TECHNICAL NOTES

Health Equity Assessment Toolkit (HEAT)

BUILT-IN DATABASE EDITION, VERSION 4.0

World Health Organization

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1 Introduction

Equity is at the heart of the United Nations 2030 Agenda for Sustainable Development, which aims to "leave no one behind". This commitment is reflected throughout the 17 Sustainable Development Goals (SDGs) that Member States have pledged to achieve by 2030. Monitoring inequalities is essential for achieving equity: it allows identifying vulnerable population subgroups that are being left behind and helps inform equity-oriented policies, programmes and practices that can close existing gaps. With a strong commitment to achieving equity in health, the World Health Organization (WHO) has developed a number of tools and resources to build and strengthen capacity for health inequality monitoring, including the Health Equity Assessment Toolkit.

The **Health Equity Assessment Toolkit** is a free and open-source software application that facilitates the assessment of within-country health inequalities, i.e. differences in health that exist between different population subgroups within a country. Through innovative and interactive data visualizations, the toolkit makes it easy to analyse and communicate data about health inequalities. Disaggregated data and summary measures are visualized in a variety of graphs, maps and tables that can be customized according to your needs. Results can be exported to communicate findings to different audiences and inform evidence-based decision making in countries.

The toolkit is available in **two editions**:

- **HEAT** (built-in database edition), which contains the WHO Health Equity Monitor database
- **HEAT Plus** (upload database edition), which allows users to upload their own datasets

These **HEAT technical notes** accompany the built-in database edition of the toolkit and provide detailed information about the data presented in HEAT, including the disaggregated data (Section 2) and the summary measures of inequality (Section 3). Following a general introduction to disaggregated data, Section 2 provides details about the health indicators and inequality dimensions available in HEAT (Sections 2.1 and 2.2). A full list of study countries, data sources and notes about map availability is available in Annex 1. Section 3 first gives a general overview of summary measures and then lists detailed information about the 19 summary measures calculated in HEAT (Sections 3.1–3.19). For each summary measure, information about the definition, calculation, and interpretation are provided; examples illustrate the use and interpretation of each summary measure. Additional information are available in the Annex, including a summary table of all summary measures (Annex 2) and a decision tree on which summary measures to use for your analysis (Annex 3). Throughout the technical notes, blue boxes highlight links to further resources and summarize the most salient points of each section.

You may want to read these technical notes sequentially and in its entirety, or consult different sections as required. You are also encouraged to consult the other documents that accompany HEAT, including the user manual, which provide detailed information about the features and functionalities of HEAT. Moreover, you may want to supplement these resources with materials that provide further information on the theoretical and/or practical steps of health inequality monitoring, such as the WHO's *Handbook on health inequality monitoring* and *National health inequality monitoring: a step-by-step manual*.

LINKS

- WHO Health Equity Monitor
- WHO Health Equity Monitor database
- Health Equity Assessment Toolkit (HEAT and HEAT Plus)

2 Disaggregated data

Assessing within-country health inequalities requires the use of health data that are disaggregated according to relevant dimensions of inequality. Disaggregated data break down overall averages, revealing differences in health between different population subgroups. They are useful to identify patterns of inequality in a population and vulnerable subgroups that are being left behind.

Two types of data are required for calculating disaggregated data: data about "health indicators" that describe an individual's experience of health and data about "dimensions of inequality" that allow populations to be organized into subgroups according to their demographic, socioeconomic and/or geographic characteristics.

HEAT contains disaggregated data from the WHO Health Equity Monitor database (2020 update). The database currently comprises data for over 30 reproductive, maternal, newborn and child health (RMNCH) indicators, disaggregated by six dimensions of inequality. Data are based on re-analysis of more than 450 Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS) and Reproductive Health Surveys (RHS) conducted in 118 countries between 1991 and 2019.

Micro-level DHS, MICS and RHS data were analysed by the WHO Collaborating Center for Health Equity Monitoring (International Center for Equity in Health, Federal University of Pelotas, Brazil). Disaggregated child malnutrition indicator data are from the Joint Child Malnutrition Estimates compiled by UNICEF, WHO and the World Bank. Survey design specifications were taken into consideration during the analysis. The same methods of calculation for data analysis were applied across all surveys to generate comparable estimates across countries and over time.

The following two sections provide more information about the health indicators (Section 2.1) and inequality dimensions (Section 2.2) from the WHO Health Equity Monitor database. A full list of study countries, data sources and notes about map availability is given in Annex 1.

DISAGGREGATE DATA

- ✓ **Disaggregated data** are data on health indicators disaggregated by relevant dimensions of inequality (demographic, socioeconomic or geographic factors)
- ✓ HEAT contains the WHO Health Equity Monitor database (2020 update), currently comprising disaggregated data on
    - >30 reproductive, maternal, newborn and child health indicators
    - Disaggregated by 6 inequality dimensions (economic status, education, place of residence, and subnational region, as well as age and sex)
    - From >450 international household surveys (DHS, MICS and RHS)
    - Conducted in 118 countries between 1991 and 2019

2.1 Health indicators

Table 1 lists the health indicators currently available in the WHO Health Equity Monitor database, along with their basic characteristics. Detailed information about the criteria used to calculate the numerator and denominator values for each indicator are available in the indicator compendium.

Table 1 Health indicators available in the WHO Health Equity Monitor database (2020 update)

Indicator name	Indicator abbreviation	Indicator type	Indicator scale
Adolescent fertility rate (births per 1000 women aged 15-19 years)*	asfr1	Adverse	1000
Antenatal care coverage - at least four visits (in the five years preceding the survey) (%)	anc45	Favourable	100
Antenatal care coverage - at least four visits (in the two or three years preceding the survey) (%)	anc4	Favourable	100
Antenatal care coverage - at least one visit (in the five years preceding the survey) (%)	anc15	Favourable	100
Antenatal care coverage - at least one visit (in the two or three years preceding the survey) (%)	anc1	Favourable	100
BCG immunization coverage among one-year-olds (%)	vbcg	Favourable	100
Births attended by skilled health personnel (in the five years preceding the survey) (%)	sba5	Favourable	100
Births attended by skilled health personnel (in the two or three years preceding the survey) (%)	sba	Favourable	100
Births by caesarean section (in the five years preceding the survey) (%)**	csection5	Favourable	100
Births by caesarean section (in the two or three years preceding the survey) (%)**	csection	Favourable	100
Children aged 6-59 months who received vitamin A supplementation (%)	vita	Favourable	100
Children aged < 5 years sleeping under insecticide-treated nets (%)	itnch	Favourable	100
Children aged < 5 years with diarrhoea receiving oral rehydration salts (%)	ors	Favourable	100
Children aged < 5 years with diarrhoea receiving oral rehydration therapy and continued feeding (%)	ort	Favourable	100
Children aged < 5 years with pneumonia symptoms taken to a health facility (%)	carep	Favourable	100
Composite coverage index (%)	cci	Favourable	100
Contraceptive prevalence - modern and traditional methods (%)	cpmt	Favourable	100
Contraceptive prevalence - modern methods (%)	cpmowho	Favourable	100
DTP3 immunization coverage among one-year-olds (%)	vdpt	Favourable	100
Demand for family planning satisfied - modern and traditional methods (%)	fps	Favourable	100
Demand for family planning satisfied - modern methods (%)	fpsmowho	Favourable	100
Early initiation of breastfeeding (in the two years preceding the survey) (%)	bfearly	Favourable	100
Full immunization coverage among one-year-olds (%)	vfull	Favourable	100
Infant mortality rate (deaths per 1000 live births)	imr	Adverse	1000

