and non-distorted are highlighted in Box 23.11.

BOX 23.11. Best practices for accurately presenting data using graphs

The following best practices should be followed when creating health inequality graphs:

- If charting data across multiple time periods, ensure consistent axis spacing for time, especially when data are available at irregular intervals.
- Use a logarithmic scale for multiplicative measures such as ratio and relative index of inequality, so the results are displayed in accordance with the extent of inequality they represent. Keep in mind that the baseline value for no inequality for these measures is 1.
- Avoid distorting or misrepresenting data by elongating or inverting axes. Truncation of the axes should be avoided with graphs that use the height or length of objects to encode values, such as bar graphs.
- Include clear and appropriate captions to ensure graphs are as self-explanatory as possible.

For further reading about data presentation using graphs, see the following:

Asada Y, Abel H, Skedgel C, Warner G. On effective graphic communication of health inequality: considerations for health policy researchers. Milbank Q. 2017;95(4):801–835. doi:10.1111/1468-0009.12300.

Cleveland WS. Graphical methods for data presentation: full scale breaks, dot charts, and multibased logging. Am Stat. 1984;38(4):270–280. doi:10.2307/2683401.

Cleveland WS, McGill R. Graphical perception: theory, experimentation, and application to the development of graphical methods. J Am Stat Assoc. 1984;79(387): 531–554. doi:10.1080/01621459.1984.10478080.

Few S. Now you see it: simple visualization techniques for quantitative analysis. Berkeley, CA: Analytics Press; 2009.

Few S. Show me the numbers. Berkeley, CA: Analytics Press; 2004.

Kosslyn SM. Graph design for the eye and mind. New York: Oxford University Press; 2006.

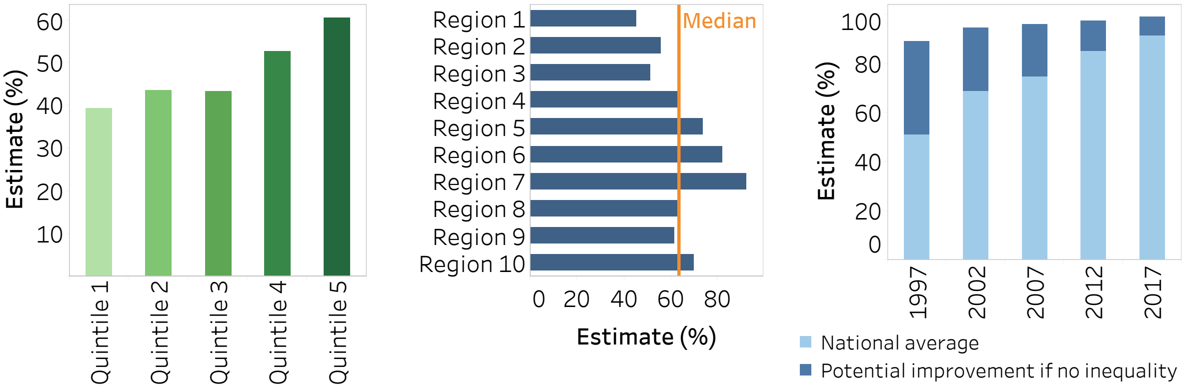
Tools for making good data visualizations: the art of charting. Copenhagen: World Health Organization Regional Office for Europe; 2021 (https://iris.who.int/handle/10665/342568, accessed 14 June 2024).

Bar graphs provide versatile options for different presentations of inequality (Figure 23.8). They may be vertical or horizontal. If the data need to be subdivided into smaller sets, they may be stacked. For example, a vertical bar graph can be used to show country data for one health indicator, disaggregated by one dimension of inequality for a single time point. Vertical bar graphs are commonly used to show country data for multiple indicators and across multiple dimensions of inequality. They can also be used to show summary measures of inequality such as difference and ratio (ensuring the use of logarithmic scales for multiplicative measures).

Horizontal bar graphs are useful to present disaggregated data across large numbers of subgroups, such as districts of a country. The horizontal orientation ensures the subgroup names can be written in full to the left of the bars, and bars can be arranged in ascending or descending order.

Stacked bar graphs, either vertical or horizontal, are useful when reporting the summary measure population attributable risk (PAR) because the stacked bars can illustrate the current and potential national average that could be achieved by eliminating inequality. Proportional stacked bar graphs are appropriate for indicators measured

FIGURE 23.8. Snapshots of vertical, horizontal and stacked bar graphs



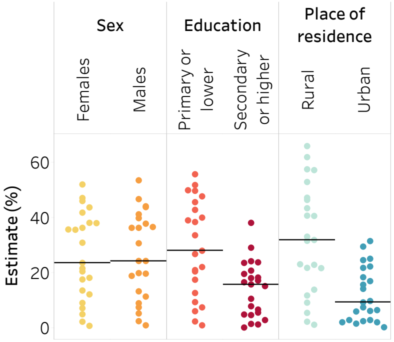
as a proportion, where the sum of the data across subgroups makes a whole.

Dot plots serve the same function as bar graphs, but they allow for the quantitative scale to start at a value above zero. Equiplots, which are a type of dot plot, have special applicability when comparing sets of disaggregated data across multiple countries, settings or time points (Figure 23.9) *(8)*. Dots (or other shapes) representing disaggregated data points are plotted in a line corresponding to a specified date and/or setting. A solid line connects the dots (data points) at either extreme, representing the range between the minimum and maximum values. Equiplots that contain two dots per line (or column, if oriented vertically) are sometimes called dumbbell plots. Various tools for creating equiplots are available *(7, 9, 10)*.

Strip plots are useful when showing the distribution of multiple data points across several populations (Figure 23.10). They can be used to show disaggregated data or summary measures. Using one column per subgroup, strip plots illustrate how a set of data points are clustered and distributed. Dots in a strip plot can be jittered – that is, slightly offset to

FIGURE 23.9. Snapshots of vertical and horizontal equiplots

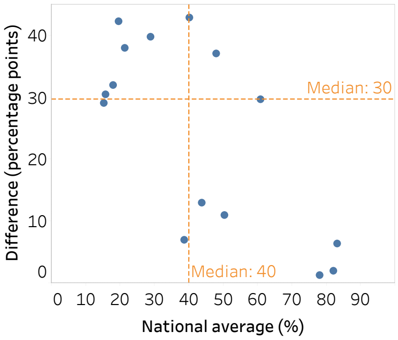
FIGURE 23.10. **Snapshot of a strip plot**



avoid overlapping – to enhance their visibility. A strip plot could be used, for example, to show the level of a health indicator in females versus males for multiple countries. For data to be reported in this way, there must be no subgroups with missing data – that is, each column must contain a data point for each country. A solid horizontal line can be used to show the median across the countries for each subgroup. Note that strip plots can also be oriented horizontally, with each row containing data for a given subgroup.

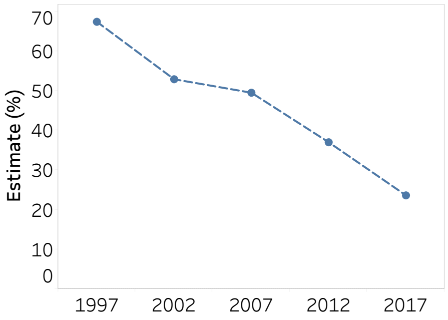
Scatterplots contain information about two variables, plotted together on the same graph to show the relationship between them. In the context of presenting health inequality data, scatterplots are commonly used to show summary measure results alongside setting averages (Figure 23.11). For example, a scatterplot might show difference or ratio plotted on the *y*-axis against national average plotted on the *x*-axis for all countries within a particular region (see Box 23.3). In this application, a scatterplot can help to quickly group countries according to the magnitude of inequality and their overall situation (noting countries to the left or right side of the graph). Scatterplots can also be used to illustrate the relationship between a health indicator and a determinant of health (see Chapter 25 for more on ecological analysis).

FIGURE 23.11. **Snapshot of a scatterplot**



Line or slope plots are useful for showing time trend data and making comparisons across subgroups, indicators or settings (Figure 23.12). Line graphs with multiple lines require labels or legends to identify the data represented by each line. Although they have some similar applications as vertical bar graphs and equiplots, line graphs are only appropriate for displaying data across an interval scale, such as time.

FIGURE 23.12. **Snapshot of a line plot**



Maps

Choropleth maps display divided geographical areas or regions that are coloured or shaded in relation to a data variable, such as a health indicator or a summary measure of inequality. These maps tend to be visually impactful, highlighting areas of advantage and disadvantage, but there are important limitations in terms of their interpretation. For example, the area of a map does not correspond to population size or density – a limitation that should be acknowledged when guiding audiences through the interpretation of maps (e.g. a large rural province of a country occupies more space on a map than a densely populated capital city).

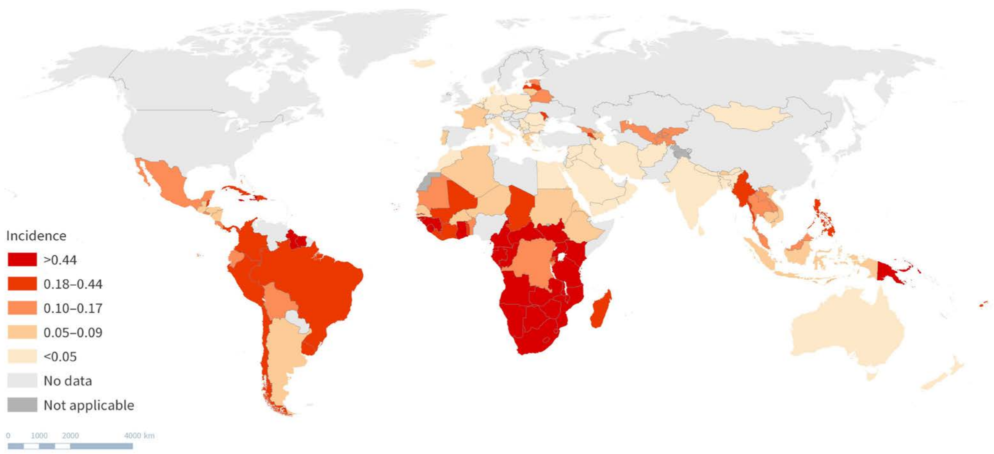
Apart from geographical information, maps generally only display one variable at a time. Defining the criteria to colour-code areas on a map (such as data thresholds or ranges) is not straightforward and limits the level of detail provided about the data. Maps tend to be most useful for showcasing approximate comparisons, although the chosen thresholds for colour-coding should allow for an assessment of the public health significance of the findings. Maps should indicate where data are not available or not applicable. Any contested borders or areas should be noted on the map, if applicable.

> The use of thresholds facilitates quick data interpretation, but a drawback is that it lacks precision. For example, defining a threshold of high inequality as a difference of 20 percentage points or higher would mean that an inequality of 60 percentage points would be colour-coded the same, and therefore treated the same, as an inequality of 20 percentage points.

There are several ways that maps may be used when reporting inequality data. Maps may be used to provide background contextual information, such as national averages of relevant health indicators. Figure 23.13 is a snapshot of a map featured in the *State of inequality: HIV, tuberculosis and malaria report (4)*. Maps of this type were used to present background information such as the overall HIV incidence across countries. Colour-coding corresponds to five defined thresholds, with the lowest incidence in lighter colour, and the highest incidence in darker colour. Light grey indicates no data, and dark grey indicates not applicable.

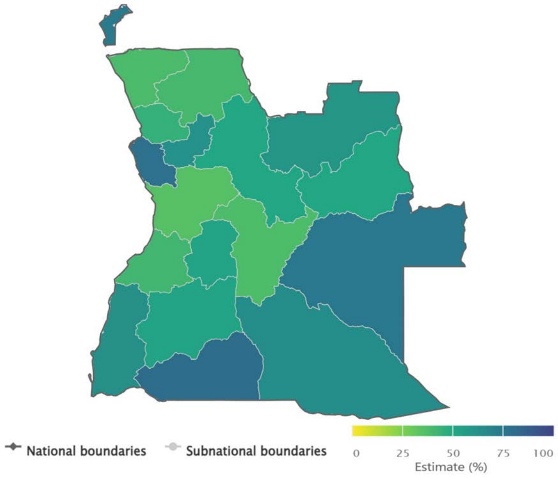
When using maps to show disaggregated data, they may present data disaggregated by a geographical dimension of inequality, such as subnational region. This is the most straightforward way of showing inequality on a map. The snapshot in Figure 23.14 is a map derived from the Health Equity Assessment Toolkit (HEAT), showing data about an indicator of accepting attitudes towards people with AIDS (would buy fresh vegetables from a shopkeeper with AIDS) among females in Angola, according to 18 subnational regions (provinces). The colours correspond to the level of coverage, ranging from around 36% in the central west province of Cuanza Sul to 80% in the southern province of Cunene.

FIGURE 23.13. **Snapshot of map providing contextual information about national averages: HIV incidence (new infections per 1000 population) in 130 countries**



Source: derived from the WHO *State of inequality: HIV, tuberculosis and malaria* report *(4)*, with data from 2021 sourced from the Joint United Nations Programme on HIV/AIDS, the United Nations Children's Programme and WHO.

FIGURE 23.14. **Snapshot of map showing disaggregated data: accepting attitudes towards people with AIDS (would buy fresh vegetables from a shopkeeper with AIDS) by subnational region, Angola**



Source: derived from the WHO Health Inequality Data Repository HIV/AIDS dataset *(1)*, with data sourced from the 2015 Demographic and Health Surveys.

To show data disaggregated by nongeographical dimensions, multiple maps may be used and compared. For example, disaggregated health data pertaining to the least educated subgroup may be shown on one map, and disaggregated health data pertaining to the most educated subgroup may be shown on another map. This use of multiple maps, however, requires substantial effort by users to compare between the images and interpret the findings. The technique should be used sparingly, and only when the intended interpretation is compelling.

For example, Figure 23.15 uses multiple maps to show data about household air pollution exposure, using the indicator "proportion of population with primary reliance on clean fuels and technologies for cooking", disaggregated by urban and rural place of residence. The two maps portray data from urban and rural areas. A darker colour indicates higher coverage of clean fuels and technologies for cooking, and a lighter colour indicates lower coverage. Looking at the two maps, several countries reported lower coverage in rural compared with urban areas.

Maps may also be used to present the results of summary measures of health inequality across

FIGURE 23.15. **Snapshot of two maps presenting disaggregated data: household air pollution exposure (population with primary reliance on clean fuels and technologies for cooking) by place of residence**

(A) Urban areas

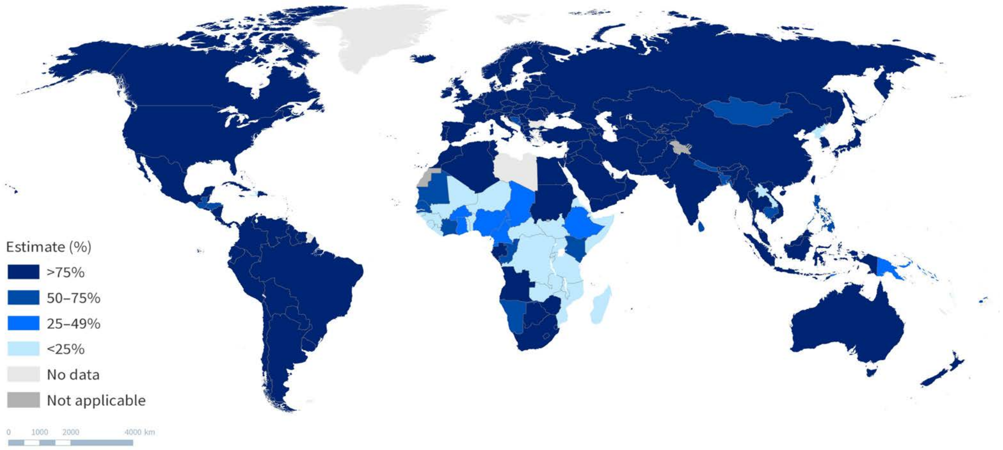
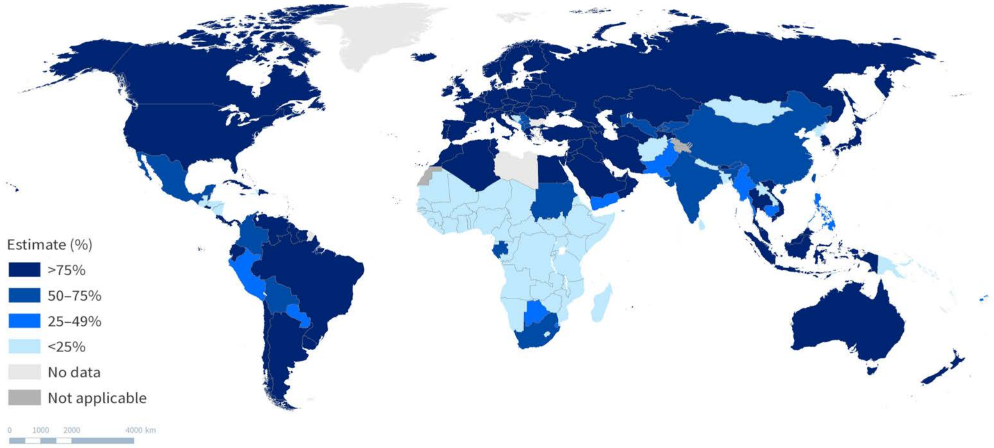


FIGURE 23.15. *continued*

(B) Rural areas

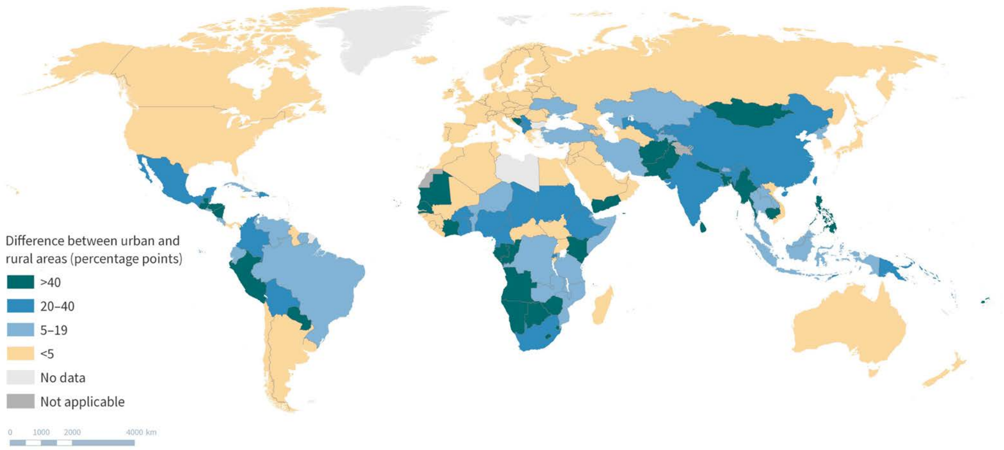


Source: derived from the WHO Health Inequality Data Repository Environmental Health dataset *(1)*, with data from 2021 sourced from the WHO Global Health Observatory.

multiple settings, defining thresholds to colour-code different levels of inequality. For example, a summary measure of place of residence-related inequality could be calculated using data about urban and rural subgroups. The summary measure could then be portrayed on a map using colour-coded thresholds to show different levels of inequality.

Figure 23.16 shows place of residence-related inequality, calculated as difference between urban and rural areas, for the indicator "proportion of primary reliance on clean fuels and technologies for cooking" in 190 countries. Countries on the map are coloured according to defined thresholds of <5 percentage points, 5–19 percentage points, 20–40 percentage points and >40 percentage points.

FIGURE 23.16. Snapshot of map showing summary measure of health inequality: urban–rural difference in household air pollution exposure (population with primary reliance on clean fuels and technologies for cooking)



Source: derived from the WHO Health Inequality Data Repository Environmental Health dataset *(1)*, with data from 2021 sourced from the WHO Global Health Observatory.

See Chapters 16 and 25 for examples of how maps may be used to present data used for geospatial analysis.

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Interactive data visualizations

Interactive data visuals can present large amounts of data in an approachable and modifiable format, integrating text, tables, graphs and maps. Other interactive elements, such as tooltip boxes that appear when hovering over the data, may be used to provide additional information about the data. Often, interactive data visuals can be tailored by the user through the selection of health indicators, inequality dimensions and settings of interest, allowing for extensive data exploration. Interactive data visuals are particularly useful to help experienced users navigate large datasets because they make it possible to drill through levels of data to create a narrow view that fits the specific interests of the user.

Interactive data visuals may consist of a single view or multiple dashboards. In some cases, a series of connected interactive data visuals may be used to construct a storyline based on the data. This can be an impactful way for users to navigate across multiple dashboards. When designing interactive visuals, it is important to ensure they are appropriately matched to the skills and experience of the intended users. The use of multiple filters, visualization types and interactive components may add confusion for users that are not accustomed to in-depth data exploration. Various software programmes are available that can help to create and maintain interactive visuals, including open-source options. Certain programmes are tailored towards presenting geographical information using interactive maps. A hosting platform is required to make interactive visuals available online. The use of interactive data visuals requires audiences to have digital literacy and access. Depending on the audience and their circumstances, it may be preferable for interactive visuals to be downloadable or available offline.

Interactive data visuals related to HIV, tuberculosis and malaria are available for exploration on the *State of inequality: HIV, tuberculosis and malaria* report landing page on the Health Inequality Monitor *(11)*. Elsewhere, interactive country profiles show inequality in reproductive, maternal, newborn and child health indicators *(12)*.

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Reporting checklists and tools

As part of its series of inequality monitoring step-by-step manuals, WHO has developed a collection of best practices for reporting inequality monitoring *(13–15)*. The checklist below promotes high standards of inequality reporting and is a way to ensure the necessary technical and nontechnical information is considered when preparing reporting outputs. This checklist is widely applicable to reporting targeted to different audiences and to diverse reporting outputs:

- Tailor the type of information and its presentation to the purpose of reporting and the needs, interests and abilities of the audience.
- Review the results and reporting approaches with diverse stakeholder groups, including affected populations.
- Provide background information to situate why inequality monitoring was done and what it aims to accomplish.
- Include descriptions of the indicators, inequality dimensions, data sources, analysis methods and interpretation, highlighting any pertinent limitations.
- Adopt a wide scope, where possible and appropriate, to present the state of inequality comprehensively, including the latest status, time trends and benchmarking.

- Report findings using the most straight-forward and simple measures of inequality possible, while ensuring the conclusions are accurate and supported by the underlying data.

- Include key information about the results:
  - Report disaggregated data.
  - Report both absolute and relative summary measures of health inequality.
  - Indicate the overall value of the health indicator in the whole population.
  - Indicate the population share of subgroups.
  - Flag results based on small sample sizes, if applicable.
  - Assess whether to report measures of uncertainty and statistical significance.

- The tools used to present key messages should complement each other and avoid simply repeating the same content in different formats.

Other reporting checklists with specific applications have been developed to define and standardize reporting practices. The widespread recognition and adoption of these practices promotes scientific rigour and reproducibility. It also helps to ensure relevant information is available in a manner that is consistent, transparent and comprehensive. The Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) *(16)*, for example, are relevant to reporting quantitative estimates of health indicators (Box 23.12). The Preferred Reporting Items for Complex Sample Survey Analysis (PRICSSA) *(18)* are applicable to analyses using complex sample survey data (Box 23.13). The Sex and Gender Equity in Research (SAGER) guidelines encourage the complete and routine reporting of disaggregated data about sex and gender as part of research design, data analysis, results and interpretation *(19)*.

BOX 23.12. GATHER checklist

GATHER is applicable when reporting quantitative estimates of health indicators at a population level (including global, regional, national and subnational estimates). GATHER pertains to indicators of health status, such as estimates of total and cause-specific mortality and incidence and prevalence of diseases and injuries; and indicators of some proximal health determinants, such as health behaviours and health exposures. The guidance is relevant to studies that calculate estimates from various information sources (and not indicators derived from a single study or source) *(16)*.

The GATHER checklist consists of 18 items that should be included when reporting global health estimates. These include descriptions of the objectives and funding for the work, input data, data analysis methods, published estimates and uncertainty measures, interpretation and discussion of limitations *(17)*.

BOX 23.13. PRICSSA checklist

PRICSSA was developed for survey data analysts and researchers, for use when publishing results derived from complex sample survey data *(18)*. Recognizing that analytical and reporting errors are frequently made when reporting complex sample survey data, this itemized checklist aims to promote better quality analyses and reporting. PRICSSA consists of a checklist with items related to data collection dates, modes, response rate and sample selection process, and analytical information such as sample sizes for estimates, missing data rates and imputation methods. The guidance recommends that software code be made available to the public.

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Using health inequality analyses in evidence-informed decision-making

Overview

WHO defines evidence-informed decision-making as “a systematic and transparent approach that applies structured and replicable methods to identify, appraise, and make use of evidence across decision-making processes, including for implementation” *(1)*. In the context of health inequality monitoring, the results generated by inequality analysis constitute a form of scientific codified evidence obtained through systematic and replicable processes. This evidence, interpreted within the context of other scientific and tacit evidence (which includes opinions, expertise, lessons learnt, and operational insights from diverse stakeholders), is used to help identify high-priority areas for action and inform and evaluate actions to tackle health inequity.

Parts 1 and 2 of this book underscore the general importance of health inequality monitoring for advancing health equity, emphasizing continuous engagement with affected and target populations (see Chapter 4); audience- and purpose-driven reporting (see Chapter 7); and the role of health inequality monitoring in equity-oriented policy making (see Chapter 8). This chapter bridges a gap between data analysis and implementation, focusing on the integration of evidence derived from inequality analysis with other forms of evidence in decision-making processes.

The objective of this chapter is to describe approaches and considerations for using evidence about health inequalities to inform equity-oriented decision-making. It outlines a systematic approach to appraise the results of inequality analysis to identify high-priority areas for action. The chapter highlights considerations for cross-checking interpretations and consulting other forms of evidence as part of decision-making. It also demonstrates how the results of inequality analysis can be used as inputs in larger assessments and review processes for equity-oriented national health programming.

Identify high-priority areas for action

Inequality analyses can generate a plethora of results, especially if they involve multiple relevant indicators, dimensions of inequality and settings, assessed using disaggregated data and multiple summary measures of inequality. The use of a systematic approach to summarize this evidence can help to derive meaning from a large collection of findings and serve as an entry point to identify where actions are warranted. In some cases, this approach may lead to other questions that prompt further in-depth analyses and investigations, such as into the drivers of inequalities (see Chapter 25).

A scoring system to identify high-priority areas for action

The following exercise applies a systematic scoring system to the results of inequality analysis. It requires engagement with stakeholders (including affected populations) familiar with the results of inequality monitoring and the monitoring context. These stakeholders consider the inequality analysis results, with due acknowledgement of any limitations, such as those posed by sampling size and/or missing data for certain subpopulations. Stakeholders also consider these results in relation to contextual factors such as targets, health-care agendas and broader priorities relevant within the monitoring context. Typically, this process seeks to reach consensus among stakeholders.

For this prioritization exercise, inequalities across all health indicators by each dimension of inequality should be assessed. This entails reviewing the latest status, time trend and benchmarking – as well as multiple summary measures of health inequality. There may be a large amount of data to consider simultaneously. As a means of compiling the assessment, a table can be created, listing the health indicators as rows and the inequality dimensions (and overall averages) as columns. The inequality dimension columns can be divided further into absolute and relative inequality. Based on the results of monitoring, each cell of the table is assigned a score – for example, ranking from 1 to 3. Colour-coding may be applied:

- 1 (🟦 blue) indicates no or low inequality by the selected inequality dimensions. This may mean that no further action is currently needed, although there may be issues of unmet need, forgone care or underreporting that need to be explored.
- 2 (🟨 yellow) indicates some inequality, and action may be warranted.
- 3 (🟥 red) indicates high inequality and the need for urgent action.

The overall average for each indicator can also be scored from 1 to 3. The average scores are calculated for each indicator (by row) and each dimension (by column), and then ranked to show the overall level of priority for action.

Using this approach, the criteria for scoring should be established at the discretion of the people carrying out the exercise (what is considered to be high or low inequality will vary). These criteria should be well thought out and stated clearly. The example above uses a scale of 1–3, but other approaches are also possible. Depending on the context and the preferences of the stakeholders, the results could be scored using a binary scale (e.g. action needed or action not needed). Alternatively, a multiple-value scale may be used to rank the level of urgency by two, three, four or more values. See Box 24.1 for an example of the application of the scoring system.

Although this method lacks the ability to show nuances in the state of inequality, its simplicity is also an asset. Additional information, such as global and regional averages or trends over time, could be added to the table to provide extra context. The overarching purpose of priority-setting of both health indicators and dimensions of inequality is to help policy-makers interpret and apply the results of inequality monitoring. The conclusions derived from this exercise are not intended to be definitive, but they can provide input into wider discussions to determine where follow-up action is needed most. As discussed in Chapter 8, the introduction and implementation of policy is complex, depending on the availability of resources and infrastructure and political will.

BOX 24.1. Example of a scoring system to identify high-priority areas for action

Table 24.1 illustrates how a three-point scale could be applied to assess absolute and relative inequality for three maternal and child health indicators. According to average inequality and national average scores, the most urgent priority for action was evident for births attended by skilled health personnel. The indicator of antenatal care (at least one visit) demonstrated the lowest urgency for action. For all three indicators, inequality related to education tended to be of moderate to high concern.

TABLE 24.1. Example of scoring system to identify high-priority areas for action across three indicators related to maternal and child health in a hypothetical country context

🟦 No or low level of concern 🟨 Moderate level of concern 🟥 High level of concern

	Economic status		Education		Sex		Place of residence		Subnational region			
Indicator	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	**Average score**	**National average**
Antenatal care: at least one visit	1	1	2	2			1	1	1	1	1.3	1
Births attended by skilled health personnel	3	3	3	3			3	2	3	3	2.9	3
Measles immunization among children aged one year	2	2	3	3	1	1	1	1	3	2	1.9	2

A simplified variation of this approach involving thresholds and heatmaps may be undertaken by analysts as a preliminary step in exploring the findings. For a given set of results, analysts establish numerical thresholds that correspond to high, moderate and low inequality. Other thresholds may be established to identify where inequality has increased, decreased or remained constant over time. Referencing these thresholds, in a similar manner to Table 24.1, heatmaps (a type of visual that may be formatted similarly to a table, applying colour-coding that corresponds to data values; see Chapter 23) can be developed to visualize hotspots of potential concern. This approach may be a useful starting point to guide discussions and can be an input to the scoring system described above.

As one example, in the WHO *State of inequality: HIV, tuberculosis and malaria* report *(2)*, difference values of 20 percentage points or higher between the richest and poorest wealth quintiles were deemed to constitute high inequality, values of 5–20 percentage points constituted moderate inequality, and values of 5 percentage points or less were considered low inequality. These general thresholds were agreed by stakeholders involved in the analysis to aid the initial interpretation of the broad set of results across countries. Individual results for countries were interpreted in light of other contextual information. In other iterations of health inequality monitoring, different thresholds may be applicable.

Thresholds used to define low, moderate or high inequality are largely contextual and depend on the indicator and national policy and programming factors.

Consult other forms of evidence

Identification of high-priority areas for action on its own does not fully explain the results or result in the identification of the solutions that could be applied. The findings of inequality monitoring should be contextualized alongside other scientific evidence about the situation of inequality, knowledge about the lived realities of the affected population, and knowledge about the broader monitoring context and WHO guidelines and recommendations. This allows for consideration of a larger breadth of complementary evidence beyond what is captured in the immediate inequality analysis.

Consulting other forms of evidence can shed light on confusing or incomplete findings, the importance of the findings, local factors, root causes of inequalities (or inequities), and possible inroads for remedial actions. Quantitative analyses may be useful to answer questions exploring causation and associations, patterns and trend. Qualitative studies may help to delve into questions of how and why inequalities are observed, including understanding the underlying context and lived experiences. Mixed methods is "research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or programme of inquiry" *(3)*. The WHO *Handbook for conducting assessments of barriers to effective coverage with health services* elaborates on how health inequality monitoring can feed into a mixed-methods assessment of the reasons behind differences in service coverage *(4)*.

Engagement with existing literature about inequalities should begin at the planning stages of health inequality monitoring, and be done continuously as monitoring is conducted, including when assessing and applying the analysis results. A review of existing qualitative and quantitative and mixed-methods studies may entail conducting structured syntheses, such as modelling, literature reviews or evidence and gaps maps (see Chapter 3). Joint displays that show qualitative evidence alongside quantitative results may be particularly useful for integrating different types of information at the planning, implementation and presenting stages of monitoring *(5)*.

Sometimes inequality analyses lead to new questions for which further study or assessments may be required. After considering the strengths and limitations of various evidence sources, possible explanations can be assessed and areas for further exploration can be identified. See Chapter 16 for more on the use of emerging and novel data sources, and Chapter 25 on further quantitative approaches and measures to explore inequalities and their drivers.

Situations in which evidence is insufficient (e.g. due to a lack of data or lack of analysis or synthesis of existing data) may lead to recommendations for extended monitoring activities. Some of the main conclusions in the WHO *State of inequality: HIV, tuberculosis and malaria* report *(2)*, for example, pointed to the need for more and better data to address gaps in inequality monitoring for these diseases, and the need for regular inequality analysis and reporting to track changes over time *(6)*.

Cross-check interpretations

The actions that are ultimately taken to address health inequalities should be based on a thorough assessment of available evidence to ensure the results are accurately interpreted and contextualized.

The contents of this book endeavour to provide a foundational knowledge base of issues pertaining to health inequality monitoring, including critically evaluating the results and conclusions derived from the process. The issues highlighted below represent some general considerations that should be cross-checked when considering how to prioritize and use evidence to inform actions to improve population health. This is not a comprehensive overview of all possible issues that may be pertinent when interpreting the results.

An initial consideration is whether subgroups mask inequalities. As described in Chapter 17, decisions about the composition and number of subgroups for inequality monitoring have implications for the analysis and interpretation of inequalities. When subgroups are constructed in a way that includes heterogeneous populations, they may mask inequalities. For example, monitoring inequalities by subnational region where multiple provinces or districts are grouped together can mask the situation in single provinces or districts. An approach that defines rural areas broadly may not capture the situation in remote communities within the rural area or rural communities that are located in close proximity to large urban centres (see Chapter 5). Data triangulation from different sources can help explore how the categorization of inequality dimension may be masking the realities contained within a subgroup and prompt more nuanced analysis.

The limitations in the underlying health information system may factor into the conclusions of inequality monitoring. For example, underreporting for certain indicators may occur due to human resource shortages; information, communication and technology and computerization deficits; and inadequate coordination for information flows. Underdiagnosis of some diseases (e.g. tuberculosis, HIV, neglected tropical diseases, hypertension and some other noncommunicable diseases) tends to be higher in areas or subgroups experiencing disadvantage. Furthermore, the absence of reliable information on population counts makes it challenging to estimate denominator values (see Chapter 13). Thus, data about the number of people with a given disease or condition may not be able to capture the extent to which underdiagnosis and unmet need are happening for a given subpopulation or area.

Attention is warranted to ensure the population from which data were collected corresponds to the population where action is to be implemented. When considering evidence for action, the geographical unit for which the data are available should ideally match the scope at which programming occurs. For example, data that reflect the situation in a province would be more appropriate for use to inform provincial-level programming than data collected from a national sample. Often, however, this correlation is suboptimal. When conducting inequality analysis for uptake by subnational governments, attention to getting to the lowest geographical unit possible for which disaggregated findings are still statistically relevant is important.

Inequality monitoring as part of larger assessments and review processes

Inequality monitoring may be integrated as part of larger assessments and review processes in the health sector. For example, the results of inequality monitoring yield evidence and inputs into several aspects of the WHO *Innov8 approach for reviewing national health programmes to leave no one behind (7)*. This approach provides a systematic and comprehensive eight-step method for integrating the results of health inequality monitoring into national health programmes. It involves a comprehensive review of national health programming and related evidence by a multidisciplinary team, as detailed in the technical handbook for the approach. The results of inequality analyses are used in the Innov8 first step of understanding the baseline of the programme through a diagnostic checklist; the third step of identifying who is being left out of the programme; and the eighth step of strengthening monitoring and evaluation practices, including through the incorporation and/or strengthening of health inequality monitoring on a routine basis.

The Innov8 approach has been adapted and applied across several countries and different contexts, and the approach continues to evolve *(8)*. For example, it was used in Indonesia as part of a review of national neonatal and maternal health action plans, and efforts to expand their equity orientation, rights basis and gender responsiveness, and to address social determinants of health *(9)*. The review process helped to bolster demand for health inequality monitoring and its use in planning. In Nepal, the Innov8 approach helped to identify populations not covered by the national Adolescent Sexual and Reproductive Health Programme *(10)*.

WHO has been advancing mixed methods to unpack barriers to health services *(4, 11)*. Health inequality monitoring is part of these mixed-methods approaches, which also draw on a desk review, key informant interviews and focus groups and apply data triangulation techniques across all sources. The assessments can be done as parallel convergent or explanatory sequential. For example, in 2017, the Nigerian Government decided to revise and update its policy on the health and development of adolescents and young people in Nigeria. The Government commissioned a national situation analysis to inform the update, and a barrier assessment (including health inequality monitoring) was conducted to complement the analysis *(12)*. The findings of the assessment fed into the development of a new adolescent health policy and related strategic plan.

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Further quantitative inequality analysis approaches and measures

Overview

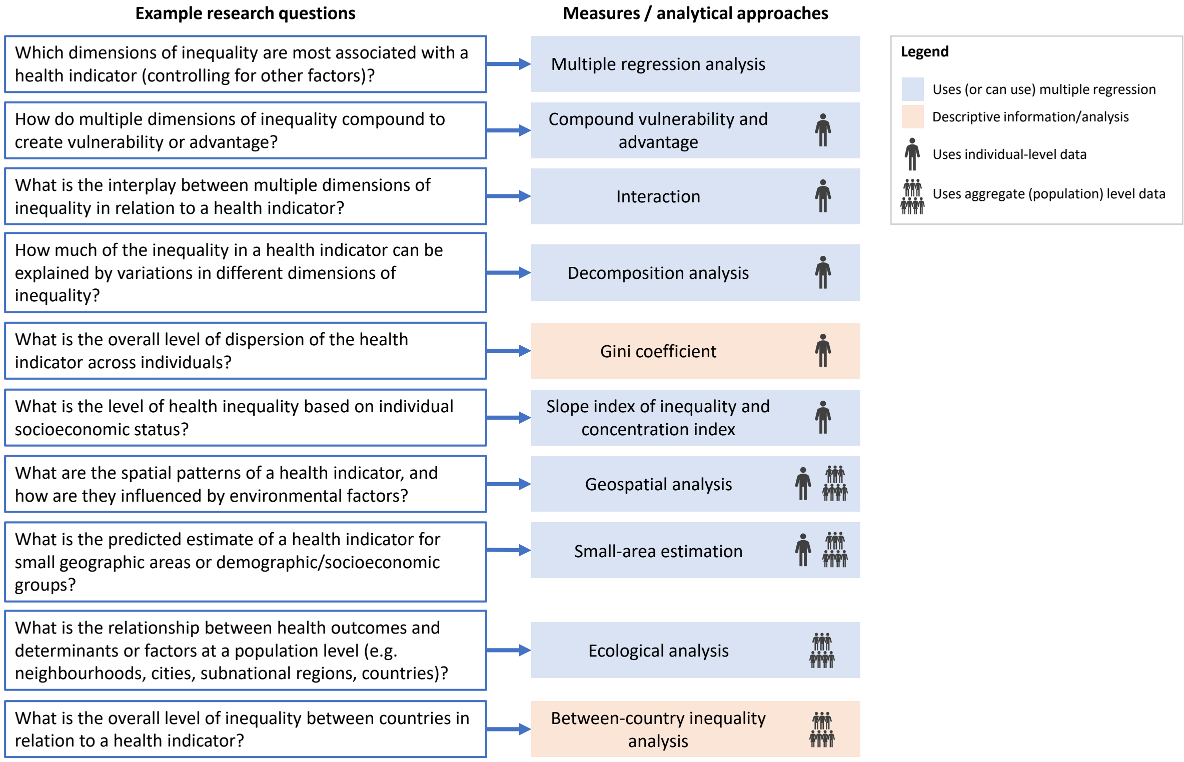
Health inequalities are driven by a complex system of demographic, socioeconomic, environmental and geographical factors. The approaches for analysing disaggregated data and summary measures of health inequality (see Chapters 17–23) quantify a bivariate relationship between a health variable and a dimension of inequality and can be used to gain initial insights into the patterns and magnitude of health inequalities related to one or more dimensions of inequality at a time. There are, however, other research questions about health inequalities that these methods cannot be used to answer. For example, which dimensions of inequality are most associated with a health indicator (controlling for the others)? What is the interplay between multiple dimensions of inequality in relation to a health indicator? How do environmental and spatial factors influence health inequalities? To answer these questions, other quantitative inequality analysis approaches and methods can be used.

This chapter explores examples of other health inequality monitoring research questions and demonstrates the application of common analytical approaches to answering them. After highlighting some initial considerations, the chapter introduces multiple regression analysis, which underpins many of the approaches discussed later. To answer research questions related to the dispersion of health indicators in a population or inequalities at the individual level, the chapter discusses measurement of inequality with individual-level data. The use of geospatial analysis and small-area estimation to answer research questions related to spatial and environmental inequalities is explored. Finally, the chapter addresses methods of exploring population-level inequalities, including ecological analysis of the associations between a health indicator and a health determinant, and the measurement of between-country inequalities. The approaches discussed in this chapter are not intended to be an exhaustive discussion of inequality analysis methods or a comprehensive resource for each. Detailed descriptions of these methods are available elsewhere *(1–3)*.

Initial considerations

This chapter describes methods and measures used to answer some of the research questions that may arise from the analysis of inequalities using disaggregated data and summary measures of health inequality (Figure 25.1). When considering relationships between health indicators and health

FIGURE 25.1. Selected research questions and corresponding measures and analytical approaches



Example research questions	Measures / analytical approaches
Which dimensions of inequality are most associated with a health indicator (controlling for other factors)?	🟦 Multiple regression analysis
How do multiple dimensions of inequality compound to create vulnerability or advantage?	🟦 Compound vulnerability and advantage 🧍
What is the interplay between multiple dimensions of inequality in relation to a health indicator?	🟦 Interaction 🧍
How much of the inequality in a health indicator can be explained by variations in different dimensions of inequality?	🟦 Decomposition analysis 🧍
What is the overall level of dispersion of the health indicator across individuals?	🟧 Gini coefficient 🧍
What is the level of health inequality based on individual socioeconomic status?	🟦 Slope index of inequality and concentration index 🧍
What are the spatial patterns of a health indicator, and how are they influenced by environmental factors?	🟦 Geospatial analysis 🧍 👥
What is the predicted estimate of a health indicator for small geographic areas or demographic/socioeconomic groups?	🟦 Small-area estimation 🧍 👥
What is the relationship between health outcomes and determinants or factors at a population level (e.g. neighbourhoods, cities, subnational regions, countries)?	🟦 Ecological analysis 👥
What is the overall level of inequality between countries in relation to a health indicator?	🟧 Between-country inequality analysis 👥

Legend

🟦 Uses (or can use) multiple regression
🟧 Descriptive information/analysis
🧍 Uses individual-level data
👥 Uses aggregate (population) level data

determinants, it is important to distinguish between association and causation. Many approaches discussed in this chapter assess associations (i.e. whether a health indicator is more likely in people with particular demographic, socioeconomic or geographic characteristics), and further analysis and investigation would be needed to establish causal links. The target audience and application of more advanced inequality analysis should always be considered. Analysts, researchers and others with expertise may need to be involved in interpretation of the findings to make them relevant to more general audiences.

Multiple regression analysis

Regression analysis is used to gain a deeper understanding of intersectionality. Intersectionality is a concept describing the overlap of interconnected social identities (especially race/ethnicity, income/wealth and gender) and how this results in systemic discrimination or disadvantage *(4)*. Studying intersectionality involves researching how dimensions of inequality overlap and intersect, resulting in differing experiences of health. Regression analysis can be used to research how multiple dimensions of inequality might compound to exacerbate vulnerability or advantage, estimate how they might interact to affect the health indicator, and estimate how much health inequality is driven by variations in different dimensions of inequality.

For more in-depth analysis, multiple regression analysis, or the analysis of multiple independent variables simultaneously, can be used to estimate the independent average effect of a characteristic (or dimension of inequality) on a health indicator, while accounting for all other observed dimensions of inequality. Multiple regression can support understanding of the dimensions of inequality that are most associated with a health indicator. Multiple regression analysis is used in several of the approaches discussed in this chapter. The multiple regression approach comes with several limitations – and even when a strong association is present, this does not necessarily indicate a causal link *(3)*.

> Multiple regression is a statistical technique used to analyse the relationship between a single dependent variable and several independent variables.

The choice of a particular regression model depends on the nature of the dependent variable (i.e. the health indicator). Linear regression is used when a dependent variable is continuous (e.g. height or weight). If the dependent variable is binary (i.e. measured as two possibilities – either not achieved or achieved, such as vaccinated versus non-vaccinated) or the relationship between the dependent and independent variables is nonlinear, logistic regression can be used. If the dependent variable is measured as a count (e.g. number of hospital admissions), Poisson regression or negative binomial regression can be used. There are also other forms of regression models *(2,3)*.

To run a multiple regression model, data about the health indicator and dimensions of inequality are needed for each unit of analysis (individual-level or population-level), and specialized statistical software is usually required. Practical and theoretical considerations also play an important role when formulating a regression model. First, developing a framework of variables to include in the regression model (e.g. using directed acyclic graphs (DAGs) *(5)*) requires some knowledge of the factors that could arguably be considered associated with health indicator. This is often guided by a literature review and the availability of data. Some other considerations are summarized in Box 25.1.

A multilevel model (also known as a hierarchical model or mixed-effects model) is a type of regression model that accounts for the clustering of individuals in a hierarchical or nested structure. For example, with household surveys, such as the Demographic and Health Surveys (DHS) or Multiple Indicator

BOX 25.1. Considerations for formulating multiple regression models

- The more independent variables that are added, the more the statistical power of the model decreases, due to smaller sample sizes for each possible combination of independent variables. A general rule is to limit the number of independent variables to less than the sample size divided by 10 *(6)*. For example, to have six independent variables in the model, the sample size should be at least 60.
- Multicollinearity is the condition in which there is a very high correlation between two or more independent variables in the model, resulting in unstable estimates because it is difficult to disentangle their individual effects on the dependent variable *(7, 8)*. It is important to be aware of cases in which the same variable is (often inadvertently) used as both a dependent and an independent variable in the regression model (e.g. using a composite measure as an independent variable, which contains a component that is the same as or similar to the dependent variable).
- If the data being analysed come from a survey, it is important to take survey design characteristics (e.g. individual sample weights, primary sampling units and strata) into account in the analysis (see Annex 8).

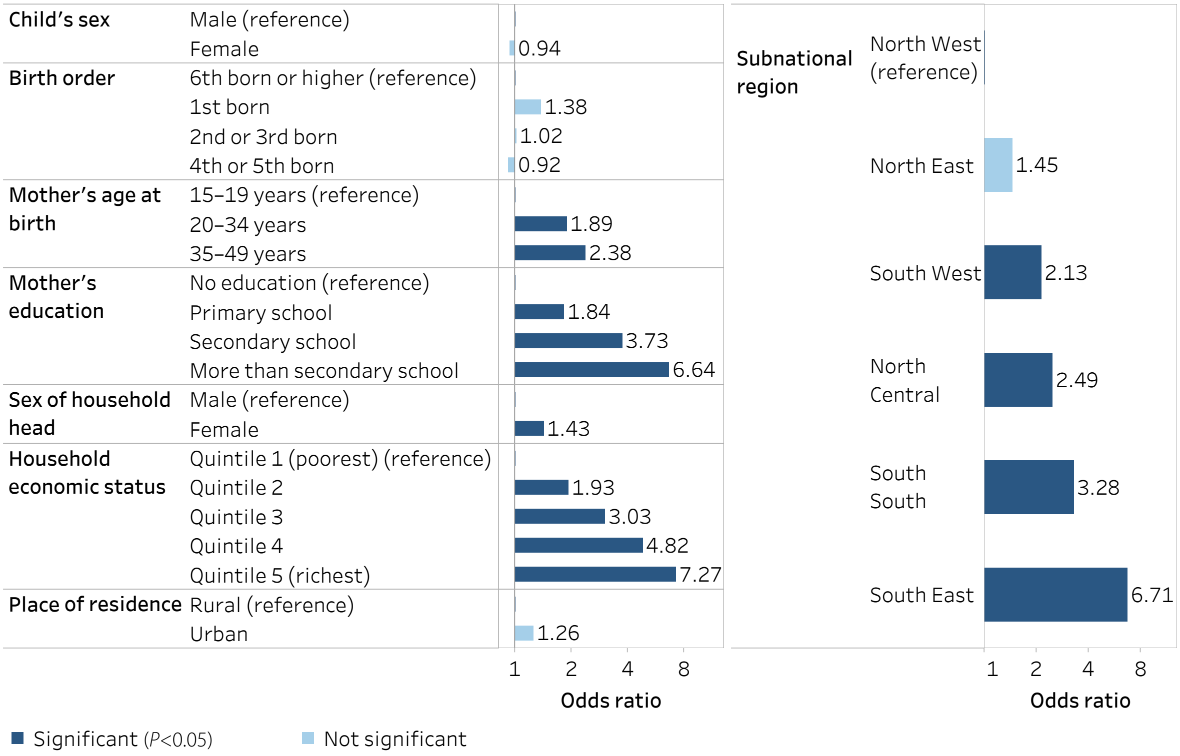
Cluster Survey (MICS) (see Chapter 12), individuals (level 1) are typically nested within districts (level 2), which are nested within states (level 3). One strength of a multilevel regression is its ability to quantify the proportion of the total residual variation (i.e. the unexplained variation in the regression outcome after accounting for covariate effects) lying at the various levels of the model's hierarchy. For example, if a multilevel model includes individuals nested within districts, this allows the quantification of how much variation in a health indicator is related to individual-level factors (e.g. age, economic status or sex) versus district-level factors (e.g. air pollution rates, population density or public health-care funding).

The results of a regression analysis can be reported using different measures of association, such as absolute differences, odds ratios and prevalence ratios, where the outcome in one subgroup is compared against a reference subgroup within a given dimension of inequality. For example, the results from logistic regression analysis can be reported as odds ratios, where an odds ratio greater than 1 indicates that the characteristic is associated with higher odds of the outcome compared with the reference subgroup. For a health indicator where the goal is to achieve a maximum level (e.g. complete coverage of antenatal care), the reference subgroup selected could be the most disadvantaged subgroup (e.g. the poorest subgroup) so that odds ratios are generally greater than 1 and hence easier to interpret. When interpreting results, it is important to consider the uncertainty about the estimates using 95% confidence intervals and statistical confidence with the *P* value. Small sample sizes within subgroups, however, can increase the width of confidence intervals and affect whether results are statistically significant or not.

The WHO *Explorations of inequality: childhood immunization* report used logistic regression to analyse adjusted associations between immunization coverage with a third dose of diphtheria, tetanus toxoid and pertussis vaccine (DTP3) and selected demographic, socioeconomic and geographic characteristics in 10 countries *(9)*. For example, Figure 25.2 shows the results from a household survey in Nigeria in 2013. Controlling for the other characteristics, a child aged one year in the richest quintile had a 7.3 times odds of being covered than a child in the poorest quintile; and a child whose mother had received more than secondary school education had a 6.6 times odds of being covered than a child whose mother who had received no education. The child's sex, birth order and urban–rural place of residence showed nonsignificant association with DTP3 immunization coverage after adjusting for other factors (based on $P \geq 0.05$).

Although multivariable regression methods are often used in inequality analysis to analyse associations between a health indicator and dimensions of inequality (rather than to establish causal links), controlling for confounding in regression models is important to obtain unbiased estimates. A confounding variable is a third variable that is related to the independent and dependent variables and that distorts the causal relationship between them. For example, when assessing the relationship between mortality rates among children aged under five years at the individual level and household economic status, the educational attainment of the child's mother is likely a confounder of the relationship between economic status and under-five mortality because women with more education tend to live in wealthier households and their children experience lower mortality rates on average. Therefore, an analysis that ignores maternal education would likely lead to overestimating the protective effect of higher economic status by misattributing some of the protective effect of education to economic status. A confounding variable typically has a causal association with the dependent variable (e.g. if the dependent variable is a disease, it must be a risk factor or a protective factor for the disease); it must be distributed unevenly between the subgroups

FIGURE 25.2. **Adjusted odds ratios: immunization coverage with a third dose of diphtheria, tetanus toxoid and pertussis vaccine among children aged one year and background characteristics in Nigeria**



Source: derived from the WHO *Explorations of inequality: childhood immunization* report *(9)*, with data sourced from the 2013 Demographic and Health Surveys.

of the independent variable(s) (e.g. if age is a confounding factor for cancer mortality, it should be distributed unevenly among economic status subgroups); and it must not be part of the causal pathway between the independent variable(s) and the dependent variable *(3)*. Literature reviews and DAGs are often used to guide the selection of confounding variables and enable them to be controlled for in the multiple regression analysis.

Compound vulnerability and advantage

Certain demographic, socioeconomic and geographic conditions can compound to exacerbate vulnerability or advantage. For example, how much more likely is a person to be unhealthy if they have a low level of education and have a low income and live in a rural area, compared with a person with higher education from a high-income household in an urban area? Summary measures of health inequality (see Chapters 19–22) cannot capture such differences arising from the effects of intersecting characteristics.

Compounding vulnerability or advantage could be assessed by stratifying the population into separate subgroups, each containing a combination of certain characteristics. A disadvantage of this approach is that subgroup sample sizes can get very small, affecting the robustness of the results. A simple approach to quantify compound vulnerability and advantage (when no interaction is present – see below) is to multiply the odds ratios of two or more associated factors from a logistic regression analysis.

Building on the previous example from the report *Explorations of inequality: childhood immunization* (Figure 25.2), in Nigeria in 2013, children with highly educated mothers aged 35–49 years who belonged to the richest 20% of the population had a 115 times odds of being vaccinated, compared with children born to teenaged mothers with no education in the poorest 20% of the population *(9)*. The calculation method for this example is shown in Table 25.1. Interactions between the inequality dimensions were tested during the analysis (e.g. interactions between mother's education and wealth quintile) and were not statistically significant (based on $P \geq 0.05$).

Interaction

One way to research the interplay between multiple dimensions of inequality in relation to a health indicator is through investigating interaction within a regression model. In regression analysis, interaction (or effect modification) means that the relationship between two variables changes, or is modified, depending on the value or a category of another variable. For example, when studying the relationship between smoking and income in a particular setting, it could be found that higher smoking prevalence is associated with lower income. Other factors, however, might change this relationship (e.g. sex). When an interaction is present, it would be incomplete to compute only an overall association without allowing for the fact that the association is different for people with or without the additional factor.

Multiple regression can be used to assess how the combined effect of income and sex on smoking prevalence differs from the sum of their individual effects that would be estimated from a model that did not allow for the interaction. Examining interactions between two independent variables in a regression model can be achieved via the inclusion of an interaction term (also referred to as a product term) that is the product of the two variables. The results of including an interaction term of income and sex would be similar to estimating the association between income and smoking within each sex.

Table 25.2 illustrates the example with empirical data from the World Health Survey conducted by WHO in 2003 *(10)*. Data correspond to estimates from Ecuador and show the prevalence of smoking by sex and wealth quintile. The association between income and smoking is depicted by the relative index of inequality (RII) (which is calculated using a regression model, see Chapter 21), for which a value higher than 1 indicates inequality favouring the

TABLE 25.1. Calculation of compound advantage using odds ratios from multiple regression analysis: immunization coverage with a third dose of diphtheria, tetanus toxoid and pertussis vaccine, Nigeria

Odds for more than secondary school education subgroup compared with no education subgroup [A]	Odds for age 35–49 years subgroup compared with age 15–19 subgroup [B]	Odds for richest quintile compared with poorest quintile [C]	Compound advantage [A × B × C]
6.64	2.38	7.27	114.89

Source: derived from the WHO *Explorations of inequality: childhood immunization* report *(9)*, with data sourced from the 2013 Demographic and Health Surveys.

TABLE 25.2. **Relative index of inequality: smoking prevalence, by economic status, females and males, Ecuador**

	Prevalence (%)						
	Overall	Quintile 1 (poorest)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (richest)	**Relative index of inequality**
Males	28.7	37.1	28.7	27.2	23.6	26.3	1.62
Females	7.1	4.2	5.5	5.8	8.3	11.8	0.28

Source: derived from Hosseinpoor et al. *(10)*, with data sourced from the 2003 World Health Survey.

richest and a value less than 1 indicates inequality favouring the poorest. In this example, RII estimates differ substantially by sex, showing opposite associations between smoking and economic status. Among males there is a higher smoking prevalence at lower economic status, but the relation is inverse among females, with higher prevalence among the wealthier. Therefore, sex is considered an effect modifier.

Decomposition methods

Decomposition methods can be used to answer research questions such as how much of the inequality in a health indicator can be explained by variations in different dimensions of inequality. These methods are usually based on linear regression models for two subgroups and by at least one dimension of inequality (e.g. regression of a health indicator by economic status, for urban and rural subgroups). Rather than producing the average estimate for each subgroup while controlling for the others (which is the output from multiple regression – see above), the output from decomposition methods quantifies the magnitude of the health inequality related to differences between specific population subgroups – for example, the difference in the health indicator between urban and rural residents.

Oaxaca–Blinder (O–B) decomposition is a method used to explain the gap in the means of a health indicator between two groups (e.g. between urban and rural, rich and poor, or female and male). It decomposes the observed health inequality into two components – group differences in the determinants included in the model (referred to as the explained component or endowment effects), and group differences in the partial associations of these determinants with the outcome (referred to as the unexplained component or discrimination effects) *(1)*. It is crucial to note that the second component encompasses any associated differences arising from unobserved factors that are associated with both the outcome and the group indicator. The O–B decomposition method helps identify whether inequality in health between two groups arises from differences in the observable characteristics of those groups or from correlated unobserved factors *(11)*.

For example, the O–B decomposition method can be used to estimate how much of the inequality in body mass index (BMI) between urban and rural residents of the Islamic Republic of Iran in 2011 was related to urban and rural differences in age, gender, physical activity and socioeconomic status (i.e. group differences, or the first component), and how much is driven by other factors (i.e. the second, unexplained, component). Two linear regressions – one for urban and one for rural residents – were estimated with BMI as the dependent variable and age, gender, physical activity and socioeconomic status as the independent variables. In Table 25.3, the difference in BMI between urban and rural subgroups was 1.16 points (BMI was 26.40 among urban adults and 25.24 among rural adults); 75% of this difference (0.87 of 1.16) was due to urban–rural differences in age, gender, physical activity and socioeconomic status, and the remainder of the urban–rural inequality was unexplained by the factors in the model. Differences in socioeconomic status between the urban and rural subgroups accounted for 72% (0.83 of 1.16) of the urban–rural inequality in BMI *(11)*.

TABLE 25.3. Oaxaca–Blinder decomposition of place of residence inequality: body mass index (BMI) by place of residence, Islamic Republic of Iran

	Coefficient	*P*
Overall		
BMI among urban adults	26.40	<0.001
BMI among rural adults	25.24	<0.001
Difference between urban and rural BMI	1.16	<0.001
Decomposition		
Explained component	0.87	<0.001
Age	0.07	0.045
Socioeconomic status	0.83	<0.001
Gender	−0.05	0.012
Physical activity	0.01	0.065
Unexplained component	0.29	0.034

P values test whether the coefficient is different from 0.

Source: derived from Rahimi and Hashemi Nazari *(11)*, with data sourced from the 2011 WHO STEPwise Approach to NCD Risk Factor Surveillance (STEPS) *(12)*.

Beyond decomposing differences between groups, decomposition can also be used to decompose summary measures of inequality, such as the concentration index *(1)*. For example, a concentration index measure of socioeconomic inequality in child nutritional status in Viet Nam was decomposed and combined with a O–B decomposition of change over time in this inequality. Household consumption was identified as a key driver for rising inequalities *(13)*.