Indicator name	Indicator abbreviation	Indicator type	Indicator scale
Measles immunization coverage among one-year-olds (%)	vmsl	Favourable	100
Neonatal mortality rate (deaths per 1000 live births)	nmr	Adverse	1000
Obesity prevalence in non-pregnant women aged 15-49 years, BMI >= 30 (%)	bmi30wm	Adverse	100
Overweight prevalence in children aged < 5 years (%)	overweight	Adverse	100
Polio immunization coverage among one-year-olds (%)	vpolio	Favourable	100
Pregnant women sleeping under insecticide-treated nets (%)	itnwm	Favourable	100
Severe wasting prevalence in children aged < 5 years (%)	sevwasting	Adverse	100
Stunting prevalence in children aged < 5 years (%)	stunting	Adverse	100
Total fertility rate (births per woman)*	tfr	Adverse	1
Under-five mortality rate (deaths per 1000 live births)	u5mr	Adverse	1000
Underweight prevalence in children aged < 5 years (%)	underweight	Adverse	100
Wasting prevalence in children aged < 5 years (%)	wasting	Adverse	100

*Note that the indicators "Adolescent fertility rate" and "Total fertility rate" are treated as adverse health outcome indicators, even though the minimum level may not be the most desirable situation (as is the case for other adverse outcome indicators, such as infant mortality rate).

**Note that the indicators "Births by caesarean section (in the two or three years preceding the survey)" and "Births by caesarean section (in the five years preceding the survey)" are treated as favourable health intervention indicators, even though the maximum level may not be the most desirable situation (as is the case for other favourable health intervention indicators, such as full immunization coverage).

There are different types of health indicators, which may be reported at different scales. Differentiating between the **different indicator types and scales** is important as these characteristics have implications for the calculation of summary measures (see Section 3).

Health indicators can be divided into favourable and adverse health indicators. **Favourable health indicators** measure desirable health events that are promoted through public health action. They include health intervention indicators, such as antenatal care coverage, and desirable health outcome indicators, such as life expectancy. For these indicators, the ultimate goal is to achieve a maximum level, either in health intervention coverage or health outcome (for example, complete coverage of antenatal care or the highest possible life expectancy). **Adverse health indicators**, on the other hand, measure undesirable events, that are to be reduced or eliminated through public health action. They include undesirable health outcome indicators, such as stunting prevalence in children aged less than five years or under-five mortality rate. Here, the ultimate goal is to achieve a minimum level in health outcome (for example, a stunting prevalence or mortality rate of zero).

Furthermore, health indicators can be reported at different **indicator scales**. For example, while total fertility rate is usually reported as the number of births *per woman* (indicator scale = 1), coverage of skilled birth attendance is reported as a *percentage* (indicator scale = 100) and neonatal mortality rate is reported as the number of deaths *per 1000 live births* (indicator scale = 1000).

HEALTH INDICATORS

- ✓ **Health indicators** describe an individual's experience of health
- ✓ Different health indicators have different **characteristics**
  - **Favourable health indicators** measure desirable health events, while **adverse health indicators** measure undesirable health events
  - Health indicators are reported at different **indicator scales**

2.2 Dimensions of inequality

Health indicators from the WHO Health Equity Monitor database were disaggregated by **six dimensions of inequality**: economic status, education, place of residence and subnational region as well as age and sex (where applicable).

Economic status was determined using a wealth index. Country-specific indices were based on owning selected assets and having access to certain services, and constructed using principal component analysis. For wealth quintiles, within each country the index was divided into five equal subgroups that each account for 20% of the population. For wealth deciles, within each country the index was divided into ten equal subgroups that each account for 10% of the population. Note that certain indicators have denominator criteria that do not include all households and/or are more likely to include households from a specific quintile or decile; thus the quintile or decile share of the population for a given indicator may not equal 20% or 10%, respectively. For example, there are often more live births reported by the poorest quintile than the richest quintile, resulting in the poorest quintile representing a larger share of the population for indicators such as the coverage of births attended by skilled health personnel.

Education refers to the highest level of schooling attained by the woman (or the mother, in the case of newborn and child health interventions, child malnutrition and child mortality indicators).

For **place of residence** and **subnational region**, country-specific criteria were applied.

Table 2 lists the six inequality dimensions currently available in the WHO Health Equity Monitor database, along with their basic characteristics.

Table 2 Dimensions of inequality available in the WHO Health Equity Monitor database (2020 update)

Inequality dimension	Dimension type	Subgroups	Subgroup order	Reference subgroup
Age	Binary dimension	15-19 years 20-49 years	N/A	20-49 years
		0-1 years 2-5 years	N/A	2-5 years
Economic status	Ordered dimension	Quintile 1 (poorest) Quintile 2 Quintile 3 Quintile 4 Quintile 5 (richest)	1. Quintile 1 (poorest) 2. Quintile 2 3. Quintile 3 4. Quintile 4 5. Quintile 5 (richest)	N/A
		Decile 1 (poorest) Decile 2 Decile 3 Decile 4 Decile 5 Decile 6 Decile 7 Decile 8 Decile 9 Decile 10 (richest)	1. Decile 1 (poorest) 2. Decile 2 3. Decile 3 4. Decile 4 5. Decile 5 6. Decile 6 7. Decile 7 8. Decile 8 9. Decile 9 10. Decile 10 (richest)	N/A
Education	Ordered dimension	No education Primary school Secondary school +	1. No education 2. Primary school 3. Secondary school +	N/A
Place of residence	Binary dimension	Rural Urban	N/A	Urban
Sex	Binary dimension	Female Male	N/A	Female*
Subnational region	Non-ordered dimension	Variable	N/A	None

* Selections were made based on convenience of data interpretation. In the case of sex, the selection does not represent an assumed advantage of one sex over the other.

There are **different types of inequality dimensions with different characteristics**. It is important to take these characteristics into account as they have implications for the calculation of summary measures, too (see Section 3).