Although regression-based decompositions rely primarily on linear models, extension to nonlinear models for binary and count outcomes is possible. For example, a concentration index measure of wealth-related inequality in infant mortality (a binary outcome variable) in the Islamic Republic of Iran was decomposed and showed that the largest contributors were household economic status (36.2%) and mother's education (20.9%) *(14)*. Box 25.2 describes an example of decomposing inequalities in self-reported health, mental health and life satisfaction in European countries.

Decomposition methods offer valuable insights, but there are challenges, including selection bias, differential measurement bias and confounding, which prevent causal interpretation derived from O–B decomposition. To overcome some of these limitations, a novel decomposition method has been proposed that involves the comparison of observed and counterfactual scenarios using a variation of the O–B method *(17)*.

Measures of inequality using individual-level data

Research questions that seek to understand the extent of dispersion of health indicators across all individuals in a population or the level of health inequality based on individual characteristics require the analysis of individual-level data (rather than disaggregated data, or data broken down by population subgroups). This section explores the Gini coefficient to assess dispersion (which considers the distribution of a health indicator across individuals, irrespective of social characteristics) and measures of health inequality at the individual level (the association between health and socioeconomic status).

Gini coefficient

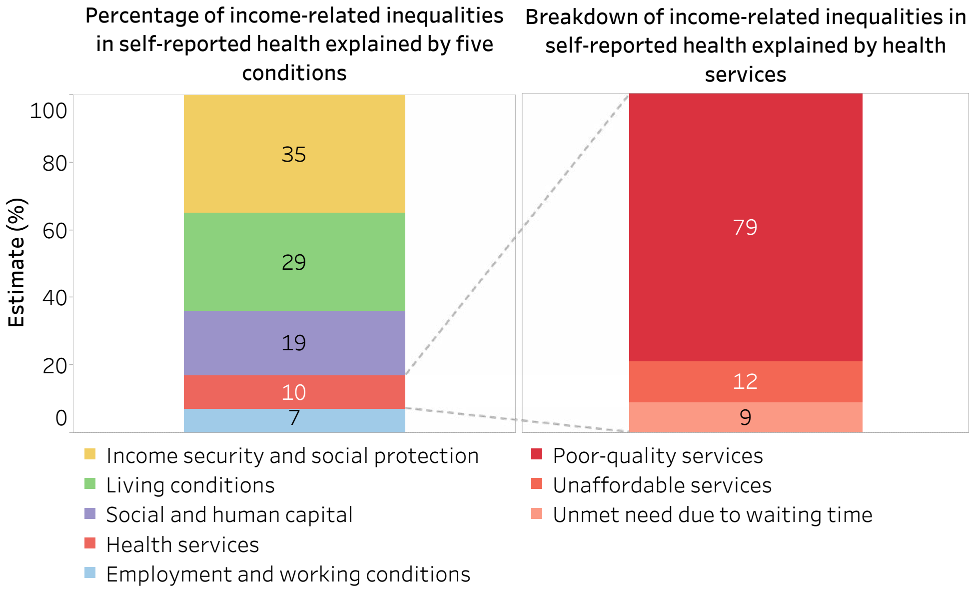
One approach to measuring dispersion of a health indicator across all individuals in a given population

BOX 25.2. Decomposition analysis in the *European health equity status report*

The *European health equity status report* reviewed the status and trends in health inequities in the WHO European Region *(15)*. Decomposition methodologies were used to quantify the (extent of the) contribution of five conditions to income-related inequalities in health (i.e. inequality between the highest and lowest income quintiles, or the most and least affluent 20% of the population). The five conditions were health services; income security and social protection; living conditions; social and human capital; and employment and working conditions. Data from the European Quality of Life Surveys for 2003–2016 from 34 countries were used for the analysis *(16)*. A variant of the O–B decomposition method was used.

For example, self-reported health is measured as the percentage of people reporting poor or fair health. Among all five conditions, income security and living conditions had the highest contributions to income-related inequality in self-reported health (Figure 25.3): 35% of the inequality was linked to income insecurity and a lack (or inadequacy) of social protection; 29% was a result of systematic differences in people's living environment and conditions; 19% was related to low social and human capital (lack of control, trust in others and low educational outcomes); 10% of the income-related inequality in self-reported health was found to be resulting from systematic differences in the quality, availability and affordability of health services; and 7% was due to employment and working conditions. Each of the conditions was broken down by subfactors. For example, the income-related inequality resulting from differences in health services was related mainly to poor-quality services rather than unaffordable services or long waiting times. Quantifying the relative contributions of different factors to income-related inequality can support policy-makers to prioritize equity-oriented interventions, although it should be kept in mind that this analysis is descriptive, not causal.

FIGURE 25.3. Contributions of five conditions to income-related inequities in self-reported health in 34 European countries



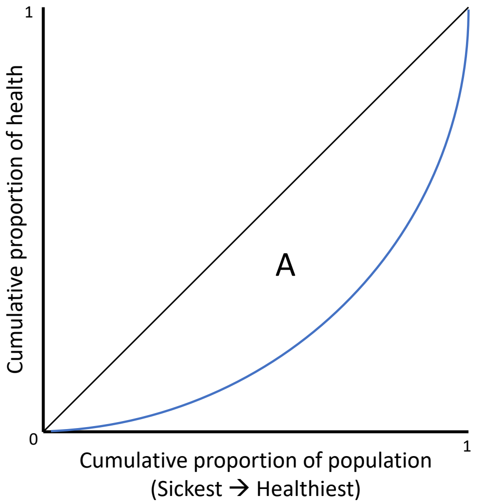
Source: derived from WHO Regional Office for Europe, *European health equity status report (15)*, with data sourced from the European Quality of Life Surveys for 2003–2016 *(16)*.

or setting is to use the Gini coefficient. This measure is used extensively in the field of economics to measure income inequality, but a Gini-like measure can also be used to measure the distribution of a health indicator *(18)*.

> When applied to health, Gini is a measure of dispersion that does not take into account the social position of individuals.

The measure is derived from the Lorenz curve, which plots the cumulative proportion of the health indicator against the cumulative proportion of the population, ranked from the sickest on the left to the healthiest on the right (Figure 25.4) *(1)*. If all individuals have the same health (i.e. the cumulative proportion of the population is exactly matched to the cumulative proportion of health), the Lorenz curve runs along the 45-degree line. If there is variation in how health is distributed across individuals in the population, the Lorenz curve lies below the 45-degree line. The greater the variation of health in the population, the further the Lorenz curve lies below the 45-degree line.

FIGURE 25.4. Lorenz curve of health



The black 45-degree line represents a situation of equality. The blue line represents the Lorenz curve, a situation of inequality. Gini coefficient is calculated as twice the area (A) between the 45-degree line and the Lorenz curve.

The Gini coefficient is twice the area (A) between the 45-degree line and the Lorenz curve. The Gini coefficient takes values between 0 and 1, with 0 being no dispersion and 1 being complete dispersion (i.e. all sickness is concentrated in one individual). This can be shown as a percentage ranging between 0% and 100%, referred to as the Gini index. See Annex 16 for an example of using Gini to measure dispersion in stunting among children in Kenya.

The Gini coefficient value becomes more meaningful if it is used to compare across time points, indicators and/or groupings of individuals or settings, to give an understanding of how the extent of dispersion has changed over time or varies across indicators and areas.

Slope index of inequality and concentration index

The slope index of inequality (SII), RII, absolute concentration index (ACI) and relative concentration index (RCI) (see Chapter 21) are summary measures of health inequality in relation to socioeconomic status (e.g. wealth or educational attainment). In addition to measuring the level of health inequality across population subgroups, they can also be used to measure inequality across individuals in a population.

Individuals are ranked from the most disadvantaged (rank 0) to the most advantaged (rank 1). This ranking can be based on a continuous measure, such as the wealth index calculated within Demographic and Health Surveys (DHS), or on a categorical measure, such as wealth quintiles or education level. The relative rank of individuals is calculated, with individuals ordered based on the socioeconomic variable and accounting for the individual sample weight in the case of data from a survey (if the data are not collected via a survey, individuals are assigned the same weight). The calculation method for SII, RII, ACI and RCI then proceeds as described in Chapter 21. Ultimately, the calculation yields a value that describes the level of inequality across all individuals from the most-advantaged to the most-disadvantaged. See Annex 17 for an example of measuring health inequality based on individual socioeconomic status.

The use of individual-level data also enables the measurement of health inequality while controlling for multiple factors, by including these factors as independent variables in the regression model used to calculate SII, RII, ACI and/or RCI. For example, Table 25.4 shows the results of a study of education-related inequalities in self-reported COVID-19 vaccination across 90 countries using SII adjusted for other individual characteristics. The gap in vaccination prevalence between the most and least educated individuals was 16.4 percentage points if no other factors were taken into account (unadjusted model) and 11.9 percentage points when characteristics including age, COVID-19-like symptoms, gender, health risk factors, household overcrowding and place of residence were controlled for (adjusted model) *(19)*.

Extensions to the concentration index

The extended concentration index allows attitudes to inequality to be made explicit (i.e. taking into account that societies are not equally averse or tolerant to inequality) and to see how the level of inequality changes as the attitude to inequality changes *(1, 20)*. This is identical to the standard concentration index (ACI and RCI), except for the addition of a weighting function, which allows the user to determine how much weight to give to the poorest or richest individuals. A weighting of 2 is equal to the standard concentration index; a weighting of more than 2 increases weight attached to the poorest individuals. For example, the weight attached to the health of a very poor individual can be increased, and consequently the weight attached to the health of richer individuals will decrease. In a setting where the health of poor people is much worse than that of the rest of the population, such weighting will increase the magnitude of the measured inequality and therefore bring more attention to where improvements in health should be disproportionately concentrated among the poorest people.

The achievement index is another application of the concentration index, in which both health inequality

TABLE 25.4. Unadjusted and adjusted slope index of inequality: self-reported receipt of COVID-19 vaccine, by education level, globally and by country income group

		Median slope index of inequality, percentage points (95% CI)	
	Number of countries	Unadjusted	Adjusted
Global	90	16.4 (13.4–19.3)	11.9 (10.2–13.4)
High-income countries	33	10.3 (7.3–12.2)	6.9 (6.0–8.3)
Upper-middle-income countries	29	21.4 (17.3–24.5)	14.5 (12.9–17.1)
Low-income and lower-middle-income countries	28	19.5 (14.2–26.6)	13.3 (11.1–18.1)

CI, confidence interval.

Source: derived from Bergen et al. *(19)*, with data sourced from the 1 June to 31 December 2021 period of the University of Maryland Social Data Science Center Global COVID-19 Trends and Impact Survey.

and the overall mean are captured *(1, 20)*. The achievement index is defined as a weighted average of the health levels of all people in the sample, in which higher weights are attached to poorer people than to wealthier people. Consider the example of comparing wealth-related inequality in mortality rates among children aged under five years across two countries, where both countries have the same overall level of under-five mortality but one has an unequal distribution across income groups to the disadvantage of poor people, and the other country has an equal distribution. Even though the mean is the same in the two countries, the achievement index will reflect the level of inequality and be lower than the mean in the country with pro-rich inequality.

Both the extended concentration index and the achievement index can be computed using both disaggregated data and individual-level data.

Geospatial analysis

Geospatial data and geospatial analysis can be used to answer research questions about how environmental and spatial factors influence health inequalities. Geospatial data are data about objects, events or other features that have a location on the surface of the earth (see Chapter 16). Geospatial analysis uses these spatial data and statistical techniques to uncover patterns, relationships and trends within geographic areas. Geospatial analysis is particularly relevant for the study of health inequalities because space is a determinant of exposure to environmental, zoonotic or human risk factors; poverty, educational achievement and other social determinants of health tend to be distributed unevenly in space; and health-care resources tend to be clustered in urban centres. This section discusses several applications of geospatial analysis for inequality monitoring: model-based geostatistics, distance or proximity analysis, and cluster analysis. There are also many other types of geospatial analysis techniques that can be applied to monitoring health inequalities *(21)*.

Model-based geostatistics

The term “spatial statistics” is used to describe a wide range of statistical models and methods for the analysis of spatially referenced data. Within spatial statistics, model-based geostatistics refers to the application of general statistical principles of modelling and inference *(22)*. Model-based geostatistics can be used to predict or forecast health indicator estimates and identify areas or populations of increased risk or need. For example, a geostatistical model could be used to predict and map malaria prevalence based on environmental factors such as altitude, rainfall, temperature and demographic factors such as place of residence and economic status of households.

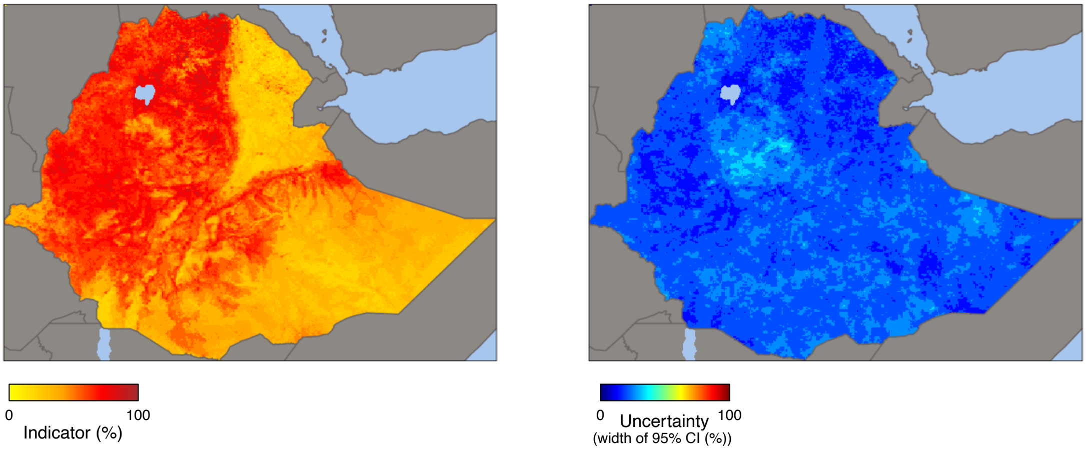
Geostatistical models use three types of data: indicator data (e.g. number of people who test positive for a disease), location data (the set of locations at which the indicator data are obtained), and covariate data (variables deemed to be associated with the indicator of interest, with their aim in the model to assist the prediction of the indicator at unsampled locations). The basic premise behind this modelling is that if there is a connection between where people live and a health intervention or outcome, then that health intervention or outcome could be estimated in areas based on geospatial data about the environment and demographics. Box 25.3 describes an example from the DHS Program, where health indicators are estimated at 5 × 5 km resolutions. The accuracy of the estimates produced depends on the quality, sample sizes and granularity of the original health indicator data and the ability to link them to high-resolution geospatial data strongly associated with the original health indicator data.

BOX 25.3. DHS Program spatial data repository

DHS are designed to provide reliable estimates of survey indicators primarily at the national level. To better address the need for fine spatial and lower-level (district) estimates, geospatial modelling has become increasingly popular. The DHS Program has made publicly available a standard set of spatially modelled surfaces via the DHS Program Spatial Data Repository, which estimates various development indicators at 5 × 5 km resolutions. These maps are produced using geostatistical methods with publicly available georeferenced data from DHS and other spatial data sources *(23)*. A series of DHS spatial analysis reports supplement other DHS reports to provide health statistics estimates at more granular levels.

For example, Figure 25.5 shows geospatially modelled immunization coverage in children in Ethiopia, based on the 2019 DHS, indicating higher immunization coverage in the western areas of the country. Such maps can be used to monitor and evaluate immunization programmes and inform decision-making about future interventions in low-coverage areas.

FIGURE 25.5. **Geospatial modelling and uncertainty: immunization coverage with a third dose of diphtheria, tetanus toxoid and pertussis vaccine at the 5 × 5 km area, Ethiopia**



These maps were not produced by WHO. The designations employed and the representation of countries and areas in these maps may be at variance with those used by WHO and do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Uncertainty was measured using the width of the 95% confidence intervals (CIs).

Source: derived from the DHS Program Spatial Data Repository *(23)*, with data sourced from the 2019 Demographic and Health Surveys.

Distance/proximity and cluster analyses

Distance and proximity analyses involve measuring the spatial relationships between geographic features or locations. They quantify the physical separation of locations (e.g. health-care facilities, population centres or environmental hazards), which supports the equitable planning of health facilities and access to health care. Distance analysis focuses on quantifying the physical separation between these locations. Proximity analysis examines the relative closeness or accessibility of one location to another. Often travel distance or travel time are used for these analyses rather than physical (Euclidean) distance. When analysing health inequalities, these methods can be used to assess, for example, the accessibility and availability of health-care services across different geographic areas, helping to highlight populations that are disadvantaged and areas where interventions are needed to improve equity in health-care delivery. Additionally, distance and/or proximity analysis can be used to study the relationship between environmental factors (e.g. pollution sources or water bodies) and health outcomes, helping to identify spatial factors associated with health inequalities.

Spatial autocorrelation is a measure of the similarity of nearby observations. Positive spatial autocorrelation occurs when observations with similar values are closer together (i.e. clustered). Negative spatial autocorrelation occurs when observations with dissimilar values are closer together (i.e. disbursed). Cluster analysis uses tests of spatial autocorrelation to identify groups, or clusters, based on the similarity of certain characteristics. It looks at the spatial distribution of health indicators to identify hotspots (i.e. areas of high concentration of the health indicator, such as areas with high cardiovascular disease) and coldspots (i.e. areas of low concentration of the health indicator, such as areas that have poor accessibility to health care) – both of which are useful for targeting interventions. The goal of cluster analysis is to partition data points into distinct groups where observations within each group are more similar to each other than to those in other groups. In the context of geospatial data analysis, cluster analysis can be applied to identify geographic areas or communities that exhibit similar patterns of health outcomes or risk factors. Analysing geospatial data related to disease prevalence rates, socioeconomic indicators or environmental exposures can be used to group communities, neighbourhoods or subnational regions with similar health profiles, revealing spatial patterns of inequalities and highlighting areas where certain population groups may be disproportionately affected by poor health outcomes or lack of health care interventions. For example, the average shortest distance travelled from settlements to medical facilities has been analysed to calculate spatial accessibility in 2859 counties in China *(24)*.

Small-area estimation

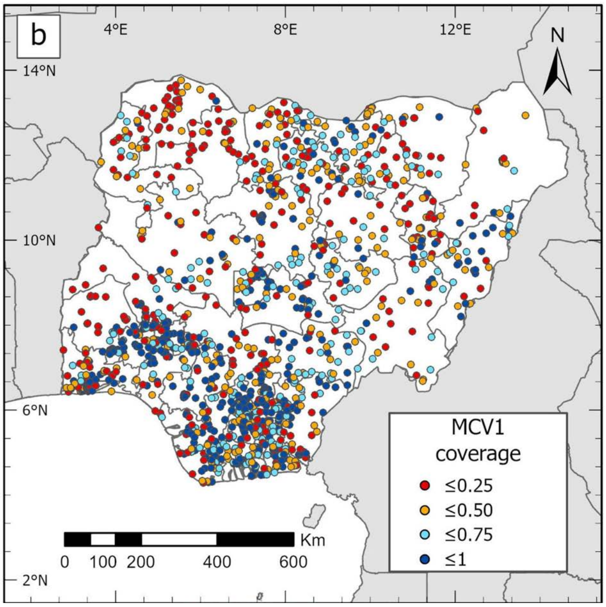
To understand how a health indicator may vary across small geographic areas or demographic and socioeconomic groups (for which data may be sparse or unavailable), small-area estimation can be used to generate reliable estimates. This methodological approach can be used in health inequality monitoring to produce estimates at a resolution that enables policy-makers to identify areas or populations at greatest risk.

As mentioned in previous chapters, inequality monitoring requires data disaggregated by demographic, socioeconomic and geographic characteristics. Household survey data (a primary data source to assess inequalities in health-care access and health burden in low-income settings) are usually designed to produce reliable estimates at the national level or by broad regions. In most subnational areas, therefore, sample sizes to produce direct survey estimates of health-care access or disease burden disaggregated by sociodemographic groups or small geographic areas are often small or there are no data. Rather than substantially increasing sample size in household surveys, which would be extremely costly and logistically challenging, small-area estimation offers the possibility to incorporate pre-existing data. By “borrowing strength” from auxiliary information included in large datasets such as census data or routinely collected programmatic data, small-area estimation can enhance the precision of estimates for small areas or specific groups, without any additional data collection effort *(25–28)*. Geospatial modelling (see above) can also be used in small-area estimation to improve predicted estimates, particularly when high-quality census or administrative data are not available. An example of the application of small-area estimation is given in Box 25.4.

BOX 25.4. Small-area estimation of measles immunization coverage in Nigeria

Small-area estimation has been used in the analysis of measles-containing vaccine (MCV1) coverage among children aged 12–23 months in Nigeria *(29)*, using data from the 2018 DHS. Traditional direct estimates revealed significant variance in vaccination rates between states (i.e. first administrative subdivisions) and across different districts (local government areas) within states (i.e. second administrative subdivisions). Some districts, however, were lacking sufficient sample size for the reliable estimation of vaccination rates. Figure 25.6 shows the cluster-level MCV1 coverage data from the survey at the state level. Many clusters were sampled in the southern, south-western, northern and north-western states, but data are sparse in the north-east. As a result, direct estimates of MCV1 coverage would likely be unstable at the state level and would be missing at lower (e.g. district) levels.

FIGURE 25.6. Cluster-level map of measles-containing vaccine (MCV1) coverage, Nigeria



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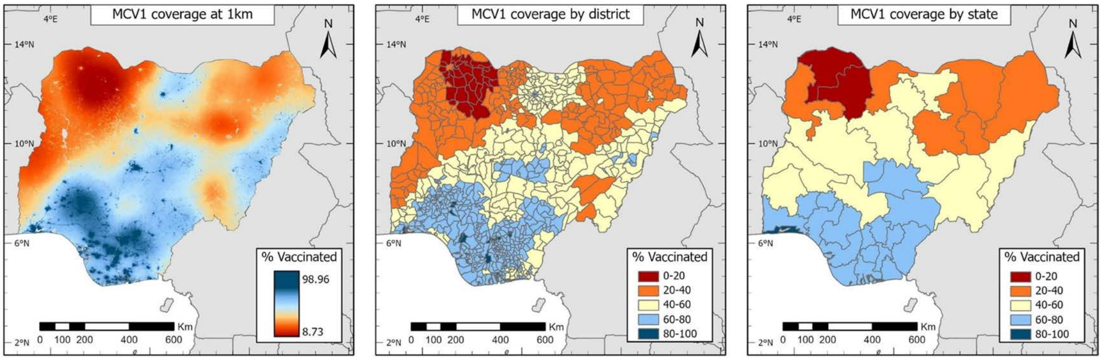
MCV1 coverage is measured as a percentage.

Source: derived from Utazi et al. *(29)*, with data sourced from the 2018 Demographic and Health Surveys.

BOX 25.4. *continued*

Using small-area estimation, researchers integrated a suite of geospatial socioeconomic, environmental and physical covariates (including population size, travel time to nearest health facility, poverty rates, nightlight intensity and land surface temperature) and laboratory-supported measles surveillance data, and also used spatial autocorrelation to model and predict vaccination coverage at the 1 × 1 km resolution at the district and the state level (Figure 25.7), ultimately identifying specific districts with critically low vaccination rates. This targeted approach can facilitate the design of focused immunization campaigns.

FIGURE 25.7. Modelled estimates of measles-containing vaccine (MCV1) coverage, Nigeria



These maps were not produced by WHO. The designations employed and the representation of countries and areas in these maps may be at variance with those used by WHO and do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Source: derived from Utazi et al. *(29)*, with data sourced from the 2018 Demographic and Health Surveys.

Ecological analysis

Investigating how health determinants or factors at a population level can affect health outcomes can be achieved through ecological analysis. Ecological analyses are based on aggregated or grouped data, such as examining relationships between a health indicator and a health determinants or exposure at a population level. In ecological studies, data are analysed at an aggregate level, such as neighbourhoods, cities, subnational regions or countries. These studies can provide insights into how various environmental, social or policy factors may influence health indicators within a population group (see Box 25.5 for examples of health determinant indicators). Ecological studies would be useful to explore, for example, the relationship between air pollution levels and respiratory disease rates; how economic status is related to obesity prevalence; or the impact of smoke-free legislation on smoking rates.

In inequality monitoring, ecological studies can be used to highlight the importance of addressing certain determinants to improve the health indicator of interest. They can also assess large-scale impacts of an intervention or a policy on population health. For example, ecological analyses of the relationship between economic status and immunization rates could be performed using data collected before

BOX 25.5. Examples of determinants of health for ecological analysis

The following are examples of health determinant indicators for conducting ecological analysis at a national level. The choice of determinant depends on the research question and data availability. This list is for illustrative purposes only and is not exhaustive.

- Physical environment:
  - air pollution;
  - population with access to electricity;
  - households that live in overcrowded dwellings;
  - population using basic sanitation.

- Livelihood and skills:
  - population living below the poverty line;
  - population living in multidimensional poverty;
  - urban population living in slums;
  - primary school completion rate;
  - unemployment rate.

- Health system coverage and inputs:
  - government health expenditure per capita;
  - universal health coverage service coverage index;
  - health worker density;
  - health facility density;
  - out-of-pocket health expenditure.

- Social and economic inclusion:
  - gender inequality index;
  - Gini index for income inequality;
  - population experiencing discrimination.

and after the introduction of a national vaccination campaign, to see whether the campaign was successful in reducing or eliminating economic-related inequality in immunization coverage. Ecological studies are valuable because they can be done relatively easily and quickly using indicator estimates at the subnational or national level.

Statistical analysis is used to explore relationships between the health indicator and health determinant. Common techniques include correlation analysis (measuring the strength of the linear or nonlinear (monotonic) relationship between the two variables and computing their association) and regression analysis (see above). An example of the use of regression models to analyse associations between gender inequality and childhood immunization is shown in Box 25.6.

The major limitation of ecological analyses is that because data are not being analysed at the individual level, care is needed in interpretation to avoid ecological fallacy (see Chapter 18). Although ecological analysis can identify associations, they cannot establish causality at the individual level. It is important to be aware of potential confounding factors that may influence the observed relationships.

Measuring between-country inequality

Answering research questions related to quantifying the overall level of inequality in a health indicator between countries can be achieved by measuring between-country inequality. Measuring between-country inequality, unlike within-country inequality, does not quantify inequalities based on demographic or socioeconomic characteristics (i.e. dimensions of inequality); rather, it simply seeks to quantify the variation across countries. It uses national average data rather than disaggregated data.

Many of the summary measures of inequality described in Chapters 19–21 used for measuring within-country inequalities can also be used to quantify inequalities between countries. The calculation methods described in these chapters

BOX 25.6. Associations between gender inequality and childhood immunization at the subnational level

Gender inequality is increasingly recognized as a key determinant of childhood immunization coverage and health equity. In an ecological study, logistic regression models were used to estimate the association between two immunization indicators (prevalence of unvaccinated, or zero-dose, children and DTP3 immunization coverage) and gender inequality, at the subnational level across 57 countries *(30)*.

Human development has been measured using the human development index (HDI), which summarizes the level of development across education, health and standard of living *(31)*. Gender inequality was measured using the subnational gender development index, which is the ratio of HDI among men to HDI among women within a subnational region.

Two regression models were used to analyse the association between gender inequality and childhood immunization – the first was a simple regression model that had no further variables (i.e. unadjusted), and the second included other factors associated with immunization coverage such as urban population and human development indicators (i.e. adjusted).

The results showed that in subnational regions with higher gender inequality, zero-dose prevalence odds were 1.7 times higher compared with subnational regions with lower inequality controlling for other factors included in the model; the odds of DTP3 immunization coverage were 39% lower (Table 25.5). This demonstrates that within-country variation in gender inequality is associated with immunization coverage at the subnational level and suggests that gender inequality may be one of many drivers of subnational inequalities in coverage.

TABLE 25.5. **Odds ratios: zero-dose prevalence and immunization coverage with a third dose of diphtheria, tetanus toxoid and pertussis vaccine (DTP3), by subnational gender development index category in 702 subnational regions across 57 countries**

	Odds ratio (95% CI)	
	Unadjusted	Adjusted
Zero-dose children	2.637 (2.122–3.275)	1.742 (1.384–2.193)
DTP3 immunization coverage	0.437 (0.364–0.524)	0.614 (0.505–0.746)

CI, confidence interval.
Source: derived from Johns et al. *(30)*, with data sourced from 2010–2019 subnational regional estimates published by the Global Data Lab.

can be used, replacing subgroup estimates for country estimates, and subgroup population sizes for country population sizes. For example, inequality in a health indicator across a group of countries can be assessed as the difference or the ratio between the countries with the highest and lowest health indicator estimates. To take all countries (and their population sizes) into account, between-group variance, between-group standard deviation, coefficient of variation and weighted mean difference from mean could be used to quantify the level of variance between all countries and the overall mean. An example of the calculation of the weighted mean difference from a best-performing subgroup (MDBW; also known as international shortfall inequality when applied to measuring between-country inequality) is highlighted in Box 25.7. The Gini coefficient (see earlier) can also be used to measure dispersion in a health indicator across countries.

BOX 25.7. Example calculation of international shortfall inequality

When measuring between-country inequality, MDBW (international shortfall inequality) is defined as the weighted average of the deviation of each country's indicator estimate from the highest estimate, weighted by country population. It measures the absolute difference, or the degree of shortfall, from the highest attained estimate. It can be turned into a relative measure by dividing the result by the highest estimate.

In the context of measuring between-country inequality, MDBW is calculated as

$$\sum p_{country}\left|y_{best}-y_{country}\right|$$

where $y_{country}$ is the country indicator estimate, y_{best} is the highest estimate (e.g. the best-performing country or the top fifth percentile of countries), and $p_{country}$ is the country's population share out of the total population of all countries.

Table 25.6 shows an example of the calculation of MDBW for a set of 19 middle-income European countries. It shows that, on average, these countries had a life expectancy of 4.6 years less than Albania (the country among them with the highest life expectancy).

TABLE 25.6. Steps to calculate mean difference from best-performing subgroup (weighted): life expectancy at birth in 19 middle-income countries in the WHO European Region

Country	Life expectancy at birth (years) [A]	Population size (thousands) [C]	Population share [E = C / D]	Difference between highest estimate and country estimate [F = B – A]	Weighted difference (years) [G = E × F]
Albania[a]	76.4 [B]	2856	0.007	0.0	0.000
Armenia	73.0	2791	0.007	3.4	0.024
Azerbaijan	72.9	10 313	0.026	3.5	0.091
Belarus	73.1	9578	0.024	3.3	0.079
Bosnia and Herzegovina	74.8	3271	0.008	1.6	0.013
Bulgaria	71.3	6886	0.017	5.1	0.087
Georgia	71.2	3758	0.009	5.2	0.047
Kazakhstan	70.3	19 196	0.048	6.1	0.293
Kyrgyzstan	72.2	6528	0.016	4.2	0.067
Montenegro	74.7	628	0.002	1.7	0.003
North Macedonia	73.0	2103	0.005	3.4	0.017
Republic of Moldova	69.6	3062	0.008	6.8	0.054
Russian Federation	70.0	145 103	0.361	6.4	2.310
Serbia	72.8	7297	0.018	3.6	0.065
Tajikistan	71.8	9750	0.024	4.6	0.110
Türkiye	75.3	84 775	0.211	1.1	0.232
Turkmenistan	69.1	6342	0.016	7.3	0.117
Ukraine	70.9	43 531	0.108	5.5	0.594
Uzbekistan	72.2	34 081	0.085	4.2	0.357
Total		*401 849 [D]*			*Mean difference from best-performing subgroup (weighted) = 4.6*

[a] Highest estimate (Albania).

Source: data from 2021 WHO Global Health Estimates *(32)*.

BOX 25.7. *continued*

A higher MDBW value indicates greater between-country inequality, or a higher absolute difference between the best-performing country and the other countries. MDBW is measured in the same unit as the health indicator. Like other summary measures, MDBW is more meaningful when used to compare inequality across different time points, different populations within countries (e.g. females and males), and different groupings of countries (e.g. regions or World Bank income groupings).

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Epilogue

Although progress has been made in advancing equity in certain aspects of health, the persistence of wide inequities in other areas is a stark reminder of the work still to be done to rectify injustice and unfairness. Robust health inequality monitoring systems and practices are needed to identify and address health inequities and ensure no one is left behind in the pursuit of better health for all.

This book is a comprehensive and contemporary resource for health inequality monitoring, consolidating foundational and emerging knowledge in the field. It supports the expansion and strengthening of health inequality monitoring practices for different applications worldwide, in service of the broader goal of advancing health equity.

Reflections and insights

Health inequality monitoring is a multistep process that begins with some key questions: Inequality of what? Inequality among whom? It then requires the sourcing and analysis of suitable inequality data. This leads to the formulation of key messages and effective reporting of the evidence, to the right audience, at the right time. The application of evidence to support actions that advance health equity then requires ongoing monitoring to track progress and promote accountability.

Health inequality monitoring draws upon diverse skills, inputs and expertise. Collaborative health inequality monitoring is strengthened by the contributions of subject matter experts (including people with lived experiences), skilled data analysts, communication experts, decision-makers and advocates. This book guides the practice of health inequality monitoring by explaining key concepts and how they may be adapted and applied to different settings, populations, levels of measurement (individual, household or small area), health topics and inequality dimensions.

Each iteration of inequality monitoring requires careful consideration and judgement in navigating a unique set of circumstances. This book underscores the importance of integrating universal and context-specific approaches to monitoring. The use of universal monitoring frameworks and approaches facilitates comparisons across settings and over time and promotes alignment with monitoring protocols for tracking global and regional goals. Context-specific elements allow monitoring to capture more localized considerations and priorities, which may lead more directly to actions at the national or subnational levels. As such, monitoring inequalities across different dimensions of inequality is an important step to increase recognition of these factors and how they affect health and health determinants.

Approaches to some of the more technical aspects of inequality monitoring, including assessing data availability, data analysis and reporting, have been developed and refined by the scientific community over decades. This book has collected and conveyed this rich body of foundational knowledge, offering a detailed overview of concepts and, where applicable, standardized guidance for the application of knowledge. For example, it overviews established and emerging sources of disaggregated data, illustrating their strengths, limitations and uses. It presents a comprehensive set of summary measures of health inequality, delving into their applications, calculation methods and interpretation, and their inherent assumptions, value judgements and limitations. It provides guidance on effective reporting practices to ensure evidence-informed key messages reach diverse audiences and motivate remedial action. As the field of health inequality monitoring continues to advance, the contents of this book serve as a base and reference for further methodological refinement.

Generating impact towards the goal of health equity is the central motivation for health inequality monitoring – that is, harnessing data to advance health equity. Understanding and addressing inequities in health is a common concern worldwide and has the potential to accelerate progress towards health and development goals, including the Sustainable Development Goals (SDGs). The use of data for such impact can be enabled through strengthened equity-oriented health information systems, effective communication efforts, and strategic policy-making. Although the actions of the health sector can reduce inequities in health, many of the factors for equitably improving population health and well-being lie beyond the health sector. Thus, tackling health inequities also requires monitoring and action on social determinants of health. This signals the importance of establishing multisectoral collaborations and acknowledging and addressing the structural roots of health inequities at the societal level.

Present realities

The current landscape of health inequality monitoring is highly variable. The availability of disaggregated data, capacity for analysis and reporting, and support for equity-oriented and evidence-informed decision-making can look very different across countries, population groups and health topics.

The World Health Organization and its partners are working to build capacity and expand the practice of inequality monitoring – and its impact – in settings and health topics where it is underused. A collection of tools facilitates the application of standardized processes, including data source-mapping, preparation of disaggregated data, calculation of summary measures of health inequality, and creation of figures and maps. These tools, together with capacity-strengthening resources, help to streamline aspects of inequality monitoring and make them more accessible to wider audiences.

In some contexts, the frontiers for sourcing data and the analytical possibilities for health inequality monitoring are expanding rapidly. Calls for intersectional data analysis are growing. The amount of data generated from digital sources – and techniques to analyse and derive meaning from them – are increasing quickly, bringing new opportunities and challenges. In some settings, the collection of disaggregated health and health-related data through more traditional means, such as censuses and household surveys, is becoming more efficient and yielding higher-quality data on expanded topic areas. Methods for linking between data sources are further advancing the usability and quality of data for inequality monitoring. Major concerns remain, however, pertaining to data governance and ownership, privacy, exclusionary practices and biases, and access to technology.

The adoption of the United Nations Sustainable Development Agenda (2015–2030) signalled high-level political support for monitoring in general and resulted in the development of a global monitoring framework. The centrality of tackling inequalities as part of the Agenda, and its emphasis on monitoring and accountability, set the stage for routine health inequality monitoring. The evidence derived from inequality monitoring is essential to track progress towards the SDGs and to identify where targeted support is needed to advance population health. National governments, multilateral organizations and various implementing agencies are more consciously integrating inequality analysis and monitoring into evaluation activities. To a large extent, this has been part of fulfilling their commitments to achieving the SDGs and other health and development agendas.

Future directions

Although the advancement of health equity and health for all have been expressed as priorities for health and development initiatives for over half a century, they continue to be relevant aspirations into the future. There has been substantial progress in understanding and addressing certain forms of health inequalities in some areas of health – although many health inequalities continue to persist or remain unacknowledged or poorly characterized. Regular and recurring health inequality monitoring is vital to generate evidence to track changes in health inequalities and to explore and expose emerging forms of inequalities. The practice of inequality monitoring should be strengthened, expanded and invested in – and it should be made a routine part of health information systems. To this end, inequality monitoring can serve its purpose as a warning system.

Mainstreaming health inequality monitoring as a regular part of the design and functioning of country health information systems, including programme evaluation and planning, can help to create a demand for evidence about inequalities. High-quality disaggregated health data are the key data inputs to monitoring inequalities in health, and efforts are needed to ensure they are available for a wide selection of relevant health indicators and inequality dimensions. The emerging importance of nontraditional data-collection processes will continue to change the landscape of such evidence and fill these gaps but necessitates innovative approaches to ensure data are used effectively and responsibly.

A key challenge lies in establishing clear pathways for the use of this evidence to drive equity-oriented action, which is contingent on political and popular support. This process continues to be meaningfully advanced across different contexts, benefitting from shared experiences and lessons learnt. Alongside the results of inequality monitoring analyses, the co-development of other forms of evidence – including further quantitative and qualitative studies – is needed to deepen and extend understandings of the process and multiple impacts of inequalities, and for effective solutions. The integration of multiple forms of knowledge can yield insights into the drivers of inequalities and reveal new aspects for exploration or continued monitoring.

The Sustainable Development Agenda has made strides in highlighting the explicit links across social, economic and environmental domains, underscoring the interdependent relationship between health and other sectors. This points to the need for strong collaborations to enable progress in advancing the art and science of health inequality monitoring and promoting its impact on improving population health.

Annexes

Annex 1

Monitoring inequalities in social determinants of health

By applying techniques similar to those used to measure inequality in health indicators across population subgroups, inequalities in social determinants of health (SDH) indicators can be measured – that is, data pertaining to SDH indicators can be disaggregated according to relevant dimensions of inequality. In this way, it is possible to quantify and track the extent of inequality in SDH indicators over time. Specific examples of disaggregated SDH indicator data include the use of clean fuels and technologies for cooking disaggregated by place of residence, literacy rates disaggregated by place of residence and sex, and secondary school attendance disaggregated by economic status.

Although most of the general approaches to health inequality monitoring can be applied directly to the measurement of inequalities in SDH, there are a few caveats. The SDH indicator and dimension of inequality must be distinct to avoid circular or non-independent analyses. For example, it is not valid to disaggregate the SDH indicator of poverty rate by economic status, because the two variables effectively capture the same type of information. Likewise, disaggregation of the literacy rate by education level should be avoided. Alternative approaches could explore the poverty rate by place of residence or the literacy rate by age.

For the same reason, caution is required when monitoring involves SDH indicators or dimensions of inequality constructed using indices. For example, the Multidimensional Poverty Index – an SDH indicator – encompasses three dimensions of poverty: health, education and living standards *(1)*. This SDH indicator should not be disaggregated by any of these dimensions. The WHO Health Inequality Data Repository, for example, contains Multidimensional Poverty Index data disaggregated by age, place of residence, sex of household head and subnational region *(2)*.

References

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2. Health Inequality Data Repository. Geneva: World Health Organization (https://www.who.int/data/inequality-monitor/data, accessed 20 June 2024).

Annex 2

Monitoring inequalities in health expenditure

Health expenditures are payments for health care. They are financed from public sources (e.g. tax-funded government budgets and social (health) insurance) and private sources (e.g. private health insurance and out-of-pocket payments). There are different methods that can be used to monitor inequalities in health expenditure.

Who benefits from public spending?

Inequality in publicly financed health expenditure is monitored to determine who benefits from public spending on health care. Redistribution from richer households to poorer households is an important policy objective for public financing of health care. It is important, therefore, to establish the extent to which different income groups benefit from health care financed by taxes and social insurance.

Benefit incidence analysis

Benefit incidence analysis describes the distribution of health expenditure over the distribution of income, and is usually done with a focus on government spending *(1)*. For this analysis, the health topic is publicly financed health expenditure, and the dimension of inequality is income or consumption expenditure. Both are measured at the household level. Public health spending on a household is not directly observed in any data source. A benefit incidence analysis usually uses survey data to estimate individuals' use of public health facilities. A quantity of use, such as the number of nights in a public hospital, is multiplied by a unit cost to get the monetary value of each individual's use. These amounts are aggregated over types of public health care – each weighted by a different unit cost – and individuals within a household to find the total public spending on the health care used by a household. Unit costs can be estimated from national health accounts.

The distribution of public health spending in relation to the distribution of income is assessed to establish whether public health expenditure is pro-poor (whereby poorer households receive absolutely more public health spending than richer households) or pro-rich (whereby richer households receive absolutely more). This analysis can also establish whether public health expenditure reduces inequality (whereby, as a percentage of income, public health expenditure on poorer households is relatively greater than on richer households) or increases inequality.

In addition to benefit incidence analysis, there are other methods available to review budgets and expenditure according to other dimensions of inequality, such as geographic location *(2)* and gender *(3)*.

Out-of-pocket expenditure and financial risk protection

Inequalities in out-of-pocket payments for health care are monitored to assess progress towards the financial protection component of universal health coverage. WHO and the World Bank use two measures of financial protection – catastrophic and impoverishing out-of-pocket health spending *(4)*. The measure of impoverishing health spending is intended to measure individuals who are pushed into poverty – or pushed further into poverty – by out-of-pocket payments for health care. This measure could be compared across demographic or geographic dimensions of inequality, such as age, age structure of the household, sex or urban/rural. There would be less reason to compare impoverishing health spending by a measure of economic status because the dimension of poverty is part of the indicator itself.

Catastrophic health spending can be compared by economic dimensions of inequality, such as poverty status, income, consumption expenditure or a wealth index, and by demographic and geographic dimensions. When assessing the prevalence of catastrophic health spending over the distribution of consumption expenditure, such as by quintile groups of this expenditure, it is important to use consumption net out-of-pocket payments for health care – otherwise households with large out-of-pocket payments will appear to be better off (because their total consumption expenditure is pushed up by out-of-pocket payments) and the analysis will give a false impression that catastrophic health spending is predominantly incurred by richer households. Summary measures of inequality can be used to capture the overall distribution of catastrophic health spending.

References

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Annex 3

Increasing the voice of the people through community-led monitoring

Community-led monitoring occurs when people accessing health care or people affected by inequalities systematically monitor services. This includes collecting and analysing data, and conducting evidence-driven advocacy to improve service delivery, generate solutions and create an enabling environment for well-being *(1)*. Some of the core principles of community-led monitoring include that it is independent from donors and national governments; communities decide what to monitor and how to act on the results; and there is an emphasis on advancing equity, advocacy and accountability. Community-led monitoring should adhere to ethical data collection, consent, confidentiality and data security, and the data should be shared publicly *(1)*.

Communities – or groups of individuals that have something in common – may organize on the basis of a common place of residence or other factor, such as age, ethnicity, experience of disadvantage, health need, occupation, religious affiliation or shared interest *(2)*.

Community-led monitoring helps to ensure the perspectives of diverse populations are part of efforts to drive changes to policies, programmes and practices that seek to benefit those populations. The outputs of community-led monitoring are important for informing and strengthening recommendations generated from health inequality monitoring, especially when they include a focus on populations experiencing disadvantage. Seeking input from groups engaged with community-led monitoring across the earlier stages of the health inequality monitoring cycle can help to align the monitoring activities with their needs *(3)*. Box A3.1 describes community engagement, participation and empowerment in relation to community-led monitoring.

BOX A3.1. Community engagement, participation and empowerment

Community engagement refers to the involvement of communities in decision-making and planning by "developing relationships which then allow for working together," further linking the concept to collaboration, power-sharing and partnership *(2)*. Community engagement, which is initiated by government actors, is distinct from community participation, which is initiated by citizens or beneficiary groups.

Empowerment can be defined as "the process by which people gain control over the factors and decisions that shape their lives. It is the process by which they increase their assets and attributes and build capacities to gain access, partners, networks and/or a voice, in order to gain control" *(4)*.

Community-led monitoring has been instrumental in galvanizing national and global responses to pertinent health issues, with notable examples from around the world. In western and central Africa, regional community treatment observatories were established across 11 countries with the aim of improving access to antiretroviral medicines for people living with HIV *(5)*. Extensive data collection from nearly 100 000 young people, more than 35 000 people from key populations and more than 105 000 people on antiretroviral therapy revealed several challenges, including a lengthy gap in returning viral load test results to clients. Social movements driven by activists and people living with HIV have had a powerful impact on raising awareness and pushing for action to redress injustice and inequity related to health *(6)*.

There are limitations and considerations for the application of community-led monitoring approaches to health inequality monitoring. In some contexts, there are insufficient linkages and accountability gaps between communities and higher levels of the health system, meaning community-led monitoring efforts may lack impact. For example, in Kenya, community awareness of the role of health facility committees was found to be low *(7)*, suggesting a need for stronger linkages between community-led monitoring and oversight mechanisms and the broader community. There may also be funding constraints in citizen accountability initiatives – related partly to the politics of community-led monitoring, but also to the extent to which this is a priority in some countries *(8, 9)*.

Yet, there are promising opportunities and lessons for integrating the ethos of community-led monitoring into health inequality monitoring. Communities are increasingly recognized as social systems rather than passive beneficiaries of services, alerting the fact that there may be significant divergences between community priorities and international actors such as donors *(10)*. Accordingly, the integration of community monitoring mechanisms and national data systems has the potential to encourage the local use, interpretation and application of data *(11)*. Decentralization and self-government efforts offer an enabling legal or statutory framework for community-based and community-led efforts to have the strength needed for impact and additional revenue streams for implementation (some of which may be outside the health sector).

Globally, detailed guidance on community-led monitoring has been developed *(1)*, with increased attention to the institutionalization of social participation for health *(12, 13)*.

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Annex 4

Ethical considerations in public health surveillance

WHO has issued guidelines on ethical issues in public health surveillance, which have relevance to health inequality monitoring activities *(1)*. The 17 guidelines seek to address key ethical considerations that arise when collecting, analysing and interpreting health-related data. Importantly, the guidelines acknowledge challenges that may arise in situations of persistent injustice or human rights violations. The guidelines are intended to assist people working in public health surveillance, including health workers and officials in government agencies, nongovernmental organizations and the private sector.

Guideline 1 Countries have an obligation to develop appropriate, feasible, sustainable public health surveillance systems. Surveillance systems should have a clear purpose and a plan for data collection, analysis, use and dissemination based on relevant public health priorities.

Guideline 2 Countries have an obligation to develop appropriate, effective mechanisms to ensure ethical surveillance.

Guideline 3 Surveillance data should be collected only for a legitimate public health purpose.

Guideline 4 Countries have an obligation to ensure that the data collected are of sufficient quality, including being timely, reliable and valid, to achieve public health goals.

Guideline 5 Planning for public health surveillance should be guided by transparent governmental priority-setting.

Guideline 6 The global community has an obligation to support countries that lack adequate resources to undertake surveillance.

Guideline 7 The values and concerns of communities should be taken into account in planning, implementing and using data from surveillance.

Guideline 8	The organizations and people responsible for surveillance should identify, evaluate, minimize and disclose risks for harm before surveillance is conducted. Monitoring for harm should be continuous, and, when any is identified, appropriate action should be taken to mitigate it.
Guideline 9	Surveillance of individuals or groups who are particularly susceptible to disease, harm or injustice is critical and demands careful scrutiny to avoid the imposition of unnecessary additional burdens.
Guideline 10	Governments and other organizations and people who hold surveillance data must ensure identifiable data are appropriately secured.
Guideline 11	Under certain circumstances, the collection of names or identifiable data is justified.
Guideline 12	Individuals have an obligation to contribute to surveillance when reliable, valid, complete datasets are required and relevant protection is in place. Under these circumstances, informed consent is not ethically required.
Guideline 13	Results of surveillance must be effectively communicated to relevant target audiences.
Guideline 14	With appropriate safeguards and justification, organizations and people responsible for public health surveillance have an obligation to share data with other national and international public health agencies.
Guideline 15	During a public health emergency, it is imperative that all parties involved in surveillance share data in a timely fashion.
Guideline 16	With appropriate justification and safeguards, public health agencies may use or share surveillance data for research purposes.
Guideline 17	Personally identifiable surveillance data should not be shared with agencies that are likely to use the data to take action against individuals or for uses unrelated to public health.

Reference

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Annex 5

Climate change and health inequality

The detrimental health impacts of climate change are broad, cross-cutting and distributed unevenly across countries and within populations. Termed a “threat multiplier” by WHO, the effects of climate change on health and health determinants are mediated by social factors *(1)*. Health issues such as pollution, poor water supply and sanitation, lack of access to clean energy sources, and unsafe homes and workplaces are associated with, and partially attributed to, low socioeconomic status; other demographic and geographic inequality dimensions also play a role *(2)*. Thus, inequality monitoring is relevant in the context of climate change to identify and track the health effects of climate change and provide evidence to inform responses.

Climate change has grave implications, directly or indirectly, within contexts and populations such as low-resourced settings, rural and remote settings, refugee and migrant populations, and emergency contexts. The risks associated with climate change, and the ability to mitigate risks and adapt to changes, are mediated by social factors and have differential impacts on population subgroups. For example, the WHO Health and Climate Change Country Profiles, developed in collaboration with national governments, identified small island developing states as some of the countries facing the largest risks from climate change *(3)*. Box A5.1 suggests some further reading on the health impacts of climate change with respect to gender and indigeneity.

BOX A5.1. Further reading on the health impacts of climate change with respect to gender and indigeneity

Brubacher LJ, Peach L, Chen TTW, Longboat S, Dodd W, Elliott SJ, et al. Climate change, biodiversity loss, and indigenous peoples’ health and wellbeing: a systematic umbrella review. PLOS Glob Public Health. 2024;4(3):e0002995. doi:10.1371/journal.pgph.0002995.

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Gender, climate change and health. Geneva: World Health Organization; 2014 (https://iris.who.int/handle/10665/144781, accessed 23 September 2024).

The risks of climate change are evident across different health domains and require equity-oriented responses *(4)*. For example, the effects of climate change threaten progress in advancing universal health coverage. The impacts of extreme weather events disproportionately impact people who already face financial barriers to health services and medicines, and put others who were previously able to afford payment at risk *(5)*. Climate change is a key factor in promoting equity in nutrition (including food security and safety), and joint actions are required to address both climate and nutrition *(6)*.

The Alliance for Transformative Action on Climate and Health, a WHO-hosted network, has convened working groups around themes including climate-resilient health systems, low-carbon sustainable health systems, supply chains, financing, and climate action and nutrition *(7)*. In 2022, WHO compiled the *Compendium of WHO and other UN guidance on health and environment* as a resource for decision- and policy-makers working at various levels in health and environmental sectors. The resource aims to assist countries in taking actions to improve the health of people and the environment and reduce health inequities *(8)*.

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Annex 6

Urbanization and health inequality

Rapid and poorly planned urbanization can have negative health implications that disproportionately impact poor people, migrants or otherwise disadvantaged people. Some of the most pressing health concerns in urban areas include noncommunicable diseases, injuries, interpersonal violence and infectious diseases *(1)*. Addressing and reducing health inequities in urban settings is key to creating healthy cities for everyone. As in rural areas, urban dwellers have a wide diversity of experiences, and health inequalities in these areas may be concealed by overall averages. Disaggregation of data on urban populations is needed to better understand the nuanced patterns of inequality in these settings *(2)*.

Urban informal settlements, characterized by a lack of basic services, poor housing conditions, overcrowding and insecure tenure, remain a priority across global policy and development initiatives *(3)*, including the United Nations Agenda for Sustainable Development. Sustainable Development Goal 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable. The associated targets and their indicators specify monitoring requirements, emphasizing the importance of disaggregation by age, disability status and sex, as applicable *(4)*.

Further resources on urbanization and health inequality are available through the WHO resource repository Local Action for Health *(5)*.

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Annex 7

Data source mapping in Indonesia

The following is an example of data source mapping, including data source linking, in Indonesia. It is derived from a data source mapping exercise conducted in 2016 for the preparation of the *State of health inequality: Indonesia* report *(1)*. The exercise was led by the Indonesian National Institute of Health Research and Development, in consultation with other stakeholders *(2)*. Templates for each of the tables are available from the Health Inequality Monitor *(3)*.

This data source mapping exercise aimed to capture a broad array of health topics and dimensions of inequality relevant to the national population.

Step 1

Table A7.1 provides a comprehensive list of potentially relevant data sources, and the year from which they are available. It includes the population census, an institution-based source, several health surveys and the vital registration system.

TABLE A7.1. Data sources for 2016 and earlier, by type, in Indonesia

Type	Name	Year
Census	Population census	1961, 1971, 1980, 1990, 2000, 2010
Institution-based	Indonesia health profile (report including health centres and hospitals)	Annually
Survey	RISKESDAS (Basic Health Research)	2007, 2010, 2013
Survey	RIFASKES (Health Facility Survey)	2011
Survey	SIRKESNAS (National Health Indicators Survey)	2016
Survey	Tuberculosis Prevalence Survey	2004, 2014
Survey	SUSENAS (National Socioeconomic Survey)	1979, 1980, 1981, 1984, 1989, then annually

TABLE A7.1. *continued*

Type	Name	Year
Survey	SUPAS (Intercensal Survey)	1995, 2005, 2015
Survey	GATS (Global Adult Tobacco Survey)	2011
Survey	GYTS (Global Youth Tobacco Survey)	2006, 2009, 2014
Survey	IDHS (Indonesia Demographic and Health Survey)	1987, 1991, 1994, 1997, 2003, 2007, 2012
Survey	PODES (Village Potential Survey)	1983, 1986, 1990, 1993, 1996, 2000, 2003, 2005, 2008, 2011, 2014
Survey	GSHS (Global School-based Student Health Survey)	2015
Vital registration	SRS (Sample Registration System)	2014, 2015

Source: derived from Hosseinpoor et al. *(2)*.

Step 2

In Table A7.2, the data sources from Table A7.1 are assigned unique numbers, and seven relevant dimensions of inequality are mapped for selected years.

TABLE A7.2. Data sources mapped by dimensions of inequality

Unique data source number	Unique data source name	Dimension of inequality						
		Income/ expenditure/ consumption/ asset index	Education	Occupation	Sex	Urban/rural	Province/ region	Ethnicity
1	RISKESDAS (Basic Health Research) 2007	✓	✓	✓	✓	✓	✓	✗
2	RISKESDAS (Basic Health Research) 2010	✓	✓	✓	✓	✓	✓	✗
3	RISKESDAS (Basic Health Research) 2013	✓	✓	✓	✓	✓	✓	✗
4	RIFASKES (Health Facility Survey) 2011	✗	✗	✗	✗	✗	✓	✗
5	SIRKESNAS (National Health Indicators Survey) 2016	✓	✓	✓	✓	✓	✓	✗

TABLE A7.2. *continued*

Unique data source number	Unique data source name	Dimension of inequality						
		Income/ expenditure/ consumption/ asset index	Education	Occupation	Sex	Urban/rural	Province/ region	Ethnicity
6	SUSENAS (National Socioeconomic Survey)	✓	✓	✓	✓	✓	✓	✗
7	SUPAS (Intercensal Survey) 2015	✓	✓	✓	✓	✓	✓	✗
8	GATS (Global Adult Tobacco Survey) 2011	✗	✓	✓	✓	✓	✓	✗
9	GYTS (Global Youth Tobacco Survey) 2014	✗	✗	✗	✓	✓	✓	✗
10	IDHS (Indonesia Demographic and Health Survey) 2012	✓	✓	✓	✓	✓	✓	✗
11	SRS (Sample Registration System) 2016	✗	✓	✗	✓	✓	✗	✗
12	Indonesia health profile 2015	✗	✗	✗	✗	✗	✓	✗
13	Population census 2010	✓	✓	✓	✓	✓	✓	✓
14	PODES (Village Potential Survey) 2011	✗	✗	✗	✗	✗	✓	✗
15	Tuberculosis Prevalence Survey 2014	✗	✗	✗	✓	✓	✓	✗
16	GSHS (Global School-based Student Health Survey) 2015	✗	✓	✗	✓	✗	✓	✗

Source: derived from Hosseinpoor et al. *(2)*.

Step 3

Table A7.3 maps the availability of data about health indicators across health topics of interest. The unique data source numbers link to the information in Table A7.2.

TABLE A7.3. Data sources mapped by health indicators

Health topic and indicator	Unique data source number
Reproductive health	
Adolescent fertility rate	2, 10
Total fertility rate	2, 10
Contraceptive prevalence – modern methods	2, 10, 16
Demand for family planning satisfied	10
Maternal health interventions	
Antenatal care coverage – at least four visits	2, 3, 5, 6, 10, 12
Births attended by skilled health personnel	2, 3, 5, 6, 10, 12
Postnatal care coverage	2, 3, 5, 6, 10, 12
Child health interventions	
Complete basic immunization coverage	1, 2, 3, 5, 6, 10, 12
Vitamin A supplementation	1, 2, 3, 5, 10, 12
Exclusive breastfeeding	1, 2, 3, 5, 6, 12
Nutrition	
Prevalence of stunting among children aged under five years	1, 2, 3, 5
Prevalence of obesity among adults	1, 2, 3, 5
Prevalence of low birth weight	1, 2, 3, 5
Infectious diseases	
Prevalence of malaria	2, 3
Prevalence of acute respiratory infection	1, 3
Prevalence of tuberculosis	15
Noncommunicable diseases	
Prevalence of diabetes mellitus	1, 3
Prevalence of anaemia	1, 3
Prevalence of hypertension	1, 2, 3

TABLE A7.3. *continued*

Health topic and indicator	Unique data source number
Injury	
Prevalence of falls	1, 3
Prevalence of road traffic accidents	1, 3
Prevalence of serious injury	16
Mental health	
Prevalence of psychosis or schizophrenia	3
Prevalence of mental emotional disorder	1, 3
Disability	
Prevalence of disability	1, 3
Child mortality	
Neonatal mortality	1, 10, 11, 13
Infant mortality	1, 7, 10, 11, 13
Under-five mortality	1, 7, 10, 11, 13
Maternal mortality	
Maternal mortality ratio	7, 10, 11, 13
Healthy/unhealthy behaviours	
Prevalence of current smoking	1, 3, 6, 8, 9, 16
Prevalence of alcohol consumption	1, 3, 8, 9, 16
Prevalence of physical inactivity	1, 3, 16
Prevalence of low fruit/vegetable consumption	1, 3, 16
Environmental health	
Proportion of households using improved drinking water	1, 2, 3, 6, 13, 14
Proportion of households using improved sanitation	1, 2, 3, 6, 13, 14
Proportion of households using pesticide	1, 2, 3, 6, 13, 14
Health insurance	
Proportion of population with national health insurance	3, 6
Proportion of population with province/district health insurance	3, 6
Proportion of population with private health insurance	3, 6

TABLE A7.3. *continued*

Health topic and indicator	Unique data source number
Health-care access	
Average travel time to health centre	1, 3, 14
Average transportation cost to health centre	1, 3, 14
Inpatient utilization rate	1, 3, 6
Outpatient utilization rate	1, 3, 6
Health facility	
Number of hospitals by province	4, 12, 14
Health centre density	4, 12
Bed occupancy rate in public hospital	12
Health financing	
Average out-of-pocket health expenditure	6
Health expenditure per capita	6
Human resource for health	
Number of doctors, midwives, nurses, nutritionists, sanitarians and health promotion staff in hospitals and in health centres	4, 12
Density of doctors, midwives, nurses, nutritionists, sanitarians and health promotion staff	4, 12

Source: derived from Hosseinpoor et al. *(2)*.