At the most basic level, dimensions of inequality can be divided into **binary dimensions**, i.e. dimensions that compare the situation in two population subgroups (e.g. females and males), versus **dimensions that look at the situation in more than two population subgroups** (e.g. economic status quintiles).

In the case of dimensions with more than two population subgroups it is possible to differentiate between dimensions with ordered subgroups and non-ordered subgroups. **Ordered dimensions** have subgroups with an inherent positioning and can be ranked. For example, education has an inherent ordering of subgroups in the sense that those with less education unequivocally have *less* of something compared to those with more education. **Non-ordered dimensions**, by contrast, have subgroups that are not based on criteria that can be logically ranked. Subnational regions are an example of non-ordered groupings.

For ordered dimensions, subgroups can be ranked from the most-disadvantaged to the most-advantaged subgroup. The **subgroup order** defines the rank of each subgroup. For example, if education is categorized in three subgroups (no education, primary school, and secondary school or higher), then subgroups may be ranked from no education (most-disadvantaged subgroup) to secondary school or higher (most-advantaged subgroup).

For binary and non-ordered dimensions, while it is not possible to rank subgroups, it is possible to identify a **reference subgroup**, that serves as a benchmark. For example, for subnational regions, the region with the capital city may be selected as the reference subgroup in order to compare the situation in all other regions with the situation in the capital city.

DIMENSIONS OF INEQUALITY

- ✓ **Dimensions of inequality** allow populations to be organized into subgroups according to their demographic, socioeconomic, and/or geographic characteristics
- ✓ Different inequality dimensions have different **characteristics**
    - Dimensions may have 2 subgroups (binary dimensions) or >2 subgroups
    - Dimensions with >2 subgroups may be ordered or non-ordered: **ordered dimensions** have subgroups with an inherent positioning, while subgroups of **non-ordered dimensions** cannot be ranked
    - Subgroups of ordered dimensions have a specific **subgroup order**
    - For non-ordered dimensions, one subgroup may be identified as a **reference subgroup**

3 Summary measures

Summary measures build on disaggregated data and present the level of inequality across multiple population subgroups in a single numerical figure. They are useful to compare the situation between different health indicators and inequality dimensions and assess changes in inequality over time.

Many different summary measures exist, each with different strengths and weaknesses. Knowing the characteristics of the different summary measures is important so that you can decide which summary measure is suitable for the analysis and interpret results correctly.

Summary measures of inequality can be divided into absolute measures and relative measures. For a given health indicator, **absolute inequality measures** indicate the magnitude of difference in health between subgroups. They retain the same unit as the health indicator.[1] **Relative inequality measures**, on the other hand, show proportional differences in health among subgroups and have no unit.

Furthermore, summary measures may be weighted or unweighted. **Weighted measures** take into account the population size of each subgroup, while **unweighted measures** treat each subgroup as equally sized. Importantly, simple measures are always unweighted and complex measures may be weighted or unweighted.

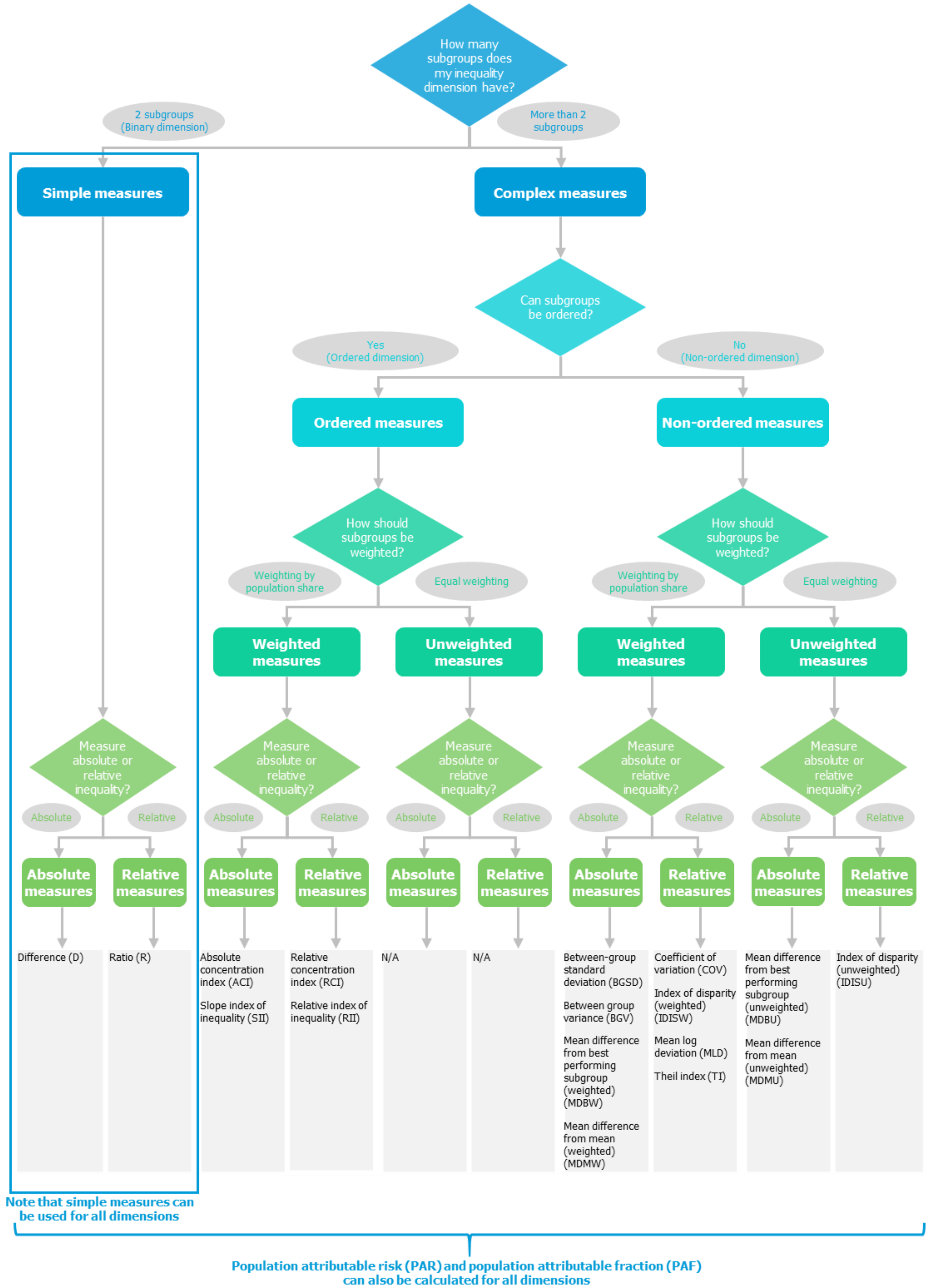
Simple measures make pairwise comparisons between two subgroups, such as the most and least wealthy. They can be calculated for all health indicators and dimensions of inequality. The characteristics of the indicator and dimension determine which two subgroups are compared to assess inequality. Contrary to simple measures, **complex measures** make use of data from all subgroups to assess inequality. They can be calculated for all health indicators, but they can only be calculated for dimensions with more than two subgroups.[2]