Step 4

In Table A7.4, information from Tables A7.2 and A7.3 is combined to show the data sources (via their unique data source numbers) that contain information about intersecting health indicators and inequality dimensions.

TABLE A7.4. Data sources mapped by health indicators and dimensions of inequality

Health topic and indicator	Dimension of inequality						
	Economic status	Education	Occupation	Sex	Urban/rural	Province/region	Ethnicity
Reproductive health							
Adolescent fertility rate	2, 10	2, 10	2, 10	N/A	2, 10	2, 10	N/A
Total fertility rate	2, 10	2, 10	2, 10	N/A	2, 10	2, 10	N/A
Contraceptive prevalence – modern methods	2, 10	2, 10, 16	2, 10	2, 10, 16	2, 10	2, 10, 16	N/A
Demand for family planning satisfied	10	10	10	10	10	10	N/A
Maternal health interventions							
Antenatal care coverage – at least four visits	2, 3, 5, 6, 10	2, 3, 5, 6, 10	2, 3, 5, 6, 10	N/A	2, 3, 5, 6, 10	2, 3, 5, 6, 10, 12	N/A
Births attended by skilled health personnel	2, 3, 5, 6, 10	2, 3, 5, 6, 10	2, 3, 5, 6, 10	N/A	2, 3, 5, 6, 10	2, 3, 5, 6, 10, 12	N/A
Postnatal care coverage	2, 3, 5, 10	2, 3, 5, 10	2, 3, 5, 10	N/A	2, 3, 5, 10	2, 3, 5, 10, 12	N/A
Child health interventions							
Complete basic immunization coverage	1, 2, 3, 5, 6, 10	1, 2, 3, 5, 6, 10	1, 2, 3, 5, 6, 10	1, 2, 3, 5, 6, 10	1, 2, 3, 5, 6, 10	1, 2, 3, 5, 6, 10, 12	N/A
Vitamin A supplementation	1, 2, 3, 5, 10	1, 2, 3, 5, 10	1, 2, 3, 5, 10	1, 2, 3, 5, 10	1, 2, 3, 5, 10	1, 2, 3, 5, 10, 12	N/A
Exclusive breastfeeding	1, 2, 3, 5, 6	1, 2, 3, 5, 6	1, 2, 3, 5, 6	1, 2, 3, 5, 6	1, 2, 3, 5, 6	1, 2, 3, 5, 6, 12	N/A
Nutrition							
Prevalence of stunting among children aged under five years	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	N/A
Prevalence of obesity among adults	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	N/A
Prevalence of low birth weight	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	1, 2, 3, 5	N/A
Infectious diseases							

TABLE A7.4. *continued*

Health topic and indicator	Dimension of inequality						
	Economic status	Education	Occupation	Sex	Urban/rural	Province/region	Ethnicity
Prevalence of malaria	2, 3	2, 3	2, 3	2, 3	2, 3	N/A	N/A
Prevalence of acute respiratory infection	1, 3	1, 3	1, 3	1, 3	1, 3	1, 3	N/A
Prevalence of tuberculosis	N/A	N/A	N/A	15	15	15	N/A
Noncommunicable diseases							
Prevalence of diabetes mellitus	1, 3	1, 3	1, 3	1, 3	1, 3	N/A	N/A
Prevalence of anaemia	1, 3	1, 3	1, 3	1, 3	1, 3	N/A	N/A
Prevalence of hypertension	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	N/A	N/A
Injury							
Prevalence of falls	1, 3	1, 3	1, 3	1, 3	1, 3	1, 3	N/A
Prevalence of road traffic accidents	1, 3	1, 3	1, 3	1, 3	1, 3	1, 3	N/A
Prevalence of serious injury	N/A	16	N/A	16	N/A	16	N/A
Mental health							
Prevalence of psychosis or schizophrenia	3	3	3	3	3	3	N/A
Prevalence of mental emotional disorder	1, 3	1, 3	1, 3	1, 3	1, 3	1, 3	N/A
Disability							
Prevalence of disability	1, 3	1, 3	1, 3	1, 3	1, 3	1, 3	N/A
Child mortality							
Neonatal mortality	1, 10, 11, 13	1, 10, 11, 13	1, 10, 11, 13	1, 10, 11, 13	1, 10, 11, 13	1, 10, 11, 13	13
Infant mortality	1, 7, 10, 11, 13	1, 7, 10, 11, 13	1, 7, 10, 11, 13	1, 7, 10, 11, 13	1, 7, 10, 11, 13	7, 10, 13	13
Under-five mortality	1, 7, 10, 11, 13	1, 7, 10, 11, 13	1, 7, 10, 11, 13	1, 7, 10, 11, 13	1, 7, 10, 11, 13	7, 10, 13	13
Maternal mortality							

TABLE A7.4. *continued*

Health topic and indicator	Dimension of inequality						
	Economic status	Education	Occupation	Sex	Urban/rural	Province/region	Ethnicity
Maternal mortality ratio	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Healthy/unhealthy behaviour							
Prevalence of current smoking	1, 3, 6	1, 3, 6, 8	1, 3, 6, 8	1, 3, 6, 8, 9, 16	1, 3, 6, 8, 9	1, 3, 6, 8, 9, 16	N/A
Prevalence of alcohol consumption	1, 3	1, 3, 8	1, 3, 8	1, 3, 8, 9, 16	1, 3, 8, 9	1, 3, 8, 9, 16	N/A
Prevalence of physical inactivity	1, 3	1, 3	1, 3	1, 3, 16	1, 3	1, 3, 16	N/A
Prevalence of low fruit/vegetable consumption	1, 3	1, 3	1, 3	1, 3, 16	1, 3	1, 3, 16	N/A
Environmental health							
Proportion of households using improved drinking water	1, 2, 3, 6, 13, 14	N/A	N/A	N/A	1, 2, 3, 6, 13, 14	1, 2, 3, 6, 13, 14	N/A
Proportion of households using improved sanitation	1, 2, 3, 6, 13, 14	N/A	N/A	N/A	1, 2, 3, 6, 13, 14	1, 2, 3, 6, 13, 14	N/A
Proportion of households using pesticide	1, 2, 3, 6, 13, 14	N/A	N/A	N/A	1, 2, 3, 6, 13, 14	1, 2, 3, 6, 13, 14	N/A
Health insurance							
Proportion of population with national health insurance	3, 6	3, 6	3, 6	3, 6	3, 6	3, 6	N/A
Proportion of population with province/district health insurance	3, 6	3, 6	3, 6	3, 6	3, 6	3, 6	N/A
Proportion of population with private insurance	3, 6	3, 6	3, 6	3, 6	3, 6	3, 6	N/A
Health-care access							
Average travel time to health centre	1, 3	N/A	N/A	N/A	1, 3	1, 3	N/A

TABLE A7.4. *continued*

Health topic and indicator	Dimension of inequality						
	Economic status	Education	Occupation	Sex	Urban/rural	Province/region	Ethnicity
Average transportation cost to health centre	1, 3	N/A	N/A	N/A	1, 3	1, 3	N/A
Inpatient utilization rate	1, 3, 6	1, 3, 6	1, 3, 6	1, 3, 6	1, 3, 6	1, 3, 6	N/A
Outpatient utilization rate	1, 3, 6	1, 3, 6	1, 3, 6	1, 3, 6	1, 3, 6	1, 3, 6	N/A
Health facility							
Number of hospitals by province	N/A	N/A	N/A	N/A	4	4, 12, 14	N/A
Health centre density	N/A	N/A	N/A	N/A	4	4, 12	N/A
Bed occupancy rate in public hospital	N/A	N/A	N/A	N/A	N/A	12	N/A
Health financing							
Average out-of-pocket health expenditure	6	N/A	N/A	N/A	6	6	N/A
Health expenditure per capita	6	N/A	N/A	N/A	6	6	N/A
Human resources for health							
Number of doctors, midwives, nurses, nutritionists, sanitarians and health promotion staff in hospitals and in health centres	N/A	N/A	N/A	N/A	4	4, 12	N/A
Density of doctors, midwives, nurses, nutritionists, sanitarians and health promotion staff	N/A	N/A	N/A	N/A	4	4, 12	N/A

N/A, no disaggregated data available.

Source: derived from Hosseinpoor et al. *(2)*.

Data source linking (Step 5)

Drawing from the unique data source numbers in the previous tables, Table A7.5 contains information about the unique identifiers found across the different data sources.

TABLE A7.5. Data sources mapped by presence of unique identifiers to assess possibility of data linking

Unique identifier	Unique data source number
Individual identification	1, 2, 3, 6, 13
Village code	13, 14
Subdistrict code	4, 13
District code	1, 3, 4, 6, 13
Health centre code	4

Source: derived from Hosseinpoor et al. *(2)*.

References

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Annex 8

Complex sampling design characteristics of household surveys

Complex sampling design characteristics of household surveys include stratification, clustering, multistage sampling and weighting.

Stratification consists of dividing the population into subgroups (strata), and then selecting the sample for each subpopulation separately. Stratification can be based on geographic location (e.g. regions or districts) or certain population characteristics (e.g. age or socioeconomic status). Estimates can then be produced for each stratum. This helps to increase the accuracy of estimates if the variable of interest is heterogeneous among subpopulations. For example, if a population is stratified into four regions, a sample could be taken from within each region. With proportionate stratification, the sample size for each region depends on the population size of each region. With disproportionate stratification, the sample size in each region is fixed to guarantee a certain level of precision (so large strata do not need proportionately larger sample sizes). The sample from each region can be considered as an independent sample, and so representative estimates can be produced for each region.

Clustering is the process of dividing the population into smaller groups (clusters), and then taking a random sample of clusters to draw a sample. The goal of clustering is to make data collection more cost-effective by geographically concentrating the sample, while maintaining representativeness of the overall population. For example, if a population is partitioned into clusters, a sample of these clusters can be selected, and a random sample of households within these clusters can be taken. A disadvantage of clustering is that no data are collected for the non-sampled clusters, necessitating reliance on estimation and modelling techniques to generate indicator estimates for those areas.

In stratified sampling, strata are constructed such that populations are homogeneous within them but heterogeneous between them – that is, the population is similar within the strata but the populations between the strata are different. On the other hand, clusters are constructed such that populations are heterogeneous within them but homogeneous between them – that is, the populations within the cluster are different enough that they can be representative of the wider population, but the populations between clusters are similar enough that the sampled clusters can be representative of the non-sampled clusters.

Unless stratification and clusters are designed specifically to be representative of certain population subgroups (e.g. if urban and rural areas are stratified and sampled separately to produce estimates that are representative in urban and rural areas, or if certain small population groups such as migrants are purposefully oversampled to produce estimates that are representative of migrant populations), sample sizes are usually based on achieving representativeness of the overall population and the population within the strata. Therefore, they may not be representative for specific population subgroups, if certain groups are not sampled at all or if sample sizes are too small to produce reliable estimates. Multistage sampling involves selecting a sample through several stages, usually involving both stratification and clustering. At each stage, the selected strata or clusters are divided into smaller strata or clusters. For example, a population could be stratified into four regions, and then each region partitioned into clusters, from which a random selection of clusters is used to identify the sample population. Representative estimates can then be produced for each region. Two-stage cluster sampling takes this a step further by randomly selecting clusters and then randomly selecting a sample from within those clusters. A primary sampling unit, such as postal codes, is the first unit to be sampled. A secondary sampling unit, such as households within the selected postal codes, is the second unit to be sampled. Individuals are then selected within households as the final sample units.

Sampling weights are used to produce estimates that reflect the situation of the whole population. Weights account for unequal selection probabilities that arise from stratification or other sampling design features, including oversampling (which may be critical for inequality analysis of smaller population subgroups). The weight for a specific observation reflects how many people that record represents. For example, a weight of 2 means the observation represents two people and will be counted twice in the analysis. Survey weights can be fractions, but they are always positive.

Annex 9

Measures of economic status applicable to health inequality monitoring

Direct measures of economic status include income and consumption *(1)*. The Organisation for Economic Co-operation and Development (OECD) defines household income as "all receipts, whether monetary or in-kind (goods and services) that are received by the household or by individual members of the household at annual or more frequent intervals" *(2)*. The components of household income cover income from employment; property income; goods or services produced within the household for the household; and transfers received (including cash, goods and services). In high-income countries, self-reported information on income may be available, but more robust measures of income are based on surveys collecting information at the individual level. When income is used as a measure of economic status, it does not account for variability in consumption over time by borrowing or depleting savings and assets.

Household consumption expenditure is the value of consumption goods and services used or paid for by a household to directly meet its needs – that is, people's use of goods and services to meet their material wants and needs for food, shelter, social activity and so on. These goods and services may be obtained through the purchase of consumption goods and services in the market; the acquisition of consumption goods and services in the form of in-kind income from employment; services produced by the household for its own consumption; and in-kind transfers received from other households and from businesses.

Compared with income, consumption may be more consistent and can often be smoothed over time as people are able to borrow or use their savings and assets to sustain a more constant level of consumption. In contexts where households have multiple or changing sources of income, or where there are large informal sectors of the economy, consumption is considered a better measure of living standards than income.

There are limitations to the measurement of economic status using direct measures of income and consumption. Reliable data about income and consumption are difficult and expensive to collect. In economies with predominantly formal sectors, richer households may be less prone to disclose their total income and less likely to participate in income surveys due to fear of taxation. Questions about income and consumption may be sensitive, especially in poorer households – although questions about consumption are perceived to be less sensitive. Data about direct measures may be susceptible to measurement errors – for example, stemming from imperfect recall. In the case of income, non-monetary income, such as in-kind gifts, transfers or trading, which tends to be more prevalent in low- and middle-income country settings, may not be captured by direct measures. In economies with substantial agricultural sectors, income measures may not capture food grown for a household's own consumption, and thus subsistence farmers may appear to have a better standard of living than urban dwellers on a similar low income. Problems may also arise regarding the calculation of income when it is transitory, irregular or received through informal employment, especially in economies with large informal sectors.

Proxy (indirect) measures are sometimes preferred to measure economic status because the collection of these data tends to be straightforward *(1)*. Proxy measures of economic status, such as asset indices, summarize household wealth using data about assets, housing and access to services. Asset indices may take the form of simple asset indices, where equal weight is given to items on a list of assets. More complex approaches, such as principal component analysis, may also be used, which rely on statistical methods to determine the weights of items in the index *(3)*. The data collected through multicountry household surveys such as the Demographic and Health Surveys *(4)* and the Multiple Indicator Cluster Surveys *(5)* permit the calculation of wealth indices, which are a standard part of their final reports and datasets *(6, 7)*.

References

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Annex 10

Using data to advance health equity: general policy responses

Used with other forms of evidence, disaggregated data can help to inform appropriate policy responses. The following general policy responses – policies targeted towards disadvantaged groups, policies aiming to narrow health gaps and policies aiming to reduce health gradients – are described as a starting point to illustrate considerations that may arise as part of equity-oriented policy-making processes. Although these responses may be roughly associated with patterns of inequality in disaggregated data, equity-oriented policy-making process are complex and iterative, often relying on a combination of responses and approaches tailored to the context for which they are designed.

Targeting disadvantaged groups

One general policy response entails a specific focus on population subgroups experiencing disadvantage *(1, 2)*, such as policies targeted towards a particular region, households experiencing poverty, workers in a particular employment sector, or adolescent parents. Policies targeted towards groups experiencing disadvantage may correspond to the marginal exclusion patterns of inequality, where one subgroup has been systematically or purposefully "left behind".

With a relatively limited scope and focus, such policies may be efficient to roll out (if the population subgroup is easily identified) and may provide clear criteria for subsequent monitoring. Improvements in the targeted population may be evident in the shorter term, albeit within a small proportion of the overall population. Such policies may be aligned with wider efforts to promote social inclusion and improve opportunities for better health and living conditions.

There are potential drawbacks to this response *(1, 3)*. Policies targeted towards improving the lives of people from subgroups experiencing disadvantage tend to conflate inequality and disadvantage (acknowledging, however, that fundamental structural changes may be an important part of advancing health equity). Progress may be measured based solely on the situation of the subgroup experiencing disadvantage. This perspective does not account for potentially accelerated improvements in the more advantaged groups. Such policies also risk unintentionally perpetuating stigma or legitimizing economic or other forms of disadvantage. Indeed, policies may intentionally or unintentionally introduce harms. Targeted policies also risk failing to reach people outside of the group who may be experiencing disadvantage.

Narrowing health gaps

Approaches that concentrate on narrowing health gaps aim to promote improvements among groups experiencing disadvantage at a rate that is faster than improvements among more advantaged groups *(1–3)*. Although this response continues to emphasize improvements in subgroups experiencing disadvantage, it also maintains a focus on the rest of the population by highlighting changes in inequality. Such policy responses facilitate target setting, and health inequality monitoring is part of assessing the impact. The implementation of responses based on this approach may be technically challenging.

A limitation of this response is that, in focusing on the subgroup experiencing disadvantage, it may ignore or obscure the situation in intermediary groups, especially those that fall slightly above the most disadvantaged. Additionally, it may encourage responses that focus on lifestyle factors rather than embedded structural determinants of health.

Addressing inequality gradients

Policy responses based on gradient approaches consider health inequalities as a population-level issue, simultaneously considering the gap between the least and most advantaged, and the distribution of health across all subgroups *(1–3)*. It widens the policy focus from seeking improvements among the subgroup experiencing disadvantage to understanding the circumstances and forces that produce and perpetuate inequality across the population overall. Accordingly, a differential rate of improvement is required for each subgroup, corresponding to its situation. Thus, gradient approaches may be part of inclusive policy goals.

Responses oriented towards addressing inequality gradients "locate the causes of health inequality not in the disadvantaged circumstances and health-damaging behaviours of [subgroups experiencing disadvantage], but in the systematic differences in life chances, living standards and lifestyles associated with people's unequal positions in the socioeconomic hierarchy" *(2)*. Gradient approaches, however, present certain technical and political challenges *(1)*. Health gradients are deep-rooted and may be complex and costly to address. Long time periods may be required to see improvements.

References

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Annex 11

Overview of summary measures of health inequality: definition, calculation and interpretation

Table A11.1 provides an overview of selected summary measures of health inequality, including pairwise measures and complex measures. For each measure, the table shows the formula and specifies whether the measure is absolute or relative, pairwise or complex, weighted or unweighted and ordered or non-ordered. It indicates whether the measure has a unit, the value of no inequality and the interpretation.

TABLE A11.1. Overview of summary measures of health inequality: definition, calculation and interpretation

Summary measure	Formula	Absolute/ relative	Pairwise/ complex	Weighted/ unweighted	Ordered/ non-ordered	Unit	Value of no inequality	Interpretation
Pairwise measures								
Difference (D)	$D = y_A - y_B$	Absolute	Pairwise	Unweighted	Ordered/ non-ordered	Unit of indicator	Zero	Larger absolute values indicate higher levels of inequality
Ratio (R)	$R = y_A / y_B$	Relative	Pairwise	Unweighted	Ordered/ non-ordered	No unit	One	R takes only positive values Values further from 1 indicate higher levels of inequality
Complex measures								
Ordered measures								
Regression-based measures								
Slope index of inequality (SII)	$SII = \hat{v}_1 - \hat{v}_0$	Absolute	Complex	Weighted	Ordered	Unit of indicator	Zero	Positive values indicate a concentration among advantaged subgroups Negative values indicate a concentration among disadvantaged subgroups Larger absolute values indicate higher levels of inequality
Relative index of inequality (RII)	$RII = \hat{v}_1 / \hat{v}_0$	Relative	Complex	Weighted	Ordered	No unit	One	RII takes only positive values Values >1 indicate a concentration among advantaged subgroups Values <1 indicate a concentration among disadvantaged subgroups Values further from 1 indicate higher levels of inequality

TABLE A11.1. *continued*

Summary measure	Formula	Absolute/ relative	Pairwise/ complex	Weighted/ unweighted	Ordered/ non-ordered	Unit	Value of no inequality	Interpretation
Ordered disproportionality measures								
Absolute concentration index (ACI)	$ACI = \sum_{j} p_j(2X_j - 1)y_j$	Absolute	Complex	Weighted	Ordered	Unit of indicator	Zero	Positive values indicate a concentration of the indicator among advantaged subgroups Negative values indicate a concentration of the indicator among disadvantaged subgroups Larger absolute values indicate higher levels of inequality
Relative concentration index (RCI)	$RCI = \frac{ACI}{\mu} \times 100$	Relative	Complex	Weighted	Ordered	No unit	Zero	RCI is bounded between −1 and +1 (or −100 and +100 if multiplied by 100) Positive values indicate a concentration of the indicator among advantaged subgroups Negative values indicate a concentration of the indicator among disadvantaged subgroups Larger absolute values indicate higher levels of inequality

TABLE A11.1. *continued*

Summary measure	Formula	Absolute/ relative	Pairwise/ complex	Weighted/ unweighted	Ordered/ non-ordered	Unit	Value of no inequality	Interpretation
Non-ordered measures								
Mean difference measures								
Mean difference from best-performing subgroup (unweighted) (MDBU)	$MDBU = \frac{1}{n} \times \sum_j \lvert y_j - y_{best} \rvert$	Absolute	Complex	Unweighted	Non-ordered	Unit of indicator	Zero	MDBU takes only positive values Larger values indicate higher levels of inequality
Mean difference from best-performing subgroup (weighted) (MDBW)	$MDBW = \sum_j p_j \lvert y_j - y_{best} \rvert$	Absolute	Complex	Weighted	Non-ordered	Unit of indicator	Zero	MDBW takes only positive values Larger values indicate higher levels of inequality
Mean difference from reference point (unweighted) (MDRU)	$MDRU = \frac{1}{n} \times \sum_j \lvert y_j - y_{ref} \rvert$	Absolute	Complex	Unweighted	Non-ordered	Unit of indicator	Zero	MDRU takes only positive values Larger values indicate higher levels of inequality
Mean difference from reference point (weighted) (MDRW)	$MDRW = \sum_j p_j \lvert y_j - y_{ref} \rvert$	Absolute	Complex	Weighted	Non-ordered	Unit of indicator	Zero	MDRW takes only positive values Larger values indicate higher levels of inequality
Mean difference from mean (unweighted) (MDMU)	$MDMU = \frac{1}{n} \times \sum_j \lvert y_j - \mu \rvert$	Absolute	Complex	Unweighted	Non-ordered	Unit of indicator	Zero	MDMU takes only positive values Larger values indicate higher levels of inequality

TABLE A11.1. *continued*

Summary measure	Formula	Absolute/ relative	Pairwise/ complex	Weighted/ unweighted	Ordered/ non-ordered	Unit	Value of no inequality	Interpretation
Mean difference from mean (weighted) (MDMW)	$MDMW = \sum_j p_j \lvert y_j - \mu \rvert$	Absolute	Complex	Weighted	Non-ordered	Unit of indicator	Zero	MDMW takes only positive values Larger values indicate higher levels of inequality
Index of disparity (unweighted) (IDISU)	$IDISU = \frac{MDMU}{\mu} \times 100$	Relative	Complex	Unweighted	Non-ordered	No unit	Zero	IDISU takes only positive values Larger values indicate higher levels of inequality
Index of disparity (weighted) (IDISW)	$IDISW = \frac{MDMW}{\mu} \times 100$	Relative	Complex	Weighted	Non-ordered	No unit	Zero	IDISW takes only positive values Larger values indicate higher levels of inequality
Variance measures								
Between-group variance (BGV)	$BGV = \sum_j p_j (y_j - \mu)^2$	Absolute	Complex	Weighted	Non-ordered	Squared unit of indicator	Zero	BGV takes only positive values Larger values indicate higher levels of inequality
Between-group standard deviation (BGSD)	$BGSD = \sqrt{BGV}$	Absolute	Complex	Weighted	Non-ordered	Unit of indicator	Zero	BGSD takes only positive values Larger values indicate higher levels of inequality
Coefficient of variation (COV)	$COV = \frac{BGSD}{\mu} \times 100$	Relative	Complex	Weighted	Non-ordered	No unit	Zero	COV takes only positive values Larger values indicate higher levels of inequality
Non-ordered disproportionality measures								
Theil index (TI)	$TI = \sum_j p_j \frac{y_j}{\mu} \ln\left(\frac{y_j}{\mu}\right) \times 1000$	Relative	Complex	Weighted	Non-ordered	No unit	Zero	TI takes only positive values Larger values indicate higher levels of inequality

TABLE A11.1. *continued*

Summary measure	Formula	Absolute/ relative	Pairwise/ complex	Weighted/ unweighted	Ordered/ non-ordered	Unit	Value of no inequality	Interpretation
Mean log deviation (MLD)	$MLD = \sum_j p_j(-\ln\left(\frac{y_j}{\mu}\right)) \times 1000$	Relative	Complex	Weighted	Non-ordered	No unit	Zero	MLD takes only positive values Larger values indicate higher levels of inequality
Impact measures								
Population attributable risk (PAR)	$PAR = y_{ref} - \mu$	Absolute	Complex	Weighted	Ordered/ non-ordered	Unit of indicator	Zero	PAR takes only positive values for favourable indicators and only negative values for adverse indicators Larger absolute values indicate higher levels of inequality
Population attributable fraction (PAF)	$PAF = \frac{PAR}{\mu} \times 100$	Relative	Complex	Weighted	Ordered/ non-ordered	No unit	Zero	PAF takes only positive values for favourable indicators and only negative values for adverse indicators Larger absolute values indicate higher levels of inequality

y_A = estimate for subgroup A.

y_B = estimate for subgroup B.

y_j = estimate for subgroup j.

y_{best} = estimate for best-performing subgroup.

y_{ref} = estimate for reference point.

p_j = population share for subgroup j.

$X_j = \sum_{i=1}^{j} p_i - 0.5(p_j)$ = relative rank of subgroup j.

μ = setting average.

$\hat{v}_0$ = predicted value of the hypothetical person at the bottom of the social group distribution (rank 0).

$\hat{v}_1$ = predicted value of the hypothetical person at the top of the social group distribution (rank 1).

n = number of subgroups.

Annex 12

Examples of difference and ratio calculations with favourable and adverse health indicators

Favourable health indicators

For favourable health indicators, difference is calculated as the advantaged subgroup estimate minus the disadvantaged subgroup estimate. For example:

- for economic status, the richest subgroup estimate minus the poorest subgroup estimate;
- for education status, the most educated subgroup estimate minus the least educated subgroup estimate;
- for urban–rural place of residence, the urban subgroup estimate minus the rural subgroup estimate.

Ratio is calculated as the advantaged subgroup estimate divided by the disadvantaged subgroup estimate. For example:

- for economic status, the richest subgroup estimate divided by the poorest subgroup estimate;
- for education status, the most educated subgroup estimate divided by the least educated subgroup estimate;
- for urban–rural place of residence, the urban subgroup estimate divided by the rural subgroup estimate.

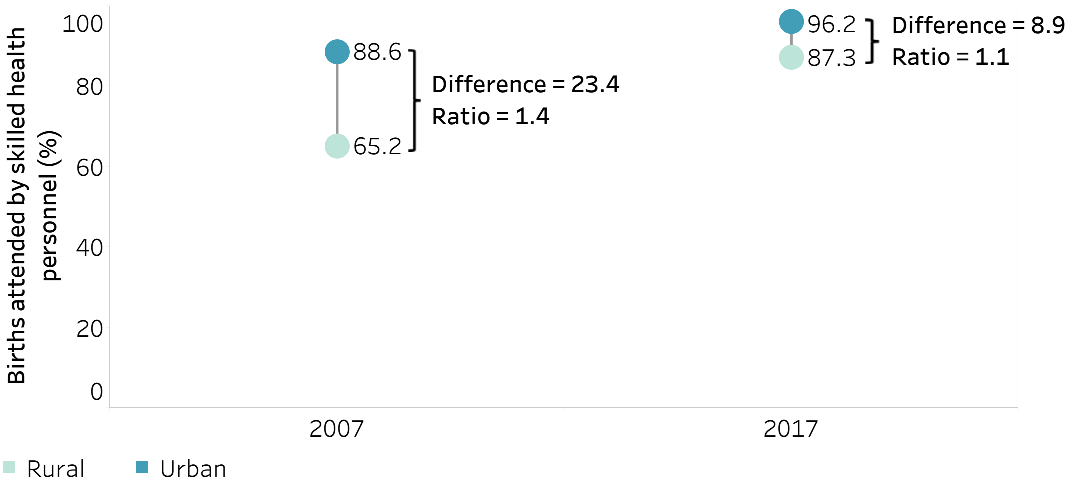
The following example from Indonesia presents data for urban and rural areas for the coverage of births attended by skilled health personnel – a favourable health indicator – in Indonesia at two time points (Table A12.1 and Figure A12.1). Difference is calculated as the urban estimate minus the rural estimate. Ratio is calculated as the urban estimate divided by the rural estimate. In this example, both absolute and relative place of residence inequality for this indicator declined over the 10-year period.

TABLE A12.1. **Difference and ratio calculations: births attended by skilled health personnel, by place of residence, Indonesia**

Year	Urban estimate (%) [A]	Rural estimate (%) [B]	Difference (percentage points) [A – B]	Ratio [A / B]
2007	88.6	65.2	23.4	1.4
2017	96.2	87.3	8.9	1.1

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

FIGURE A12.1. **Births attended by skilled health personnel, by place of residence, Indonesia**



Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data are based on three years prior to the survey.

Adverse health indicators

For adverse health indicators, difference is calculated as the disadvantaged subgroup estimate minus the advantaged subgroup estimate. For example:

- for economic status, the poorest subgroup estimate minus the richest subgroup estimate;
- for education status, the least educated subgroup estimate minus the most educated subgroup estimate;
- for urban–rural place of residence, the rural subgroup estimate minus the urban subgroup estimate.

Ratio is calculated as the disadvantaged subgroup estimate divided by the advantaged subgroup estimate. For example:

- for economic status, the poorest subgroup estimate divided by the richest subgroup estimate;
- for education status, the least educated subgroup estimate divided by the most educated subgroup estimate;
- for urban–rural place of residence, the rural subgroup estimate divided by the urban subgroup estimate.

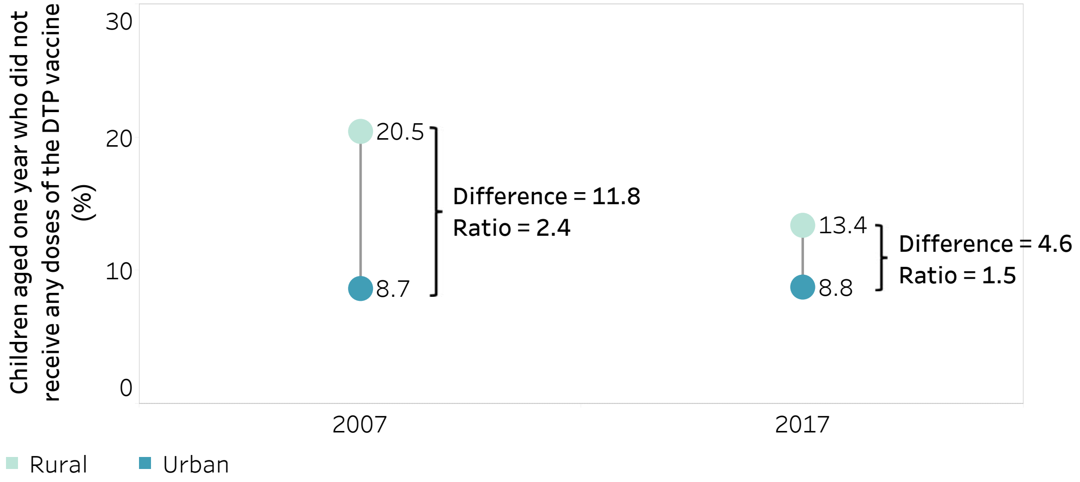
Another example from Indonesia presents data for urban and rural areas for the adverse indicator, children aged one year with zero doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, at two time points (Table A12.2 and Figure A12.2). Difference is calculated as the rural estimate minus the urban estimate. Ratio is calculated as the rural estimate divided by the urban estimate. This example demonstrates a reduction in absolute and relative place of residence inequality for zero-dose DTP prevalence among children in Indonesia over this time period. Improvements among the rural subgroup are evident from the disaggregated data.

TABLE A12.2. Difference and ratio calculations: children aged one year who did not receive any doses of diphtheria, tetanus toxoid and pertussis vaccine, by place of residence, Indonesia

Year	Urban estimate (%) [A]	Rural estimate (%) [B]	Difference (percentage points) [B – A]	Ratio [B / A]
2007	8.7	20.5	11.8	2.4
2017	8.8	13.4	4.6	1.5

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys.

FIGURE A12.2. **Children aged one year who did not receive any doses of diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by place of residence, Indonesia**



Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys.

Reference

1. Health Inequality Data Repository. Geneva: World Health Organization (https://www.who.int/data/inequality-monitor/data, accessed 20 June 2024).

Annex 13

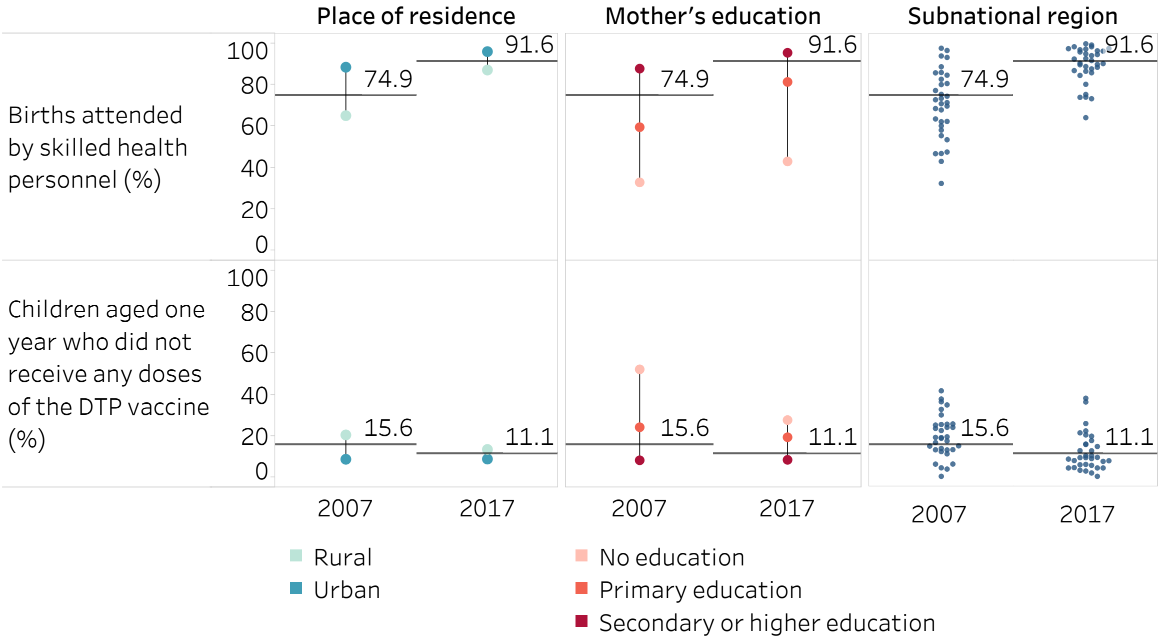
Comprehensive example showing disaggregated data and pairwise and complex summary measures of health inequality

To illustrate the interpretation of multiple summary measures of inequality, the example in this annex draws on common underlying disaggregated data for two health indicators in Indonesia: the proportion of births attended by skilled health personnel (a favourable health indicator) and the proportion of children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine (an adverse health indicator). Inequalities are considered by place of residence (a binary dimension), mother's education (an ordered dimension) and subnational region (a non-ordered dimension). Data are shown for 2007 and 2017. The example includes the underlying disaggregated data and pairwise summary measures of health inequality.

Disaggregated data

An inspection of disaggregated data demonstrates that for both indicators, the urban and most educated subgroups were advantaged (Figure A13.1). Between the two time points, coverage of skilled birth attendance increased, and prevalence of children aged one year who did not receive any doses of the DTP vaccine decreased across all residence areas and education levels. Across 34 subnational regions, improvements were also evident. An initial inspection, however, does not reveal whether and how much inequality reduced over time. Summary measures of inequality facilitate this assessment by quantifying the level of inequality.

FIGURE A13.1. Births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by place of residence, education level and subnational region, Indonesia



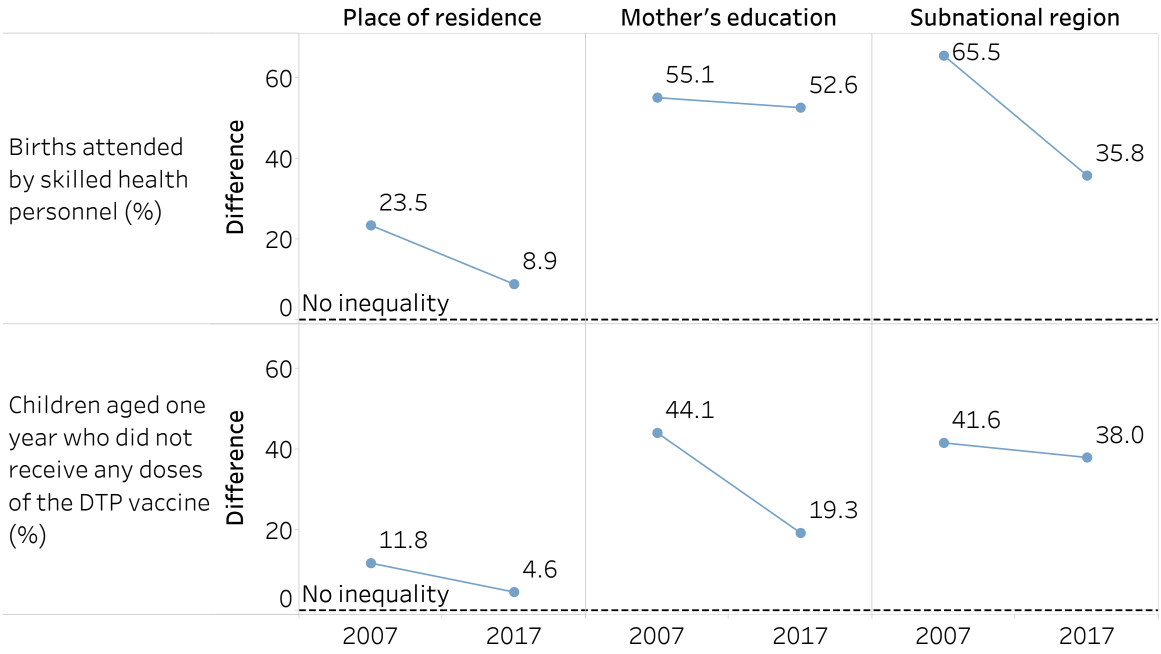
Horizontal lines indicate the national average.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data for “births attended by skilled health personnel” are based on three years prior to the survey.

Pairwise summary measures of inequality

Figures A13.2 and A13.3 show the results of the difference and ratio calculations. Based on these results, it is evident that both difference and ratio reduced over time for the two indicators and in the case of all three inequality dimensions. Reductions in subnational inequality for births attended by skilled health personnel (calculated based on the highest and lowest of the 34 subgroups) and reductions in education-related inequality in the zero-dose DTP prevalence indicator were particularly notable. These pairwise measures, however, do not account for the changes in the population share over time, and do not capture the situation in the intermediary subgroups for education and subnational region. Complex summary measures of inequality are required to provide further insights.

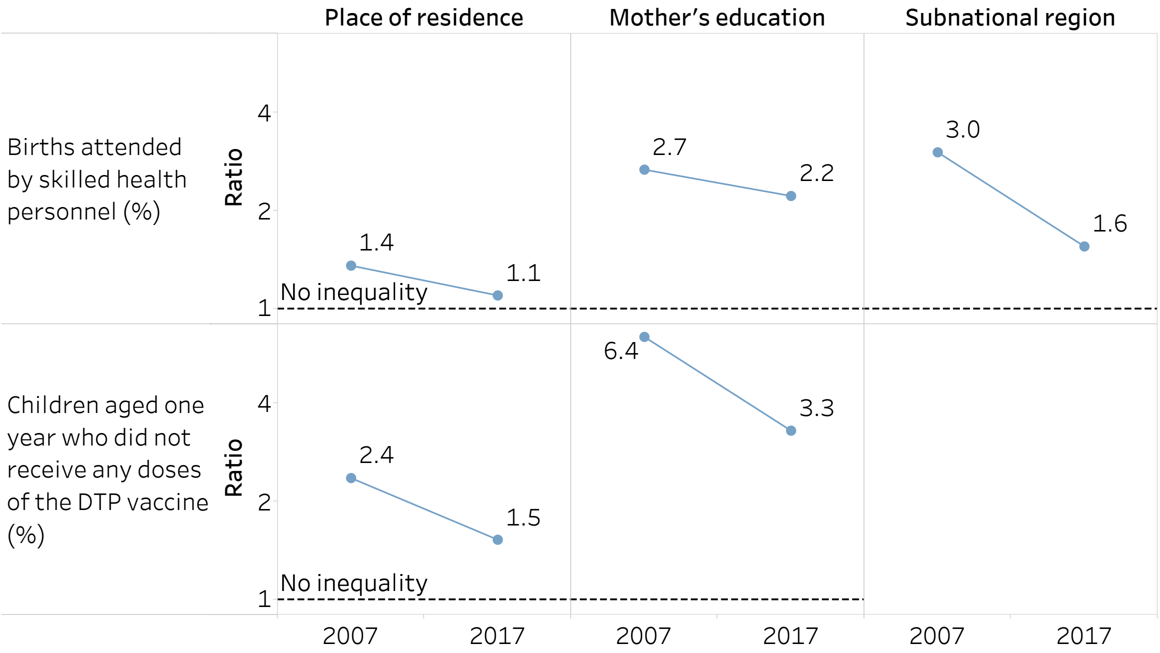
FIGURE A13.2. Difference: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by place of residence, education level and subnational region, Indonesia



Place of residence is categorized as rural or urban. Mother's education is categorized as three subgroups, and the difference is calculated based on the most and least educated subgroups. Subnational region includes 34 regions, and the difference is calculated based on the regions with the highest and lowest estimates.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

FIGURE A13.3. **Ratio: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by place of residence, education level and subnational region, Indonesia**



Place of residence is categorized as rural or urban. Mother's education is categorized as three subgroups, and the ratio is calculated based on the most and least educated subgroups. Subnational region includes 34 regions, and the ratio is calculated based on the regions with the highest and lowest estimates. The ratio could not be calculated for subnational region inequality in the zero-dose DTP prevalence indicator because the regions with the lowest estimate reported 0%.

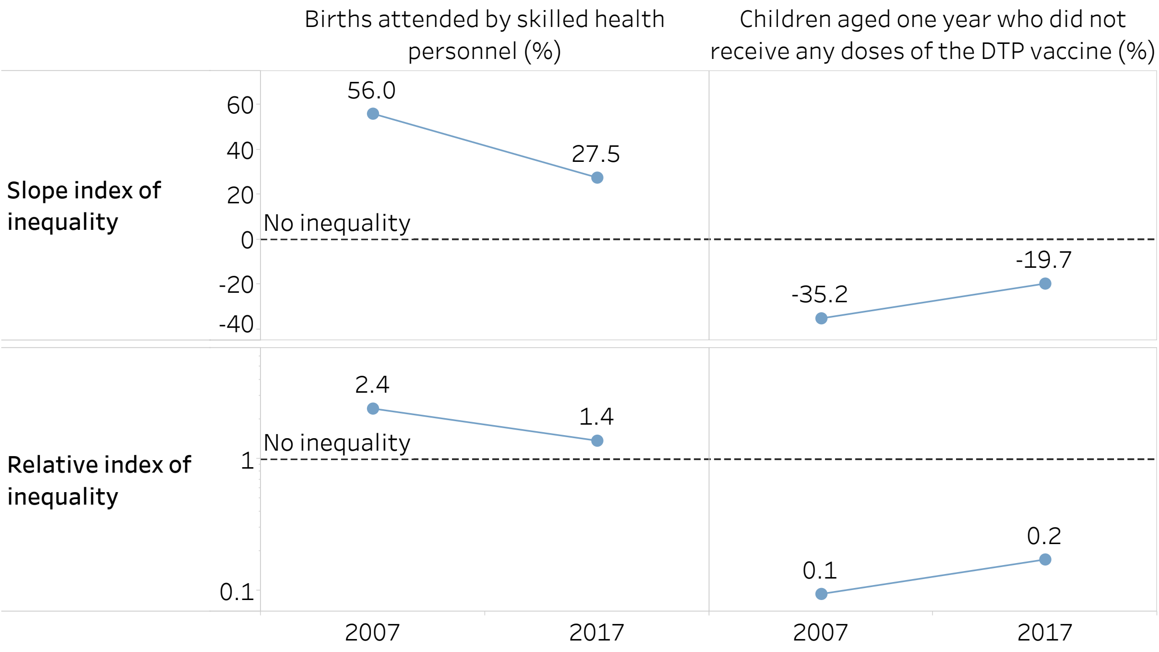
Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

Regression-based measures

Regression-based measures were calculated for the ordered inequality dimension of education. Figure A13.4 shows that absolute education-related inequality, measured by the slope index of inequality (SII), nearly halved between 2007 and 2017 for both skilled birth attendance and zero-dose DTP prevalence. In 2007, there was a difference of 56.0 percentage points between the most and least educated in skilled birth attendance, which reduced to 27.5 percentage points in 2017. (Recall that the difference measure suggested a more moderate decrease.) Similarly, in 2007, there was a difference of −35.2 percentage points between the most and least educated in zero-dose DTP prevalence, which reduced to −19.7 percentage points in 2017.

Figure A13.4 shows that relative inequality, measured by relative index of inequality (RII), decreased for both indicators between 2007 and 2017. In 2007, coverage of skilled birth attendance was 2.4 times higher among the most educated compared with the least educated, and in 2017 it was 1.4 times higher. Zero-dose DTP prevalence among the most educated was 0.1 times the prevalence of the least educated in 2007, and 0.2 times the prevalence in 2017. Equivalently, the zero-dose DTP prevalence among the least educated was 10 times higher than among the most educated in 2007 and five times higher in 2017.

FIGURE A13.4. Slope index of inequality and relative index of inequality: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by education level, Indonesia



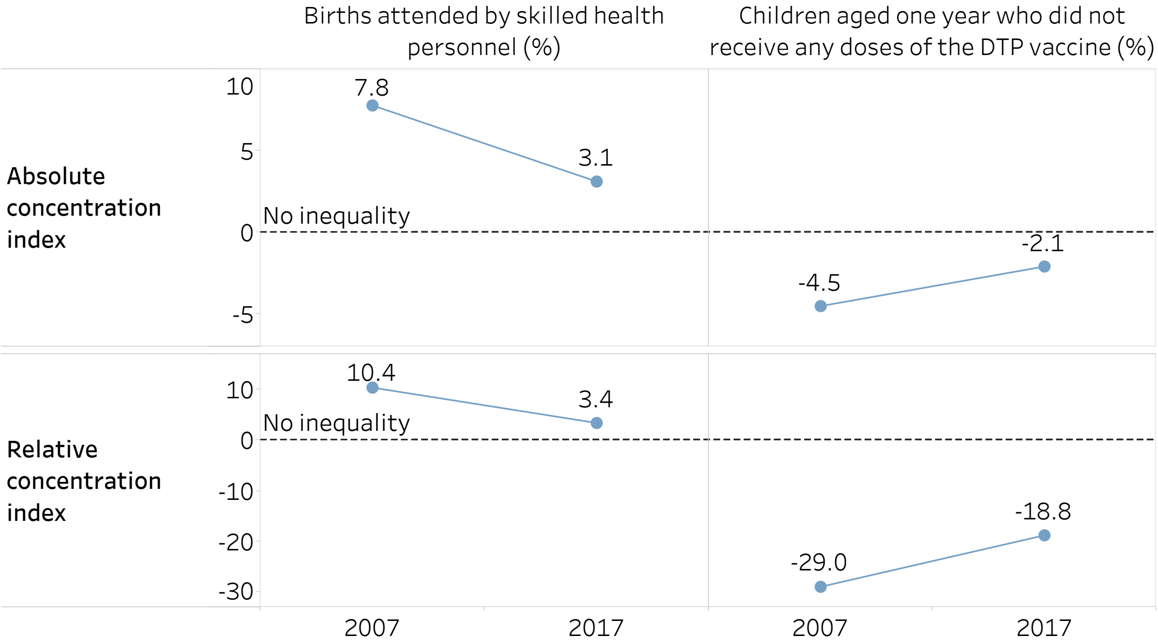
Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

Ordered disproportionality measures

Figure A13.5 shows the absolute concentration index (ACI) and the relative concentration index (RCI) for education-related inequality in two maternal and child health indicators. The ACI shows reduced inequality over time for both indicators. In 2007, skilled birth attendance was largely concentrated among mothers with higher education levels (ACI = 7.8 percentage points), and zero-dose DTP prevalence was largely concentrated among children of mothers with lower education levels (ACI = −4.5 percentage points). This inequality more than halved by 2017 for skilled birth attendance (ACI = 3.1 percentage points) and zero-dose DTP prevalence (ACI = −2.1 percentage points).

Figure A13.5 shows that relative inequality, measured by the RCI, also reduced between 2007 and 2017 for both indicators. For 2007, the RCI indicates a concentration of skilled birth attendance among mothers with higher education (RCI = 10.4) and a concentration of zero-dose DTP prevalence among children of mothers with lower education (RCI = −29.0). This inequality reduced over time for skilled birth attendance (RCI = 3.4 in 2017) and zero-dose DTP prevalence (RCI = −18.8 in 2017).

FIGURE A13.5. Absolute concentration index and relative concentration index: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by education level, Indonesia



Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

Mean difference measures

Figure A13.6 shows the mean difference from the best-performing subgroup (MDB), the mean difference from the reference point (MDR), the mean difference from the mean (MDM), and the index of disparity (IDIS) results for subnational inequality for two maternal and child health indicators in Indonesia. For this example, the weighted version of each measure is included.

For births attended by skilled health personnel, the MDB suggests that, on average, the coverage in subnational regions was 23.0 percentage points below the best-performing region in 2007 (Jakarta, 97.8%). In 2017, coverage was, on average, 8.4 percentage points below the best-performing region (Bali, 100.0%).

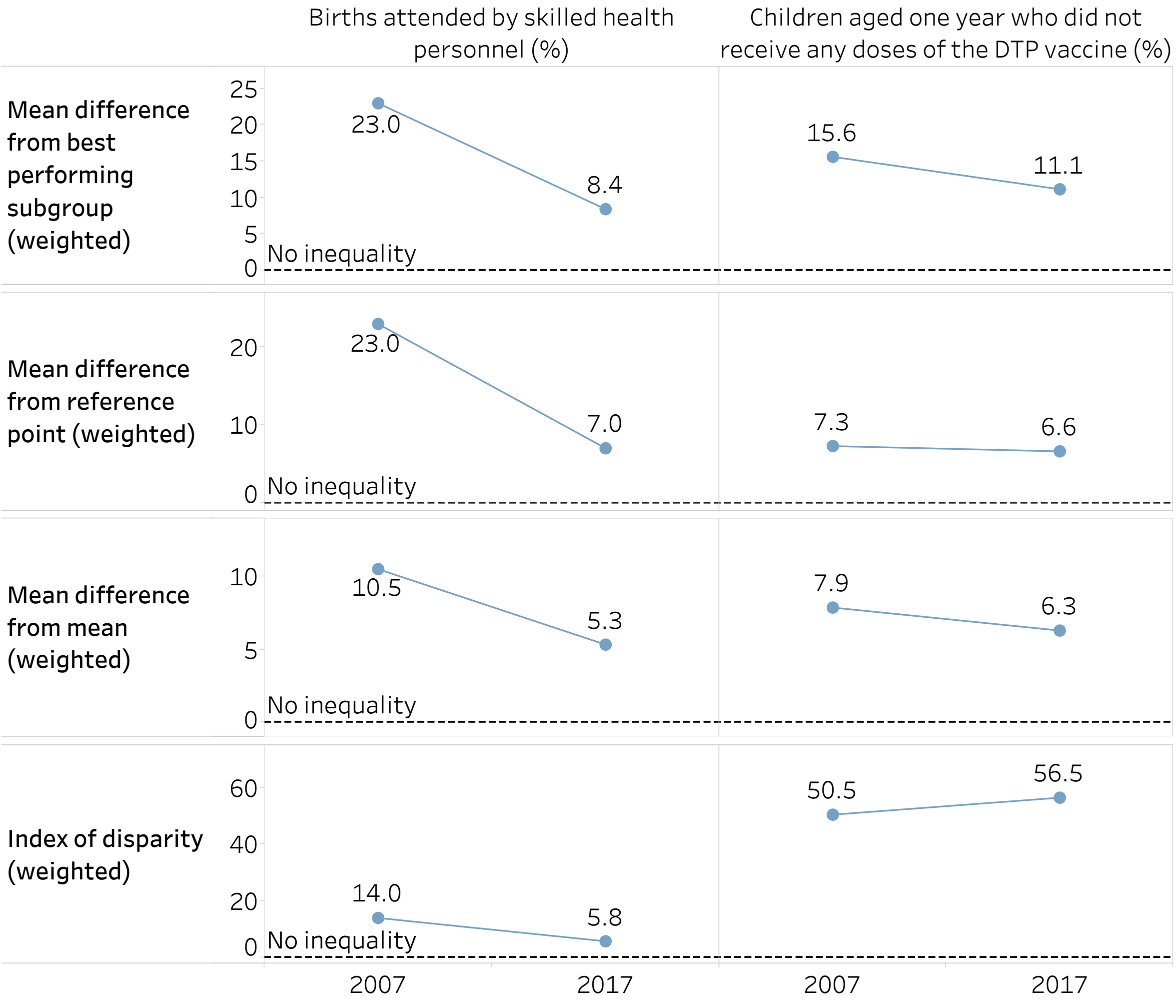
For the zero-dose DTP prevalence indicator, the mean difference from the best-performing subgroup was 15.6 percentage points in 2007 (Yogyakarta, 0.0%) and 11.1 percentage points in 2017 (North Sulawesi, 0.0%).

The MDR shows a similar decline in absolute subnational inequality over time in skilled birth attendance and zero-dose DTP prevalence. A large reduction is evident for skilled birth attendance, with coverage varying on average from the reference point Jakarta by 23.0 percentage points in 2007 and by 7.0 percentage points in 2017. A smaller reduction can be observed for zero-dose DTP prevalence, with a mean difference from the reference point Jakarta of 7.3 percentage points in 2007 and 6.6 percentage points in 2017.

Measured using the MDM, absolute subnational inequality in skilled birth attendance nearly halved between 2007 and 2017. In 2007, coverage in subnational regions varied on average by 10.5 percentage points from the national average (74.9%). In 2017, coverage varied on average by 5.3 percentage points from the national average (91.6%). Absolute subnational inequality in zero-dose DTP prevalence reduced slightly, with an MDM of 7.9 percentage points in 2007 and 6.3 percentage points in 2017.

Figure A13.6 shows the change in relative subnational inequality, measured by the weighted IDIS, over time. Inequality in skilled birth attendance more than halved (weighted IDIS = 14.0% in 2007 and 5.8% in 2017), but there was a slight increase in inequality over time for zero-dose DTP prevalence (weighted IDIS = 50.5% in 2007 and 56.5% in 2017).

FIGURE A13.6. **Weighted mean difference measures: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by subnational region, Indonesia**



Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

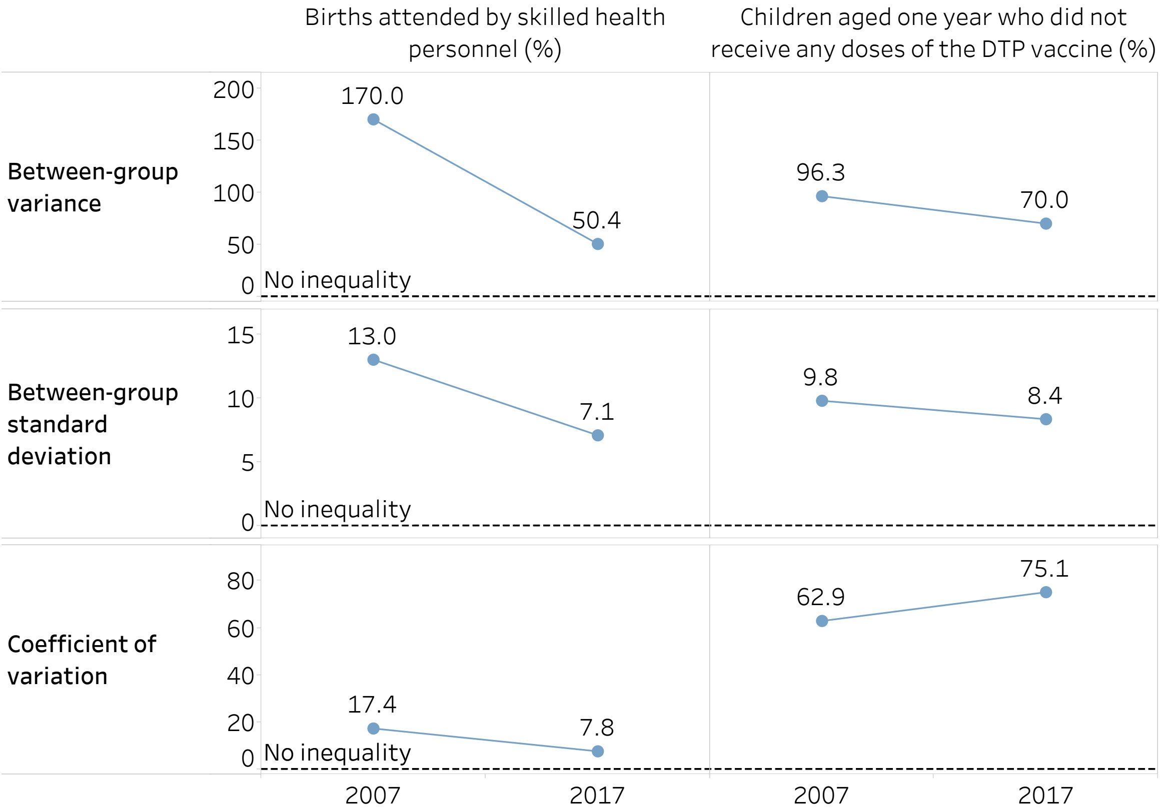
Variance measures

Figure A13.7 shows the between-group variance (BGV), the between-group standard deviation (BGSD) and the coefficient of variation (COV) for subnational inequality for two maternal and child health indicators in Indonesia. Absolute subnational inequality, as measured by the BGV, reduced over time for both skilled birth attendance and zero-dose DTP prevalence. The BGV shows a large decline for skilled birth attendance (BGV = 170.0 squared percentage points in 2007 and 50.4 squared percentage points in 2017). A smaller reduction is evident for zero-dose DTP prevalence (BGV = 96.3 squared percentage points in 2007 and 70.0 squared percentage points in 2017).

Like the BGV, the BGSD shows a decline in absolute subnational inequality over time in skilled birth attendance and zero-dose DTP prevalence. The reduction is more pronounced for skilled birth attendance (BGSD = 13.0 percentage points in 2007 and 7.1 percentage points in 2017) and less for zero-dose DTP prevalence (BGSD = 9.8 percentage points in 2007 and 8.4 percentage points in 2017).

Similar to IDIS, COV shows a reduction in relative subnational inequality over time for skilled birth attendance (COV = 17.4% in 2007 and 7.8% in 2017), but an increase for zero-dose DTP prevalence (COV of 62.9% in 2007 and 75.1% in 2017).