Complex measures can further be divided into ordered complex measures and non-ordered complex measures of inequality. **Ordered measures** can only be calculated for dimensions with more than two subgroups that have a natural ordering. Here, the calculation is also influenced by the type of the health indicator (favourable vs. adverse). **Non-ordered measures** are only calculated for dimensions with more than two subgroups that have no natural ordering.[3]

HEAT enables the assessment of inequalities using 19 different summary measures of inequality, which are calculated based on the disaggregated data from the WHO Health Equity Monitor database. The following sections give detailed information about the definition, calculation and interpretation of each summary measure. Examples are provided to illustrate how each summary measure can be used and interpreted. Annex 2 provides an overview the 19 summary measures currently available in HEAT along with their basic characteristics, formulas and interpretation. Figure 1 presents a quick guide (in the form of a decision tree) on which summary measure(s) to use for your analysis.

1 One exception to this is the between-group variance (BGV), which takes the squared unit of the health indicator.
2 Exceptions to this are the population attributable risk (PAR) and the population attributable fraction (PAF), which can be calculated for all dimensions of inequality.
3 Non-ordered complex measures could also be calculated for ordered dimensions, however, in practice, they are not used for such dimensions and are therefore only reported for non-ordered dimensions.

Figure 1 Quick guide: which summary measure can I use for my analysis?



SUMMARY MEASURES

- ✓ **Summary measures** build on disaggregated data and present the level of inequality across multiple population subgroups in a single numerical figure
- ✓ Different summary measures have different **characteristics**
  - **Absolute measures** assess absolute differences in health; **Relative measures** capture proportional differences between subgroups
  - **Weighted measures** take into account the population size of each subgroup; **Unweighted measures** treat each subgroup as equally sized
  - **Simple measures** compare the situation between two subgroups; **Complex measures** consider all subgroups
  - **Ordered measures** are calculated for ordered inequality dimensions with >2 subgroups; **Non-ordered measures** are calculated for non-ordered inequality dimensions with >2 subgroups

3.1 Absolute concentration index (ACI)

Definition

ACI shows the health gradient across population subgroups, on an absolute scale. It indicates the extent to which a health indicator is concentrated among disadvantaged or advantaged subgroups.

ACI is an absolute measure of inequality that takes into account all population subgroups. It is calculated for ordered dimensions with more than two subgroups, such as economic status. Subgroups are weighted according to their population share. ACI is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

The calculation of ACI is based on a ranking of the whole population from the most-disadvantaged subgroup (at rank 0) to the most-advantaged subgroup (at rank 1), which is inferred from the ranking and size of the subgroups. The relative rank of each subgroup is calculated as: $X_j = \sum_j p_j - 0.5p_j$. Based on this ranking, ACI can be calculated as:

$$ACI = \sum_j p_j(2X_j - 1)y_j$$

where y_j indicates the estimate for subgroup j, p_j the population share of subgroup j and X_j the relative rank of subgroup j.

Interpretation

If there is no inequality, ACI takes the value zero. Positive values indicate a concentration of the health indicator among the advantaged, while negative values indicate a concentration of the health indicator among the disadvantaged. The larger the absolute value of ACI, the higher the level of inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by economic status (by wealth quintile) for two years (2005 and 2010). For each year, there are five bars – one for each wealth quintile. The graph shows that, overall, coverage increased in all quintiles and inequality between quintiles reduced over time. ACI quantifies the level of inequality in each year. Figure b shows that absolute economic-related inequality, as measured by the ACI, reduced from 13.2 percentage points in 2005 to 8.4 percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by economic status (wealth quintiles)

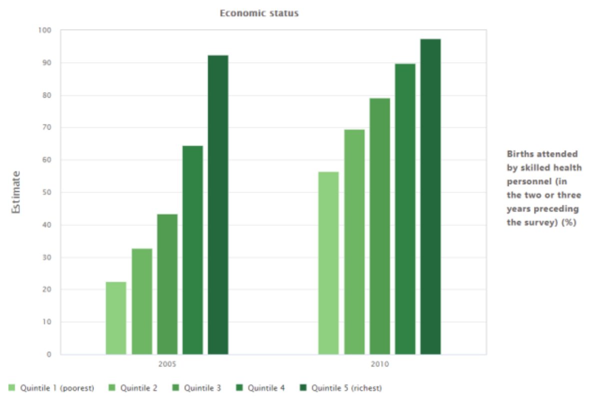
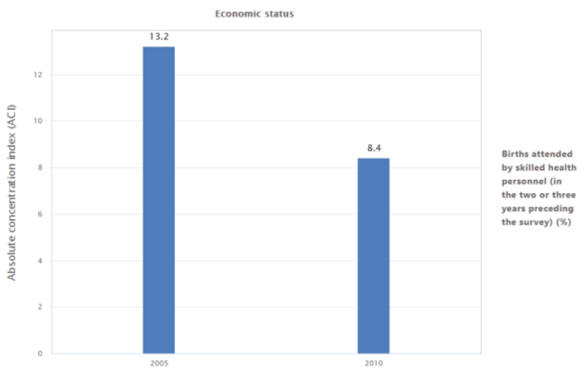


Figure b. Economic-related inequality in births attended by skilled health personnel: absolute concentration index (ACI)



ABSOLUTE CONCENTRATION INDEX (ACI)

Measures the extent to which a health indicator is concentrated among disadvantaged or advantaged population subgroups.

Takes the value zero if there is no inequality. Positive values indicate a concentration among advantaged, negative values among disadvantaged subgroups. The larger the absolute value, the higher the level of inequality.