FIGURE A13.7. Variance measures: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by subnational region, Indonesia

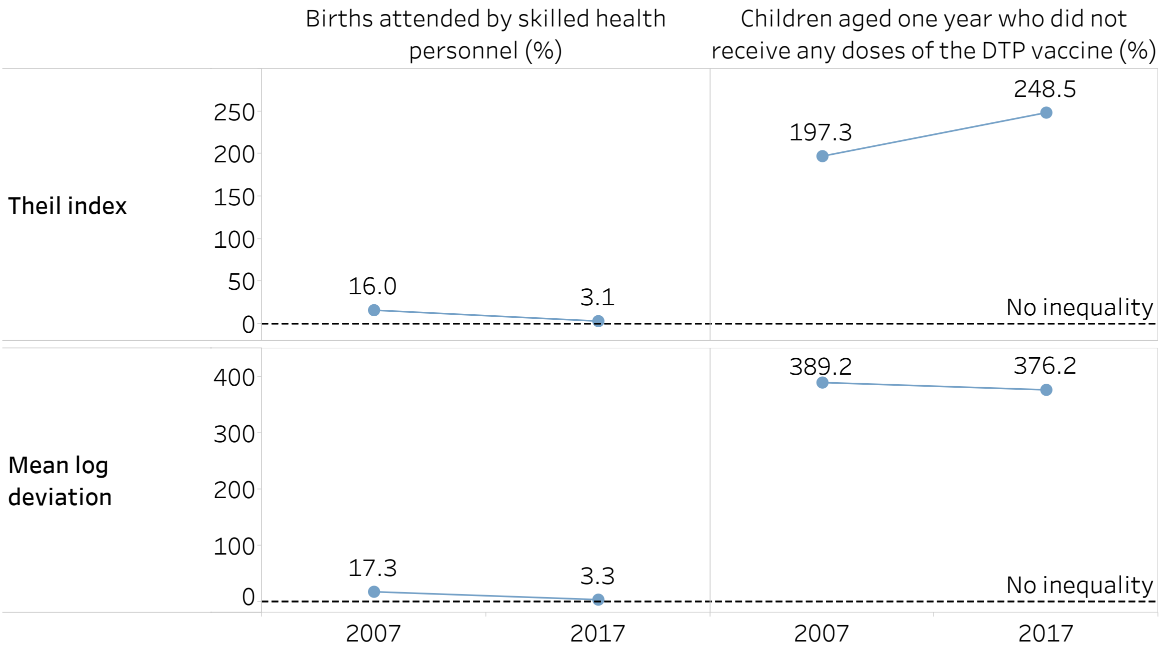


Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

Non-ordered disproportionality measures

The Theil index (TI) and mean log deviation (MLD) measures show the extent of relative subnational inequality in two maternal and child health indicators in Indonesia (Figure A13.8). The TI and MLD suggest a reduction in relative subnational inequality in skilled birth attendance over time (TI = 16.0 in 2007 and 3.1 in 2017; MLD = 17.3 in 2007 and 3.3 in 2017). Conversely, although the MLD also shows a small decrease in subnational regional inequality in zero-dose DTP prevalence over time (MLD = 389.2 in 2007 and 376.2 in 2017), the TI demonstrates a large increase (TI = 197.3 in 2007 and 248.5 in 2017).

FIGURE A13.8. Theil index and mean log deviation: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by subnational region, Indonesia

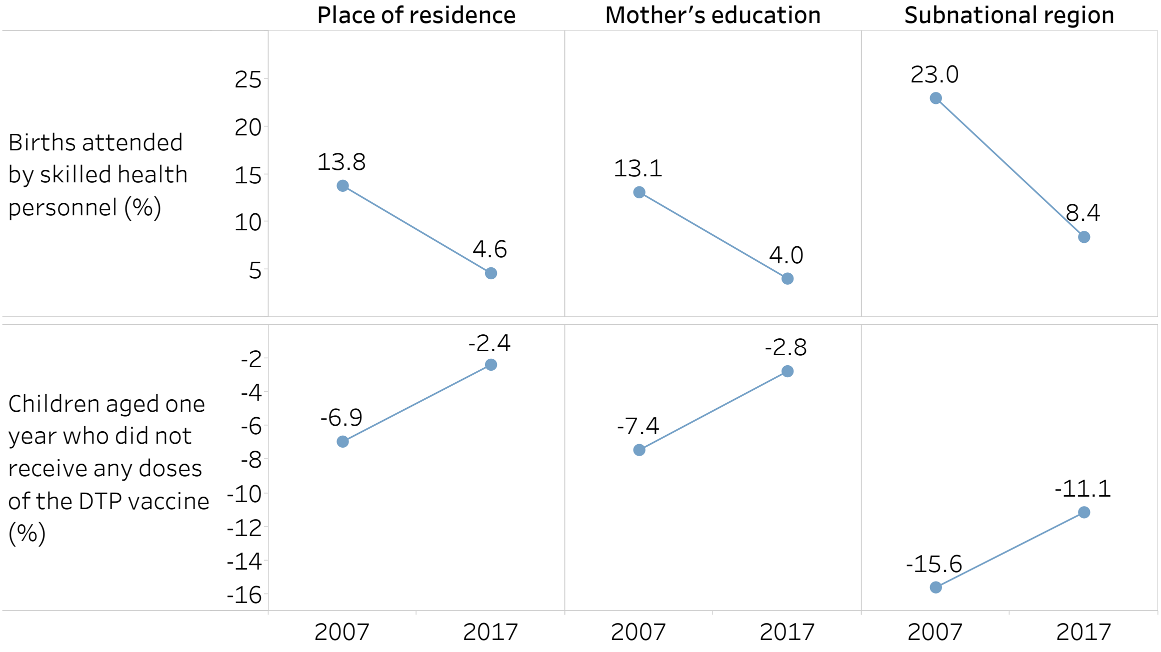


Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

Impact measures

Figures A13.9 and A13.10 illustrate the impact measures population attributable risk (PAR) and population attributable fraction (PAF), which can be applied to both ordered and non-ordered subgroups. For both indicators and across all three inequality dimensions, PAR values were smaller (in absolute terms) in 2017 compared with 2007, suggesting the potential for improvement has declined due to decreasing inequality. In 2017, however, the results indicated the possibility of improvements by addressing subnational inequality in both skilled birth attendance (PAR = 8.4 percentage points) and zero-dose DTP prevalence (PAR = −11.1 percentage points). PAF results also suggested decreasing potential for improvement in 2017 compared with 2007. In the case of subnational inequality in the zero-dose DTP prevalence indicator, PAF suggested a 100% improvement to the national average, if all regions were to achieve the same level as the best-performing region (i.e. zero prevalence of zero-dose DTP).

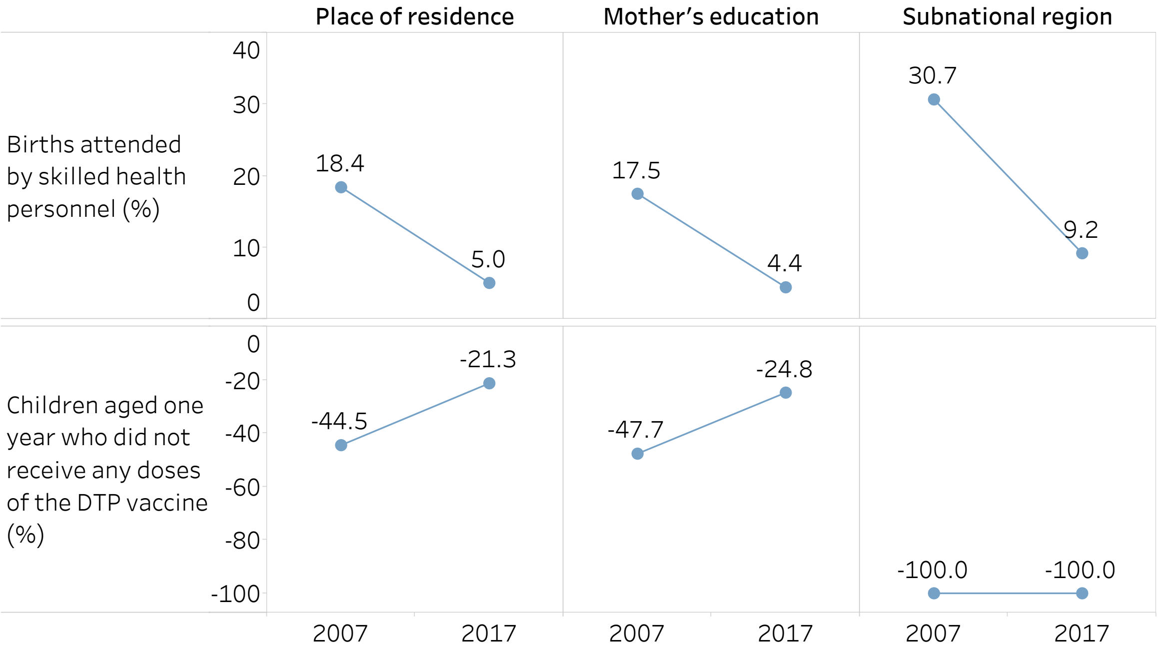
FIGURE A13.9. Population attributable risk: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by place of residence, education level and subnational region, Indonesia



The figure shows absolute potential for improvement in the national average by eliminating inequality.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

FIGURE A13.10. **Population attributable fraction: births attended by skilled health personnel and children aged one year who did not receive any doses of the diphtheria, tetanus toxoid and pertussis (DTP) vaccine, by place of residence, education level and subnational region, Indonesia**



The figure shows relative potential for improvement in the national average by eliminating inequality.

Source: derived from the WHO Health Inequality Data Repository Reproductive, Maternal, Newborn and Child Health dataset *(1)*, with data sourced from the 2007 and 2017 Demographic and Health Surveys. Data for "births attended by skilled health personnel" are based on three years prior to the survey.

Reference

1. Health Inequality Data Repository. Geneva: World Health Organization (https://www.who.int/data/inequality-monitor/health-inequality-data-repository, accessed 20 June 2024).

Annex 14

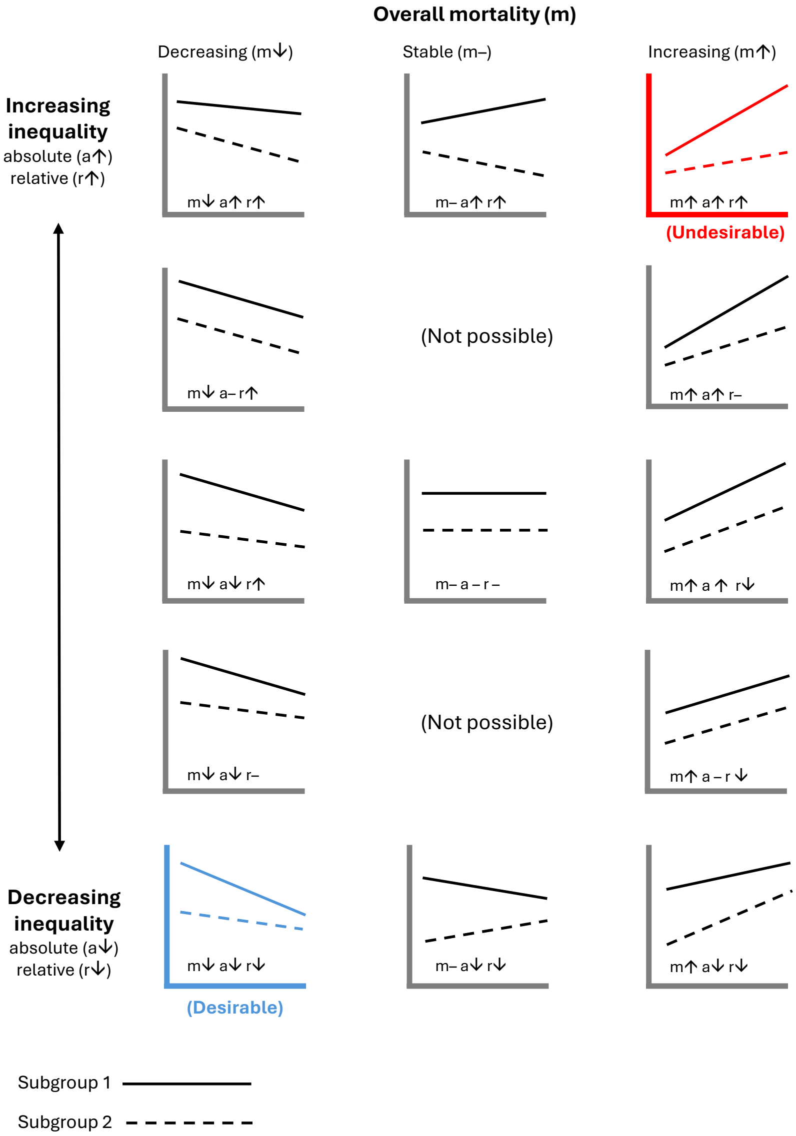
Typology of scenarios with variable inequality and overall average trends

Blakely and colleagues developed a “compass” typology visualization to describe scenarios characterized by variable (decreasing, increasing or stable) trends in three variables: overall mortality rate, absolute inequality and relative inequality *(1)*. The approach facilitates a structured assessment of the trends and a compelling visual presentation of the data. A compass analogy is used to describe the most desirable trend (decreasing mortality alongside reduced absolute and relative inequality – “southwest”) and the least desirable trend (increasing mortality alongside increased absolute and relative inequality – “northeast”).

An adapted version of the typology is included here (Figure A14.1). For mortality rate, an adverse indicator where smaller values indicate improvements, declining overall average and declining rates in all subgroups may be accompanied by increased relative inequality. Mathematically, it is also possible to observe declining overall average alongside unchanged or declining relative inequality. As indicated in the figure, it is not mathematically possible to see unchanged overall mortality alongside incongruous absolute and relative inequality trends.

This approach has been applied to report changes in the prevalence and absolute and relative income-related inequalities in mental health *(2)*. Other approaches to describe and interpret trends of absolute and relative inequalities have been described elsewhere *(3)*.

FIGURE A14.1. Compass typology of overall average and inequality trends in mortality



Source: derived from Blakely et al. *(1)*.

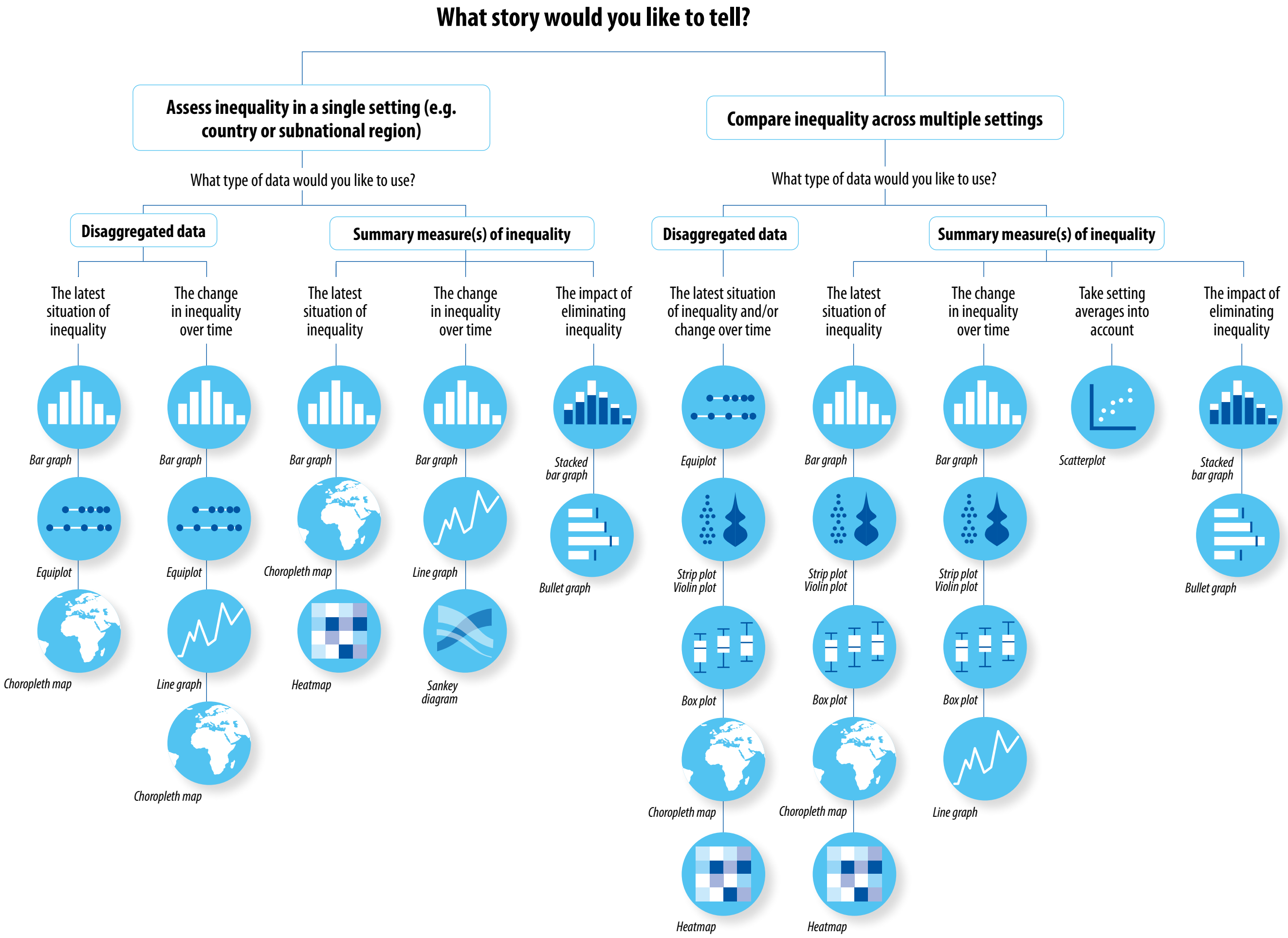
References

1. Blakely T, Disney G, Atkinson J, Teng A, Mackenbach JP. A typology for charting socioeconomic mortality gradients: "go southwest". Epidemiology. 2017;28(4):594–603. doi:10.1097/EDE.0000000000000671.
2. Asada Y, Grignon M, Hurley J, Stewart SA, Smith NK, Kirkland S, et al. Trajectories of the socioeconomic gradient of mental health: results from the CLSA COVID-19 Questionnaire Study. Health Policy. 2023;131:104758. doi:10.1016/j.healthpol.2023.104758.
3. Trends in income-related health inequalities in Canada: technical report. Ottawa: Canadian Institute for Health Information; 2016 (https://secure.cihi.ca/free_products/trends_in_income_related_inequalities_in_canada_2015_en.pdf, accessed 23 September 2024).

Annex 15

Selection of graphs and maps for reporting inequality

The graphs and maps featured in this annex are a selection of those commonly used in health inequality reporting. They are not comprehensive of all possible graphs and maps that may be used, or of all possible applications.



Bar graph

A bar graph can be vertical or horizontal. The height or width of each bar is proportional to the value it represents. Common applications in inequality monitoring include:

- showing the latest situation of inequality in a given setting, displaying disaggregated data for one or more dimensions;
- showing the change in inequality over time in a given setting, displaying either disaggregated data or a summary measure of inequality for a single dimension across multiple time points;
- comparing inequality across multiple indicators, time periods or settings using a summary measure of inequality.

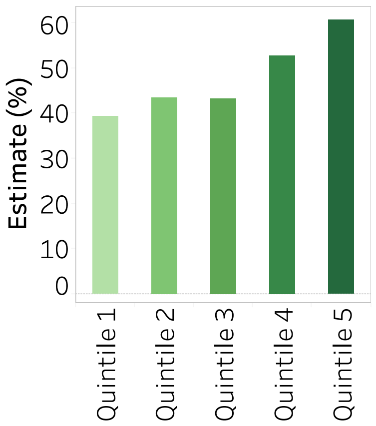
Use horizontal bar graphs when there are long labels (e.g. indicator names) or many groups (e.g. regions of a country).

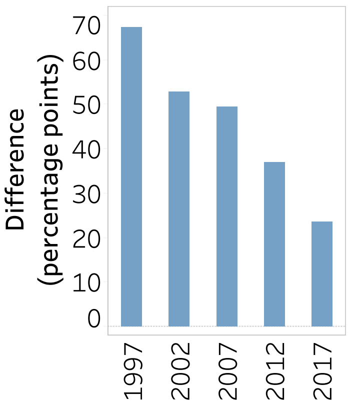
Sorting bars can add insight (e.g. arranging in ascending or descending order) or aid interpretation (e.g. arranging subgroups from the least to most advantaged).

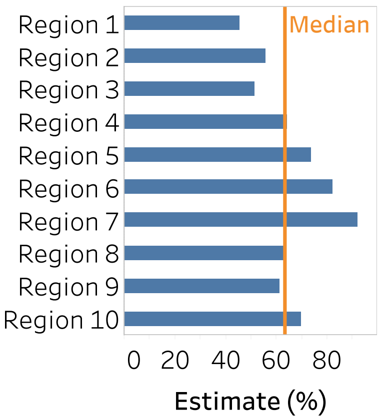
Colours can be used to aid interpretation (e.g. to differentiate between different dimensions of inequality).

Labels can be added to bars if having precise estimates would be helpful for the audience.

A line across the bars can be used to show the average across all groups.







Equiplot

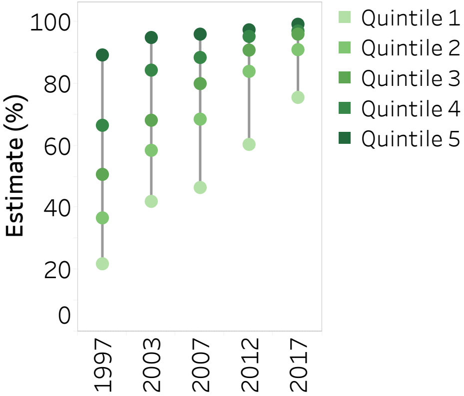
An equiplot (also known as a dot plot) presents disaggregated data points in a line, corresponding to a specified date and/or setting. A solid line connects the two extreme data points. An equiplot can help to identify patterns in disaggregated data, such as mass deprivation, a queuing pattern, universal coverage or marginal exclusion. Common applications in inequality monitoring include:

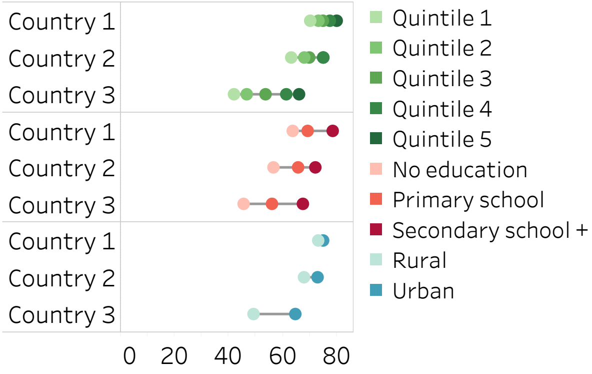
- showing the latest situation of inequality in a given setting;
- showing the change in inequality over time in a given setting for a single dimension;
- comparing the latest situation of inequality or change over time across multiple settings.

Equiplots can be horizontal or vertical.

Subgroup colours can be used to aid interpretation. A colour legend should be included.

A line across the equiplot can be used to show the average across all groups.





Line graph

A line graph shows time trend data. Data points for different time periods are connected chronologically by a line. Common applications in inequality monitoring include:

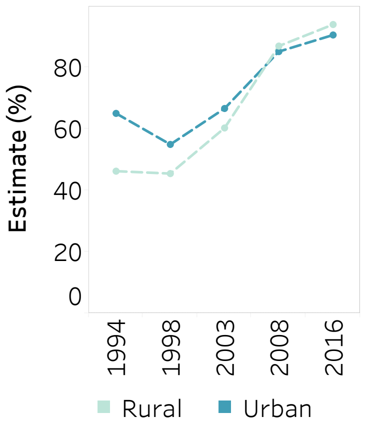
- showing the change in inequality using disaggregated data;
- showing the change in inequality using a summary measure of inequality;
- comparing changes in inequality across multiple indicators or settings using a summary measure of inequality.

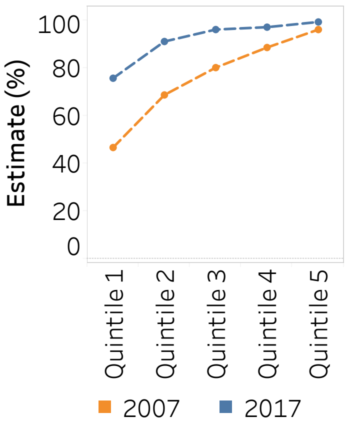
The number of lines on the graph should be limited to make the graph readable.

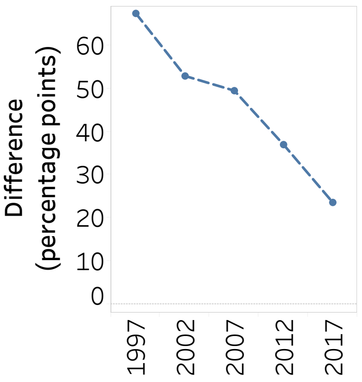
Data should be presented for indicators or summary measures with the same measurement units that can be shown on the same axis – that is, avoid using a dual axis.

Consistent axis spacing for time periods should be ensured.

A colour legend should be included.







Stacked bar graph

A stacked bar graph can be vertical or horizontal. It can show the impact of eliminating inequality, using the summary measure of inequality population attributable risk (PAR), where the lower section of the bar shows the current setting average for an indicator and the upper section of the bar shows the value of PAR. The total length of the bar shows the potential setting average if there was no inequality. Common applications in inequality monitoring include:

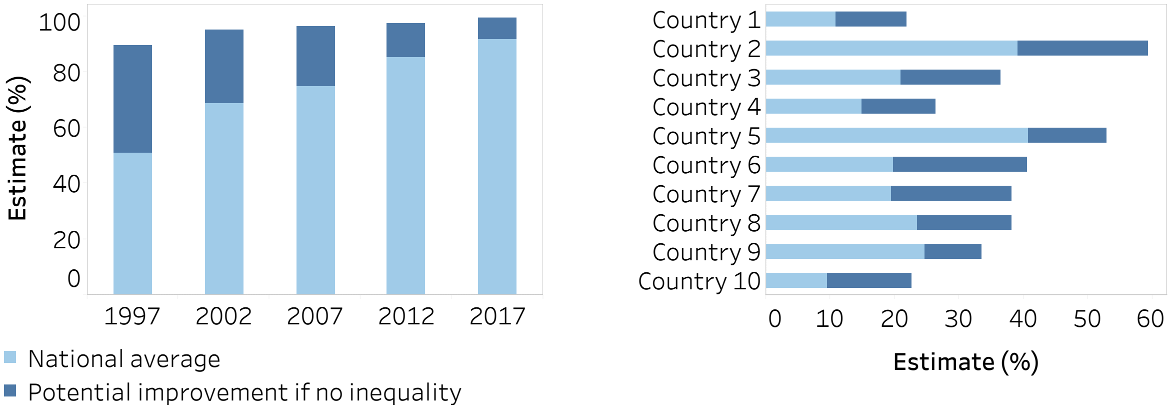
- showing PAR data for multiple time periods or indicators within a single setting;
- showing PAR data for a single indicator across multiple settings.

Stacked bar graphs should be avoided when presenting data for adverse indicators, because PAR will be negative, indicating a decrease in the setting average. Instead, bullet graphs should be used to present these data.

For long labels (e.g. indicator names) or many groups, horizontal stacked bar graphs should be used.

If comparing inequality across multiple indicators, indicators should have the same unit of measurement.

A single colour should be used for the lower section of the bar (the current setting average) and for the upper section of the bar (PAR). A colour legend should be included.



Bullet graph

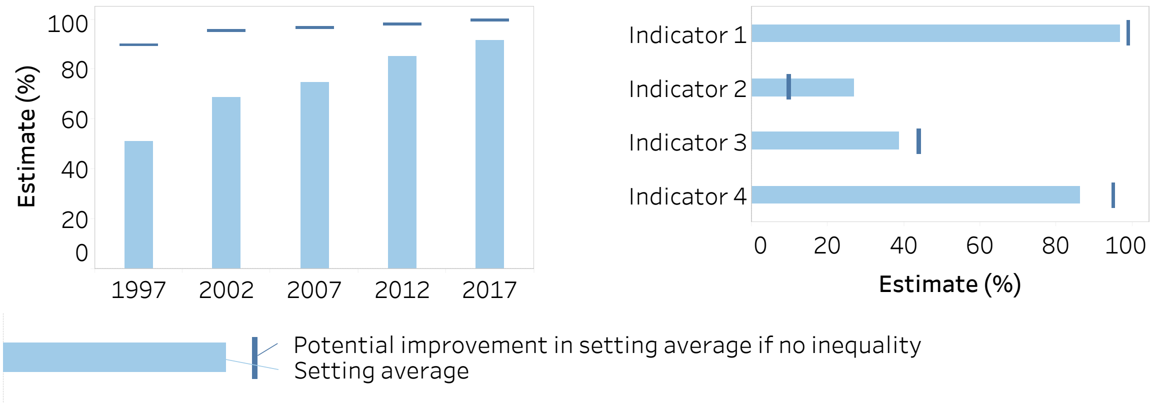
A bullet graph can be vertical or horizontal. It combines bars and lines. It can show the impact of eliminating inequality, using the summary measure of inequality population attributable risk (PAR), where the bar shows the current setting average for an indicator and the line shows the value of PAR. The gap between the bar and the line shows the potential increase (or decrease) in the setting average if there was no inequality. Common applications in inequality monitoring include:

- showing PAR data for multiple time periods or indicators within a single setting;
- showing PAR data for a single indicator, across multiple settings.

This type of graph is preferable for when some or all indicators are adverse, because PAR will be negative (i.e. it will cross the bar) and it will be easier to interpret that this means a decrease in the setting average.

For long labels (e.g. indicator names) or many groups, horizontal bullet graphs should be used.

If comparing inequality across multiple indicators, the indicators should have the same unit of measurement. A colour legend should be included.