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **ordered inequality dimensions**, such as economic status (ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.2 Between-group standard deviation (BGSD)

Definition

BGSD is an absolute measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. Subgroups are weighted according to their population share. BGSD is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

BGSD is calculated as the square root of the weighted average of squared differences between the subgroup estimates y_j and the setting (national) average μ. Squared differences are weighted by each subgroup's population share p_j:

$$BGSD = \sqrt{\sum_j p_j (y_j - \mu)^2}$$

Interpretation

BGSD takes only positive values, with larger values indicating higher levels of inequality. BGSD is zero if there is no inequality. BGSD is more sensitive to outlier estimates as it gives more weight to the estimates that are further from the setting (national) average.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. BGSD quantifies the level of inequality in each year. Figure b shows that absolute subnational regional inequality, as measured by the BGSD, reduced from 20.5 percentage points in 2005 to 14.7 percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

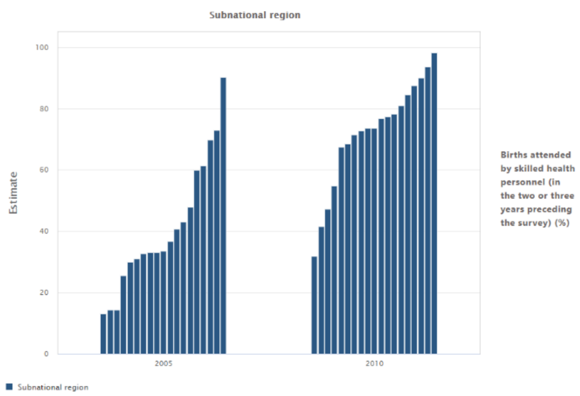
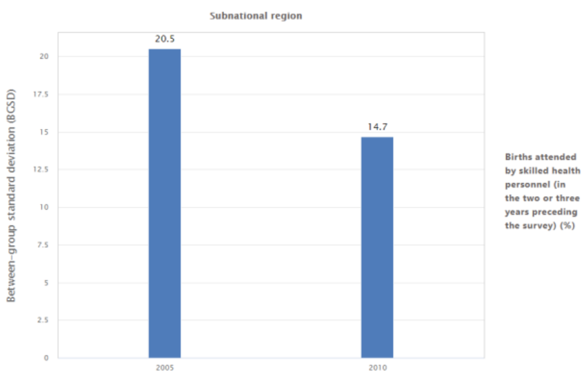


Figure b. Subnational regional inequality in births attended by skilled health personnel: between-group standard deviation (BGSD)



BETWEEN-GROUP STANDARD DEVIATION (BGSD)

Measures the square root of the weighted average of squared differences between each population subgroup and the setting (national) average.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality.

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.3 Between-group variance (BGV)

Definition

BGV is an absolute measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. Subgroups are weighted according to their population share. BGV is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

BGV is calculated as the weighted average of squared differences between the subgroup estimates y_j and the setting (national) average μ. Squared differences are weighted by each subgroup's population share p_j:

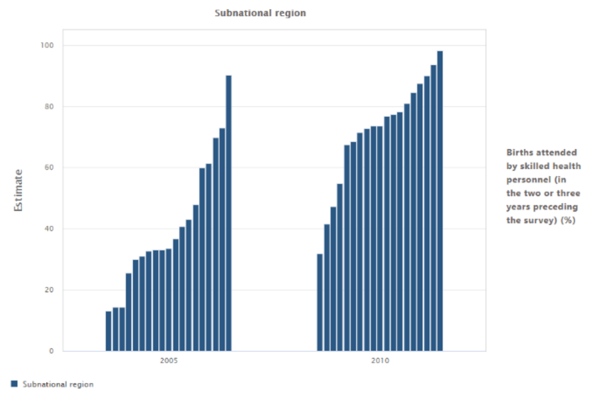
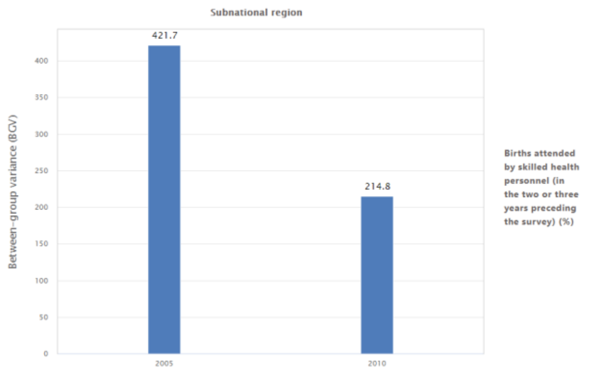
$$BGV = \sum_j p_j (y_j - \mu)^2$$

Interpretation

BGV takes only positive values with larger values indicating higher levels of inequality. BGV is zero if there is no inequality. BGV is more sensitive to outlier estimates as it gives more weight to the estimates that are further from the setting (national) average.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. BGV quantifies the level of inequality in each year. Figure b shows that absolute subnational regional inequality, as measured by the BGV, reduced from 421.7 squared percentage points in 2005 to 214.8 squared percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region	Figure b. Subnational regional inequality in births attended by skilled health personnel: between-group variance (BGV)
	

BETWEEN-GROUP VARIANCE (BGV)

Measures the weighted average of squared differences between each population subgroup and the setting (national) average.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality.

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.4 Coefficient of variation (COV)

Definition

COV is a relative measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. Subgroups are weighted according to their population share. COV is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

COV is calculated by dividing the between-group standard deviation (BGSD) by the setting (national) average μ and multiplying the fraction by 100:

$$COV = \frac{BGSD}{\mu} * 100$$

Interpretation

COV takes only positive values, with larger values indicating higher levels of inequality. COV is zero if there is no inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. COV quantifies the level of inequality in each year. Figure b shows that relative subnational regional inequality, as measured by the COV, reduced from 38.7% in 2005 to 13.3% in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

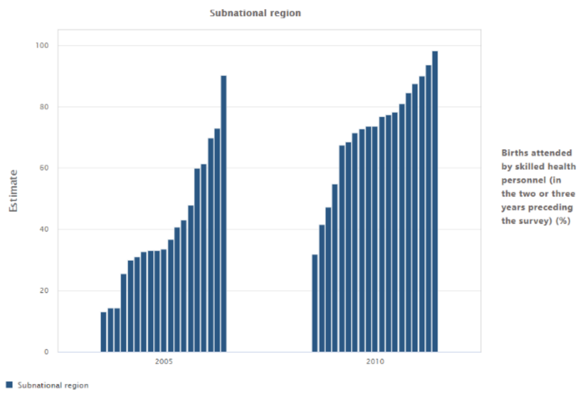
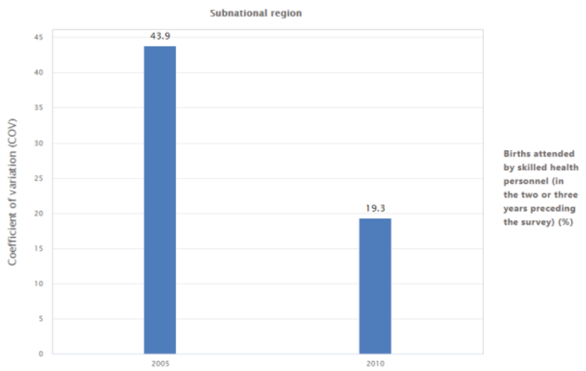


Figure b. Subnational inequality in births attended by skilled health personnel: coefficient of variation (COV)



COEFFICIENT OF VARIATION (COV)

Measures the square root of the weighted average of squared differences between each population subgroup and the setting (national) average (the between-group standard deviation) as a fraction of the setting (national) average.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality.

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.5 Difference (D)

Definition

D is an absolute measure of inequality that shows the difference in health between two population subgroups. It is calculated for all inequality dimensions, provided that subgroup estimates are available for the two subgroups used in the calculation of D.

Calculation

D is calculated as the difference between two population subgroups:

$$D = y_{high} - y_{low}$$

Note that the selection of y_{high} and y_{low} depends on the characteristics of the inequality dimension and the type of health indicator, for which D is calculated. Table 3 provides an overview of the calculation of D in HEAT.

Table 3 Calculation of the Difference (D) in HEAT

Dimension type	Reference subgroup selected?	Indicator type	
		Favourable indicator	**Adverse indicator**
Binary dimension			
Age	Yes (20–49 years)	20–49 years – 15–19 years	15–19 years – 20–49 years
	Yes (2-5 years)	2-5 years – 0-1 years	0-1 years – 2-5 years
Place of residence	Yes (Urban)	Urban – Rural	Rural – Urban
Sex	Yes* (Female)	Female – Male	Male – Female
Ordered dimension			
Economic status	N/A	Quintile 5 (richest) – Quintile 1 (poorest)	Quintile 1 (poorest) – Quintile 5 (richest)
		Decile 10 (richest) – Decile 1 (poorest)	Decile 1 (poorest) – Decile 10 (richest)
Education	N/A	Secondary school + – No education	No education – Secondary school +
Non-ordered dimension			
Subnational region	No	Highest – Lowest	Highest – Lowest

* Selections were made based on convenience of data interpretation (that is, providing positive values for difference calculations). In the case of sex, the selection does not represent an assumed advantage of one sex over the other.

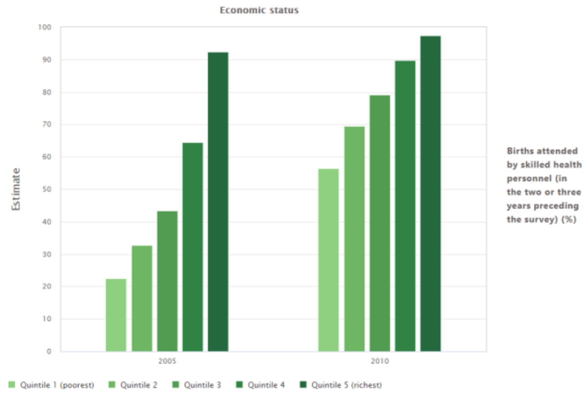
Interpretation

If there is no inequality, D takes the value zero. Greater absolute values indicate higher levels of inequality. For favourable health indicators, positive values indicate a concentration of the indicator in the advantaged subgroup and negative values indicate a concentration in the disadvantaged subgroup (except for subnational region, where D takes only positive values). For adverse health indicators, positive values indicate a concentration of the indicator in the disadvantaged subgroup and negative values indicate a concentration in the advantaged subgroup (except for subnational region, where D takes only negative values).

Example

Figure a shows data on skilled birth attendance disaggregated by economic status (by wealth quintile) for two years (2005 and 2010). For each year, there are five bars – one for each wealth quintile. The graph shows that, overall, coverage increased in all quintiles and inequality between quintiles reduced over time. The difference quantifies the level of inequality in each year. Figure b shows that the difference between quintile 5 and quintile 1 reduced from 70.0 percentage points in 2005 to 41.0 percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by economic status (wealth quintiles)	Figure b. Economic-related inequality in births attended by skilled health personnel: difference (D)



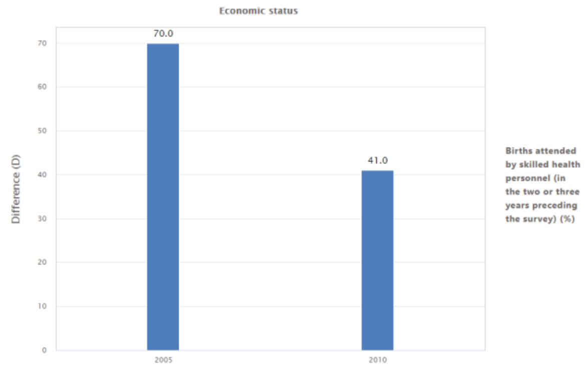
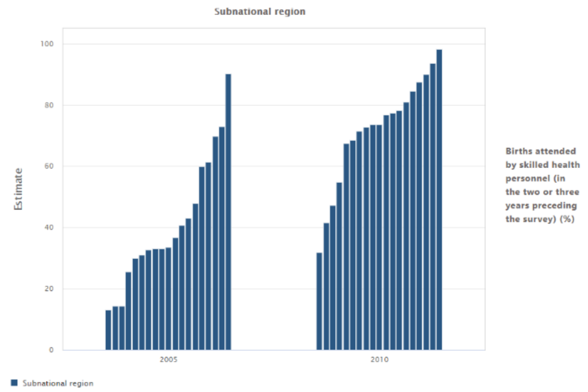
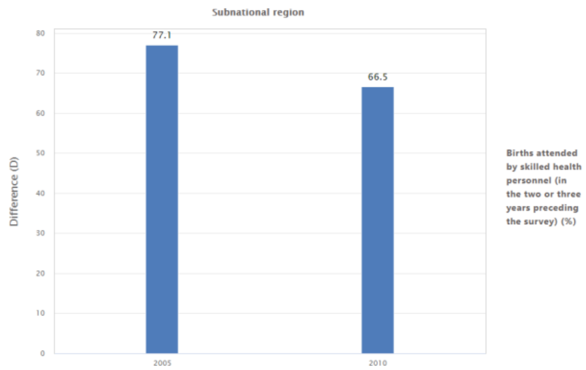


Figure c shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. The difference quantifies the level of inequality in each year. Figure d shows that the difference between the best and the worst performing region reduced from 77.1 percentage points in 2005 to 66.5 percentage points in 2010.