Strip plot

A strip plot (also referred to as a jitter plot) can be vertical or horizontal. It shows the distribution of data points. Data are organized in columns or rows, with each being a population subgroup in the case of disaggregated data, or a dimension of inequality, indicator or time period in the case of summary measures. Each data point represents a value in one setting. Common applications in inequality monitoring include:

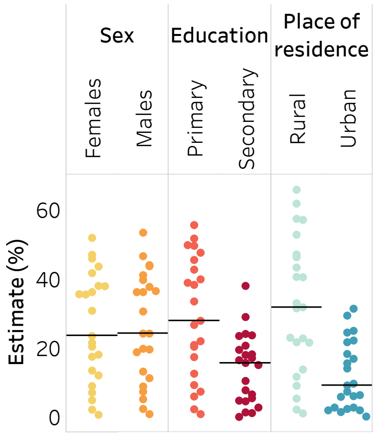
- showing the latest situation of inequality using either disaggregated data or a summary measure of inequality, across multiple settings;
- showing the change in inequality over time using either disaggregated data or a summary measure of inequality, across multiple settings.

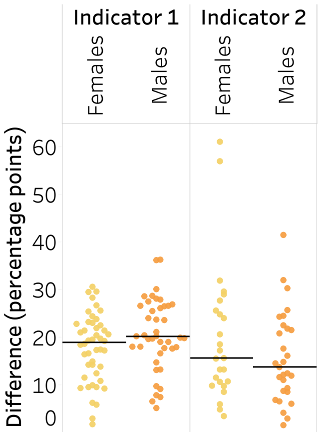
When presenting disaggregated data, there must be no subgroups with missing data (i.e. each column or row must contain a data point for each setting).

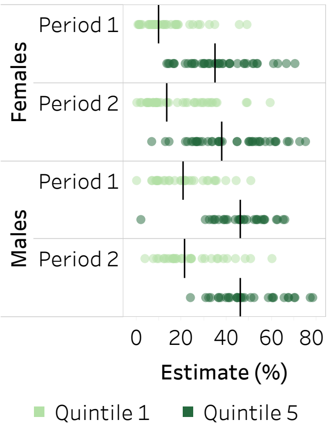
This graph type is useful for identifying clusters, outliers, and minimum and maximum values across settings.

A solid line can be used to show the median across the settings in each column or row.

Colours can be used to aid interpretation – for example, to differentiate between different dimensions of inequality, or between high and low levels of inequality. A colour legend should be included.







Violin plot

A violin plot shows the distribution of data points at different values and can be vertical or horizontal. Data are organized in columns (or rows), with each column (or row) being a population subgroup in the case of disaggregated data, or a dimension of inequality, indicator or time period in the case of summary measures. The density of the data points is shown using a shaded area. Common applications in inequality monitoring include:

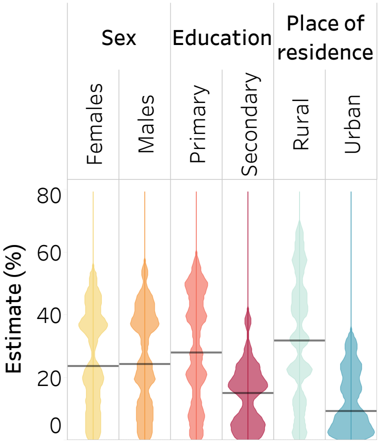
- showing the latest situation of inequality using either disaggregated data or a summary measure of inequality, across multiple settings;
- showing the change in inequality over time using either disaggregated data or a summary measure of inequality, across multiple settings.

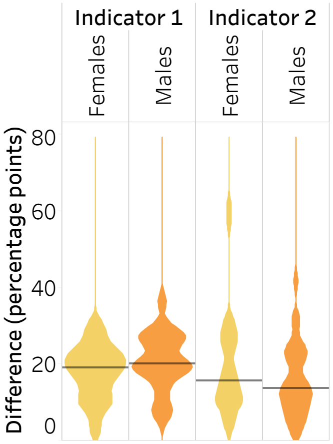
When using disaggregated data, there must be no subgroups with missing data (i.e. each column or row must contain a data point for each setting).

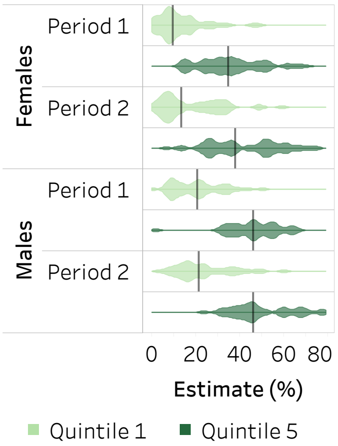
This graph type is useful for identifying patterns in the distribution across settings.

Violin plots can be overlaid to compare inequality across indicators, time periods and settings.

Colours can be used to aid interpretation – for example, to differentiate between different dimensions of inequality, or high and low levels of inequality. A colour legend should be included.







Box plot

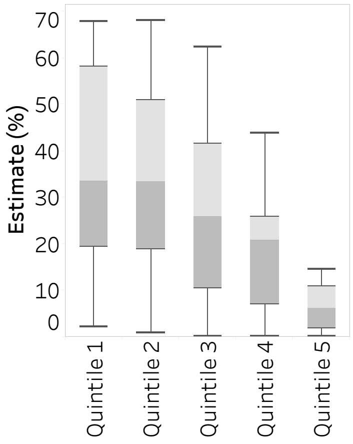
A box plot (or box-and-whisker plot) uses boxes and lines to show the distribution of data points. Data are organized in columns or rows, with each being a population subgroup in the case of disaggregated data, or a dimension of inequality, indicator or time period in the case of summary measures. The top and bottom lines indicate minimum and maximum values; the central line indicates the median (middle point of estimate); and the boxes indicate the interquartile range (central 50% of estimates). Common applications in inequality monitoring include:

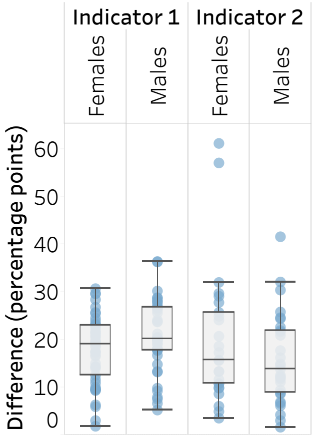
- showing the latest situation of inequality using either disaggregated data or a summary measure of inequality, across multiple settings;
- showing the change in inequality over time using either disaggregated data or a summary measure of inequality, across multiple settings.

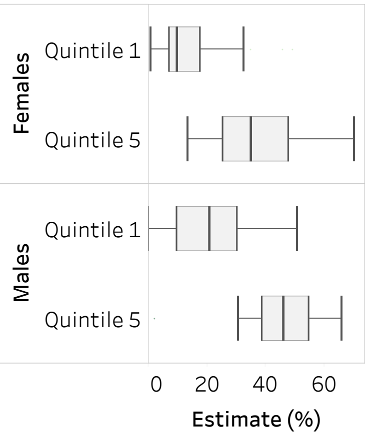
When using disaggregated data, there must be no subgroups with missing data (i.e. each column or row must contain a data point for each setting).

This graph type is useful for communicating minimum, maximum and median values across settings, without showing individual country estimates.

If desired, country data points can be shown alongside the box plot (e.g. to highlight outliers).







Choropleth map

A choropleth map displays geographical areas or regions that are coloured in relation to a data value. It allows the study of how a variable (e.g. an indicator estimate or a summary measure of inequality) differs across areas. Common applications in inequality monitoring include:

- showing subnational inequality (e.g. within one or more countries), using data disaggregated by subnational region;
- comparing subnational inequality (within one or more settings), using multiple maps;
- comparing inequality across settings using a summary measure.

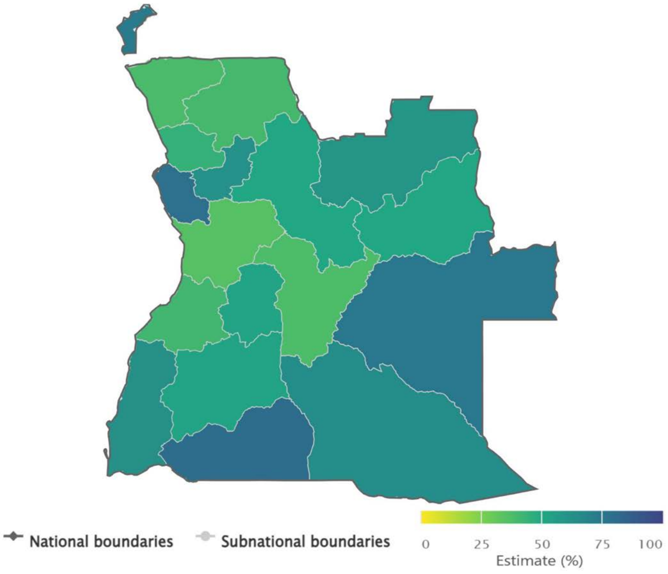
The size of an area on the map does not correspond to the population size or density.

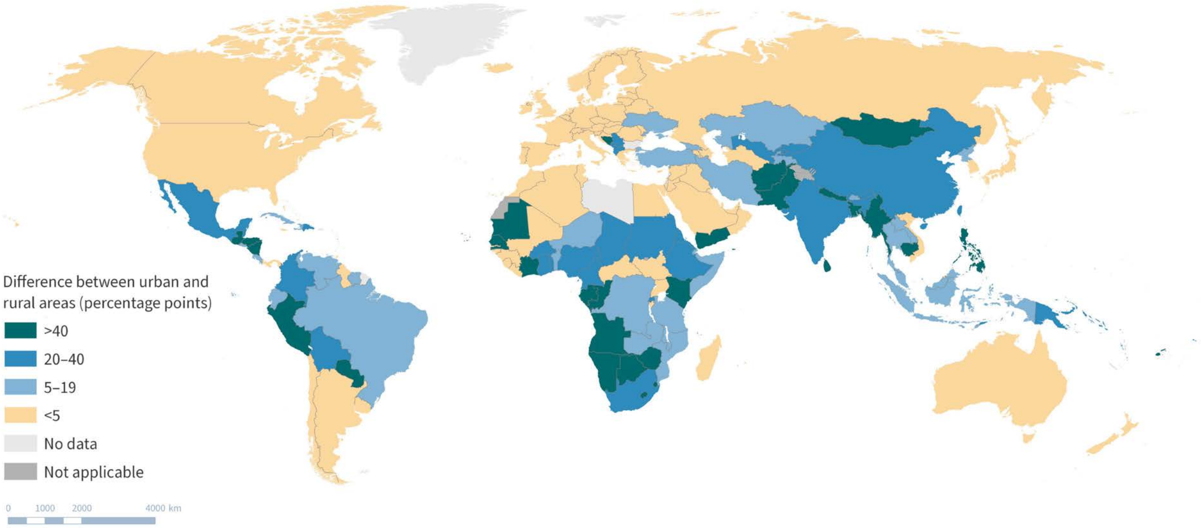
It is important to indicate where data are not available or not applicable.

Contested borders or areas should be noted.

Comparisons between multiple maps should be limited to where the interpretation is very apparent. To avoid using multiple maps to show disaggregated data for subgroups, a summary measure of inequality could be presented on a single map.

Colours can be used to aid interpretation. A colour legend should be included.


National boundaries
Subnational boundaries
0
25
50
75
100
Estimate (%)


Difference between urban and rural areas (percentage points)
>40
20–40
5–19
<5
No data
Not applicable
0
1000
2000
4000 km

Scatterplot

A scatterplot contains information about two variables, one variable on each axis. It can help to visualize patterns or associations between the two variables. Common applications in inequality monitoring include:

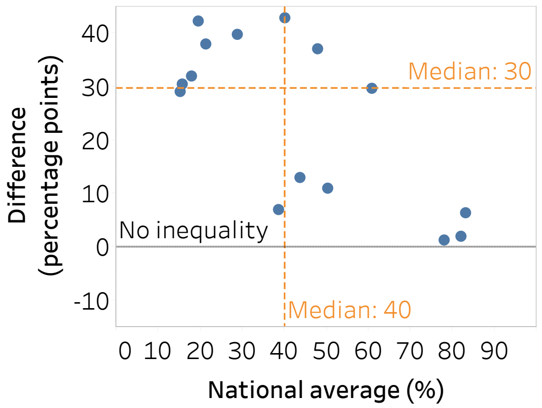
- comparing inequality across multiple settings for a given indicator and time period by plotting a summary measure of inequality alongside the setting average – this can help benchmarking of inequality across settings and identify clusters of settings with common situations (e.g. high inequality amid low setting average);
- exploring associations between health indicators and determinants of health (using a regression line).

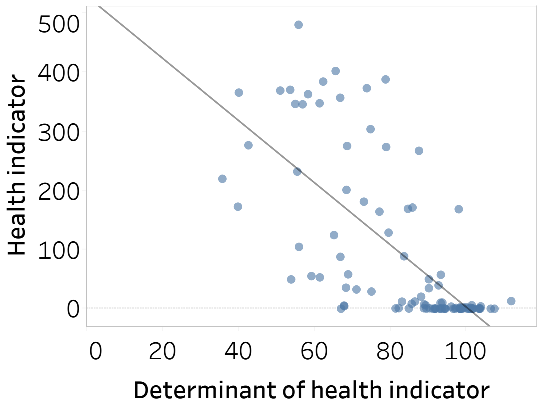
Median lines can be added to the *x*- and *y*-axes to separate settings by four quadrants – lower inequality and lower setting average; lower inequality and higher setting average; higher inequality and lower setting average; and higher inequality and higher setting average.

Labels should be added to the data points to identify certain (or all) settings.

The line of no inequality for the summary measure should be shown clearly to aid interpretation.

Be aware that, depending on the summary measure, values may be above or below the line of no inequality, affecting interpretation (i.e. inequality favouring the advantaged groups versus inequality favouring disadvantaged groups).





Sankey diagram

A Sankey diagram displays a flow or change from one set of values to another. Groups being connected are called nodes and the connections are called links. Links are represented with arrows or arcs that have a width proportional to the size of the flow. The number of nodes reflects the number of indicators within different thresholds of inequality (e.g. low, moderate and high inequality). Common applications in inequality monitoring include:

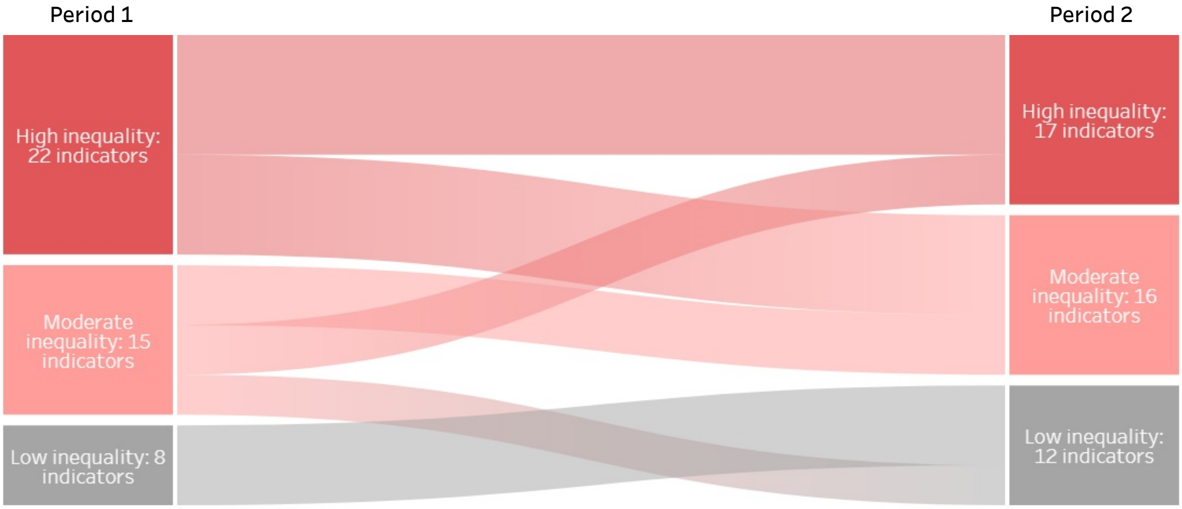
- showing the change in inequality over time in a given setting using a summary measure of inequality.

Logical thresholds of inequality should be identified to serve as the base for the groups (nodes).

The nodes should be ordered to aid interpretation.

Colours can be used to aid interpretation.

The graph should be simple, with a limited number of nodes and time points.



Heatmap

A heatmap is formatted similarly to a table, applying colour that corresponds to data values. A heatmap is useful to support rapid approximate comparisons of inequality across indicators or dimensions, make patterns in the data visible and help unusual values stand out. Common applications in inequality monitoring include:

- comparing the latest situation of inequality in a given setting across multiple indicators and/or dimensions using disaggregated data or a summary measure of inequality;
- comparing the situation of inequality across multiple settings for a given indicator and/or dimension using disaggregated data or a summary measure of inequality.

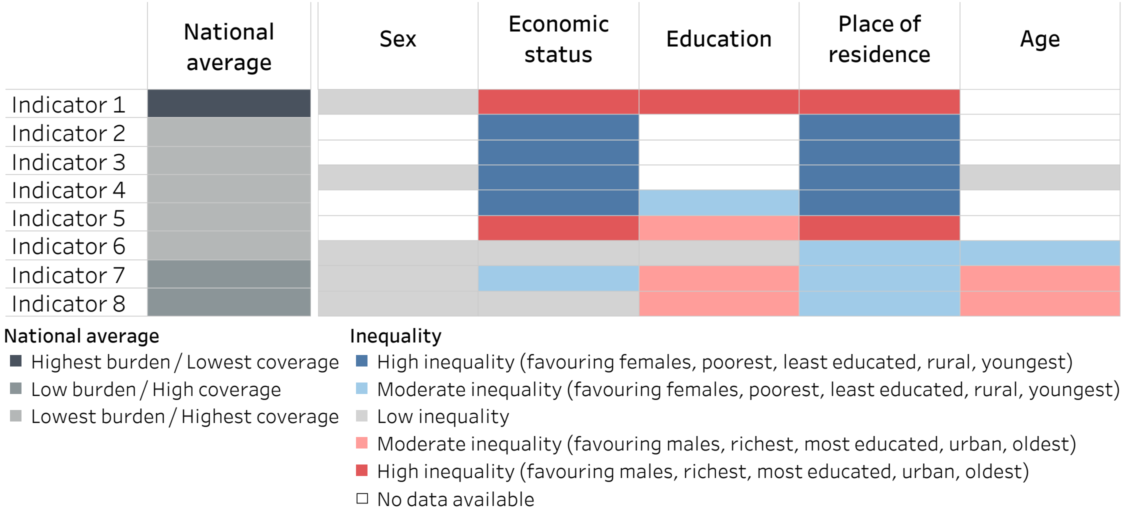
Logical thresholds of inequality should be identified for the colour scheme.

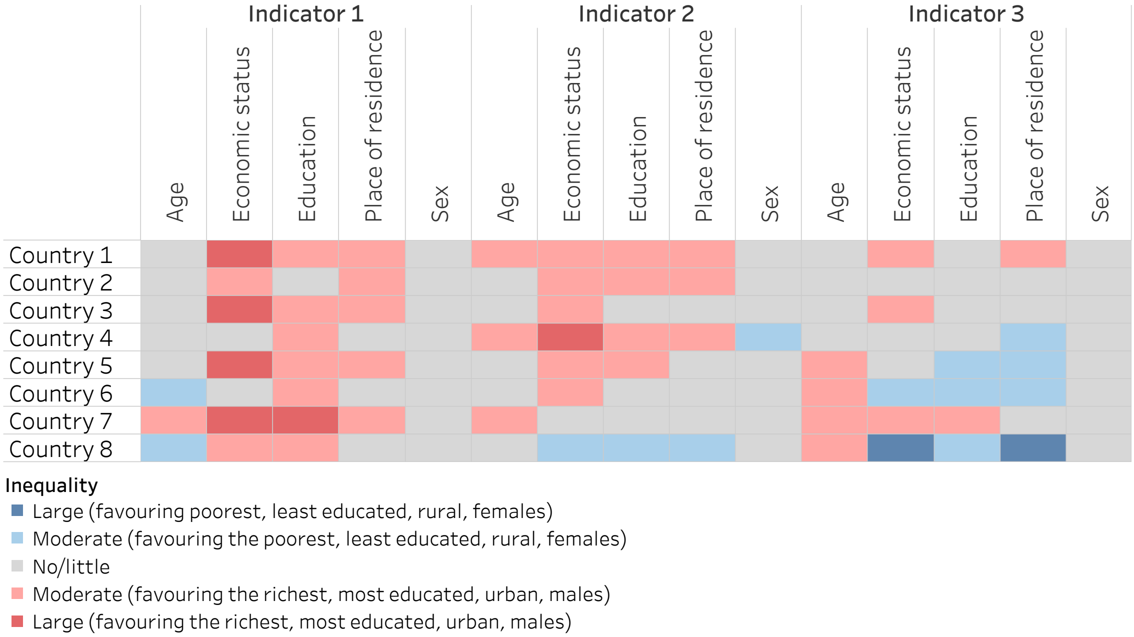
Colours should be used to support intuitive interpretation of the level of inequality.

A colour legend should be included.

Diverging colour scales are appropriate when there is a meaningful middle point and values at opposing sides of the middle are to be emphasized (e.g. when there is a directionality of inequality).

The same summary measure of inequality should be used to measure inequality throughout the heatmap.




Indicator 1
Indicator 2
Indicator 3
Age
Economic status
Education
Place of residence
Sex
Age
Economic status
Education
Place of residence
Sex
Age
Economic status
Education
Place of residence
Sex
Country 1
Country 2
Country 3
Country 4
Country 5
Country 6
Country 7
Country 8
Inequality
Large (favouring poorest, least educated, rural, females)
Moderate (favouring the poorest, least educated, rural, females)
No/little
Moderate (favouring the richest, most educated, urban, males)
Large (favouring the richest, most educated, urban, males)

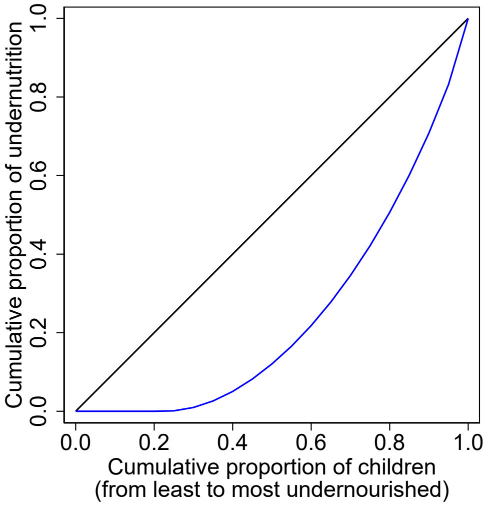
Annex 16

Example of using Gini to measure dispersion in stunting among children in Kenya

The following example calculates Gini for child undernutrition among children in Kenya using data from the 2022 Demographic and Health Survey. The sample includes children aged five years and younger. Undernutrition is measured using negative height-for-age *z*-scores (which is related to stunting), censored at 0 and multiplied by −1. A larger absolute value of this measure indicates that a child's height is further below the median height of a child of the same age and sex in a well-nourished population.

Figure A16.1 shows the Lorenz curve for undernutrition of children aged under five years in Kenya in 2022. The Lorenz curve (blue line) initially runs along the *x*-axis because some children are taller than the well-nourished median, so they are censored at 0. The curve lies well below the black 45-degree line, indicating there is variation in the extent to which Kenyan children were stunted in 2022.

FIGURE A16.1. Lorenz curve of child undernutrition, Kenya



The black 45-degree line represents a situation of equality. The blue line represents the Lorenz curve, a situation of inequality.
Source: data were sourced from the 2022 Kenya Demographic and Health Survey.

The Gini index for child stunting in 2022 is 0.515 or 51.5%. The Gini index is more meaningful when comparing across indicators, time periods or settings. For example, Table A16.1 compares the Gini index in 2008, 2014 and 2022. The variation in stunting increased slightly, from 45.7% in 2008 to 51.5% in 2022.

TABLE A16.1. Gini index: child stunting, Kenya

	2008	2014	2022
Gini coefficient	0.457	0.472	0.515
Gini index (%)	45.7	47.2	51.5

Source: data were sourced from the 2008, 2014 and 2022 Kenya Demographic and Health Surveys.

Annex 17

Applying summary measures of health inequality to individual data

Calculating the relative ranks of individuals

The calculations of the slope index of inequality (SII), relative index of inequality (RII), absolute concentration index (ACI) and relative concentration index (RCI) require individuals to be ranked from the least to the most advantaged, based on a socioeconomic characteristic such as wealth or education level. When the ranking is based on a continuous variable (e.g. wealth index scores), in which each individual has a unique score value, the formula to calculate relative rank is:

$$Relative\ rank = \sum_{i=1}^{j} p_i - 0.5(p_j)$$

where p_j is the individual sampling weight. An example is shown in Table A17.1.

TABLE A17.1. Steps to calculate the relative rank of individuals in a hypothetical weighted sample using a continuous ranking variable (wealth index score)

Record	Wealth index score	Individual sample weight [A]	Population share [C = A / B]	Cumulative population share [D]	Relative rank [X = D – (0.5 × C)]
1	–250 248	1250	0.040	0.040	0.020
2	–111 979	2468	0.079	0.118	0.079
3	–34 038	1787	0.057	0.175	0.147
4	–29 844	8873	0.283	0.458	0.317
5	–7243	2202	0.070	0.528	0.493
6	8136	1084	0.035	0.563	0.546
7	32 187	7212	0.230	0.793	0.678
8	59 185	1875	0.060	0.853	0.823
9	88 405	3387	0.108	0.961	0.907
10	308 001	1238	0.039	1.000	0.980
Total		*31 376* *[B]*			

When the ranking variable is categorical (e.g. wealth quintiles or education level), resulting in ties in the ranking variable, the relative rank can be calculated from the proportion of individuals within a given value of the ranking variable. This produces a single relative rank per subgroup, rather than individually (due to not being able to accurately sort individuals within each subgroup). An example of this calculation is shown in Table A17.2.

TABLE A17.2. Steps to calculate the relative rank of individuals in a hypothetical weighted sample using a categorical ranking variable (education level)

Record	Education level	Individual sample weight [A]	Cumulative individual sample weight [C]	Cumulative individual sample weight for Record 1 [D]	Maximum cumulative individual sample weight per category [E = max(C)]	Minimum cumulative individual sample weight for Record 1} [F = min(D)]	Relative rank [G = (F + 0.5 × (E − F)) / B]
1	No education	1250	1250	0	3718	0	0.059
2	No education	2468	3718	1250	3718	0	0.059
3	Less than primary education	1787	5505	3718	14 378	3718	0.288
4	Less than primary education	8873	14 378	5505	14 378	3718	0.288
5	Primary education	2202	16 580	14 378	17 664	14 378	0.511
6	Primary education	1084	17 664	16 580	17 664	14 378	0.511
7	Secondary education	7212	24 876	17 664	26 751	17 664	0.708
8	Secondary education	1875	26 751	24 876	26 751	17 664	0.708
9	Higher education	3387	30 138	26 751	31 376	26 751	0.926
10	Higher education	1238	31 376	30 138	31 376	26 751	0.926
Total		*31 376 [B]*					

Calculating summary measures of health inequality

The following example measures inequality in child undernutrition among children in Kenya using data from the 2022 Demographic and Health Survey (DHS). The sample includes children aged five years and younger. Undernutrition is measured using negative height-for-age *z*-scores (which is related to stunting), censored at 0 and multiplied by −1. A larger absolute value of this measure indicates that a child's height is further below the median height of a child of the same age and sex in a well-nourished population. Socioeconomic status is measured using the DHS wealth index, which is constructed from data about household assets and housing conditions.

Slope index of inequality and relative index of inequality

To calculate the SII and RII, undernutrition (height-for-age *z*-scores) is regressed against the fractional wealth index rank of each child in the survey. After running a regression model, the predicted child height-to-age estimates at the socioeconomic ranks of 1 and 0 are 0.63 and 1.47, respectively. The SII is the difference between these predicted estimates (or the slope of this line):

$$SII = \hat{v}_1 - \hat{v}_0 = 0.63 - 1.47 = -0.84$$

Since undernutrition is an adverse indicator, the negative sign indicates inequality favouring advantaged people – that is, the censored standardized height deficit of the poorest child is predicted to be 0.84 lower than that of the richest child.

The RII is the ratio between the predicted child undernutrition estimates at the socioeconomic ranks of 1 and 0:

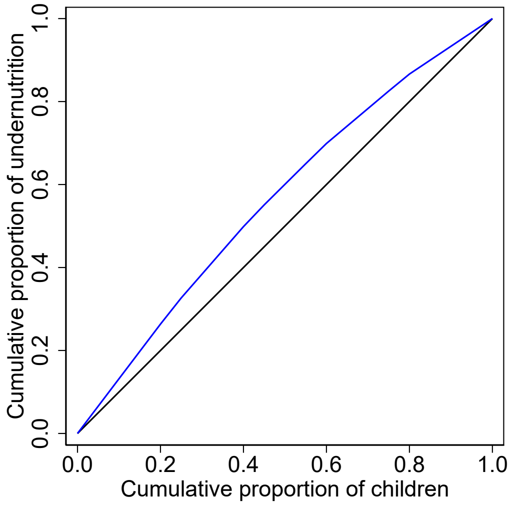
$$RII = \hat{v}_1 / \hat{v}_0 = 0.63 / 1.47 = 0.43$$

Therefore, the poorest child has a height-to-age score that is 0.43 times lower than that of the richest child.

Absolute concentration index and relative concentration index

Figure A17.1 shows a concentration curve for child undernutrition in Kenya in 2022. It plots the cumulative proportion of undernutrition against the cumulative proportion of children ranked from poorest to richest. The curve lies above the 45-degree line, confirming that undernutrition is disproportionately concentrated among poorer children. The absolute concentration index is twice the area between the concentration curve and the 45-degree line.

FIGURE A17.1. **Concentration curve: child undernutrition, Kenya**



The black 45-degree line represents a situation of equality. The blue line represents the Lorenz curve, a situation of inequality.
Source: data were sourced from the 2022 Kenya Demographic and Health Survey.

The ACI is −0.1397 and the RCI is −0.1327. The negative sign indicates inequality in undernutrition, to the disadvantage of poorer children.

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9789240102606