Figure c. Births attended by skilled health personnel disaggregated by subnational region	Figure d. Subnational regional inequality in births attended by skilled health personnel: difference (D)



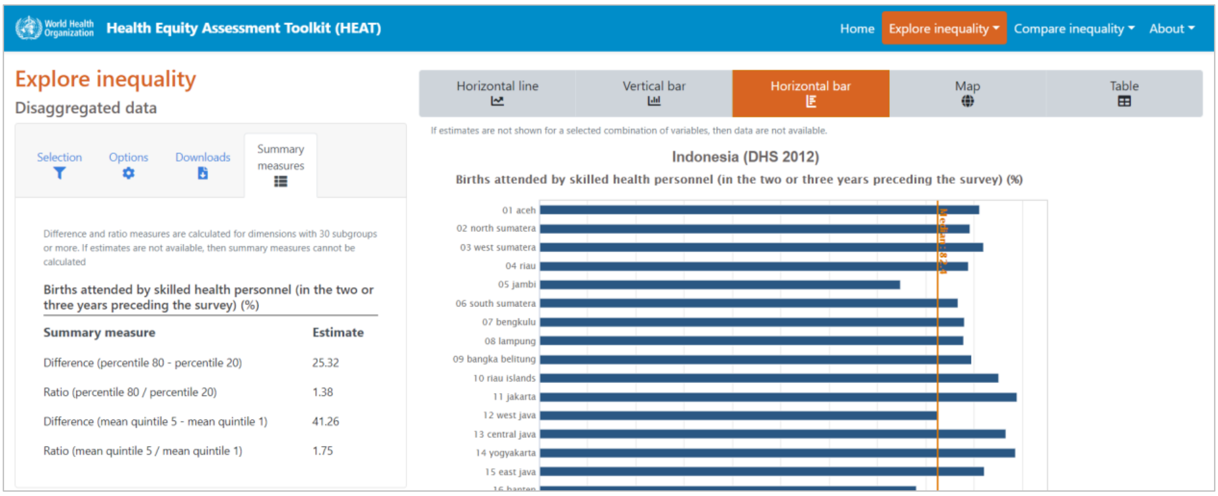


Other difference measures

In addition to the difference measure described above, variations of the difference are calculated for non-ordered inequality dimensions with many subgroups, such as subnational region. The following difference measures are calculated for countries with more than 30 subnational regions:

- **Difference between percentile 80 and percentile 20.** The difference between percentile 80 and percentile 20 is calculated by identifying the subgroups that correspond to percentiles 20 and 80 and subtracting the estimate for percentile 20 from the estimate for percentile 80: $D_{p80p20} = y_{p80} - y_{p20}$
- **Difference between mean estimates in quintile 5 and quintile 1.** The difference between mean estimates in quintile 5 and quintile 1 is calculated by dividing subgroups into quintiles, determining the mean estimate for each quintile and subtracting the mean estimate in quintile 1 from the mean estimate in quintile 5: $D_{q5q1} = y_{q5} - y_{q1}$

These measures may be a more accurate reflection of the level of geographic inequality than measuring the range between the maximum and minimum values using the (range) difference, as they avoid using possible outlier values. They are displayed in the 'Summary measures' tab of the selection menu for horizontal bar graphs showing disaggregated data under the 'Explore inequality' component of the tool.



Difference (D)

Measures the difference in health between two population subgroups.

Takes the value zero if there is no inequality. For favourable health indicators, positive values indicate a concentration among the advantaged and negative values among the disadvantaged subgroup. For adverse health indicators, it's the other way around: positive values indicate a concentration among the disadvantaged and negative values among the advantaged subgroup. The larger the absolute value, the higher the level of inequality.

Other difference measures are calculated for non-ordered inequality dimensions with many subgroups, including the difference between percentiles 80 and 20 and the difference between mean estimates in quintiles 5 and 1. These measures avoid using possible outlier values.

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **all inequality dimensions**
- ✓ Takes into account **two population subgroups** (simple measure)
- ✓ Does not take into account the **population size** of subgroups (unweighted measure)

3.6 Index of disparity (unweighted) (IDISU)

Definition

IDISU shows the unweighted average difference between each population subgroup and the setting (national) average, in relative terms.

IDISU is a relative measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. IDISU is missing if at least one subgroup estimate or subgroup population share is missing.[4]

Calculation

IDISU is calculated as the average of absolute differences between the subgroup estimates y_j and the setting (national) average μ, divided by the number of subgroups n and the setting (national) average μ, and multiplied by 100:

$$IDISU = \frac{\frac{1}{n} * \sum_j |y_j - \mu|}{\mu} * 100$$

Note that the 95% confidence intervals calculated for IDISU are simulation-based estimates.

Interpretation

IDISU takes only positive values, with larger values indicating higher levels of inequality. IDISU is zero if there is no inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. IDISU quantifies the level of inequality in each year. Figure b shows that relative subnational regional inequality, as measured by the IDISU, reduced from 39.2 in 2005 to 16.7 in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

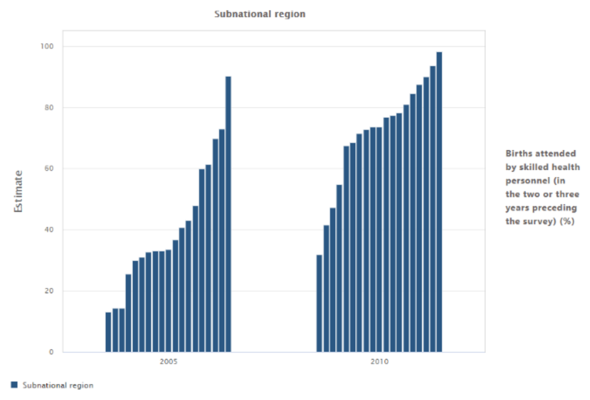
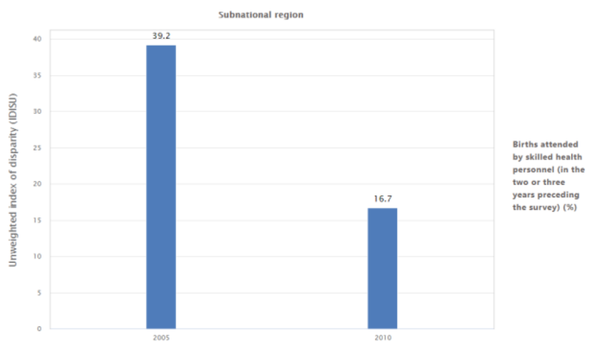


Figure b. Subnational inequality in births attended by skilled health personnel: index of disparity (unweighted) (IDISU)



[4] While IDISU is an unweighted measure, the setting (national) average is calculated as the weighted average of subgroup estimates. Subgroups are weighted by their population share. Therefore, if any subgroup population share is missing, the setting (national) average, and hence IDISU, cannot be calculated.

INDEX OF DISPARITY (UNWEIGHTED) (IDISU)

Shows the unweighted average difference between each population subgroup and the setting (national) average, in relative terms.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality.

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Does not take into account the **population size** of subgroups (unweighted measure)

3.7 Index of disparity (weighted) (IDISW)

Definition

IDISW shows the weighted average difference between each population subgroup and the setting (national) average, in relative terms.

IDISW is a relative measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. Subgroups are weighted according to their population share. IDISW is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

IDISW is calculated as the weighted average of absolute differences between the subgroup estimates y_j and the setting (national) average μ, divided by the setting (national) average μ, and multiplied by 100. Absolute differences are weighted by each subgroup's population share p_j:

$$IDISW = \frac{\sum_j p_j |y_j - \mu|}{\mu} * 100$$

Note that the 95% confidence intervals calculated for IDISW are simulation-based estimates.

Interpretation

IDISW takes only positive values, with larger values indicating higher levels of inequality. IDISW is zero if there is no inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. IDISW quantifies the level of inequality in each year. Figure b shows that relative subnational regional inequality, as measured by the IDISW, reduced from 36.5 in 2005 to 13.9 in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

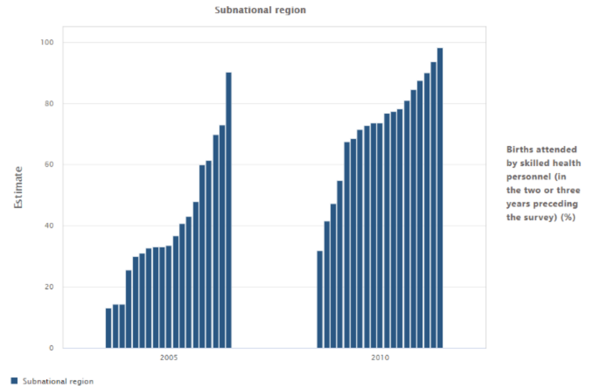
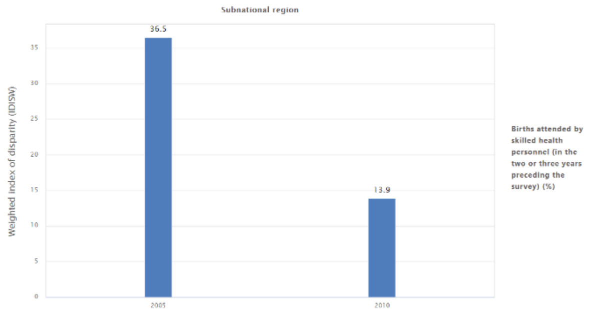


Figure b. Subnational inequality in births attended by skilled health personnel: index of disparity (weighted) (IDISW)



Index of disparity (weighted) (IDISW)

Shows the weighted average of difference between each population subgroup and the setting (national) average, in relative terms.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.8 Mean difference from best performing subgroup (unweighted) (MDBU)

Definition

MDBU shows the unweighted mean difference between each population subgroup and a reference subgroup.

MDBU is an absolute measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. MDBU is missing if at least one subgroup estimate is missing.

Calculation

MDBU is calculated as the average of absolute differences between the subgroup estimates y_j and the estimate for the reference subgroup y_{ref}, divided by the number of subgroups n:

$$MDBU = \frac{1}{n} * \sum_j |y_j - y_{ref}|$$

y_{ref} refers to the subgroup with the highest estimate in the case of favourable health indicators and to the subgroup with the lowest estimate in the case of adverse health indicators.

Note that the 95% confidence intervals calculated for MDBU are simulation-based estimates.

Interpretation

MDBU takes only positive values, with larger values indicating higher levels of inequality. MDBU is zero if there is no inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. MDBU quantifies the level of inequality in each year. Figure b shows that absolute subnational regional inequality, as measured by the MDBU, reduced from 49.0 percentage points in 2005 to 26.2 percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

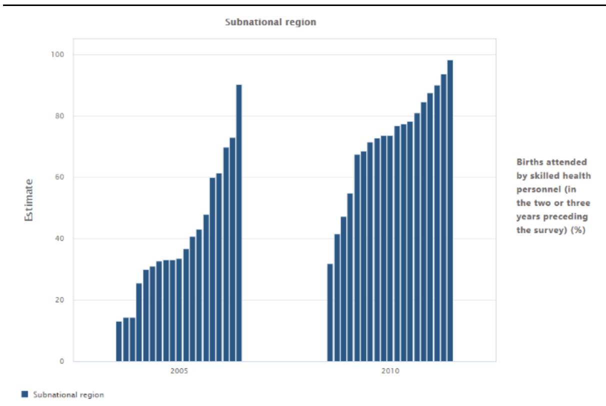
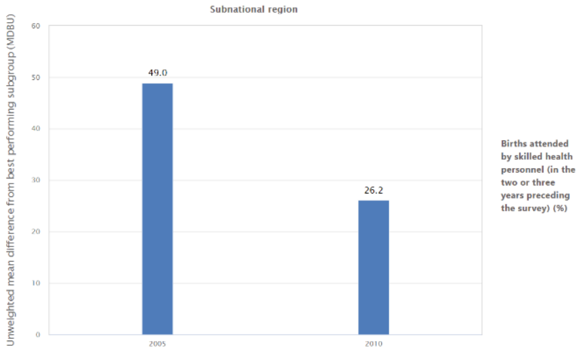


Figure b. Subnational regional inequality in births attended by skilled health personnel: mean difference from best performing subgroup (unweighted) (MDBU)



MEAN DIFFERENCE FROM BEST PERFORMING SUBGROUP (UNWEIGHTED) (MDBU)

Shows the unweighted mean difference between each population subgroup and a reference subgroup.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Does not take into account the **population size** of subgroups (unweighted measure)

3.9 Mean difference from best performing subgroup (weighted) (MDBW)

Definition

MDBW shows the weighted mean difference between each population subgroup and a reference subgroup.

MDBW is an absolute measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. Subgroups are weighted according to their population share. MDBW is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

MDBW is calculated as the weighted average of absolute differences between the subgroup estimates y_j and the estimate for the reference subgroup y_{ref}. Absolute differences are weighted by each subgroup's population share p_j:

$$MDBW = \sum_j p_j |y_j - y_{ref}|$$

y_{ref} refers to the subgroup with the highest estimate in the case of favourable health indicators and to the subgroup with the lowest estimate in the case of adverse health indicators.

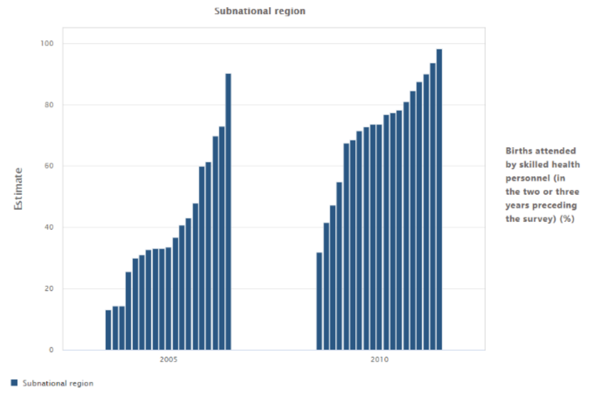
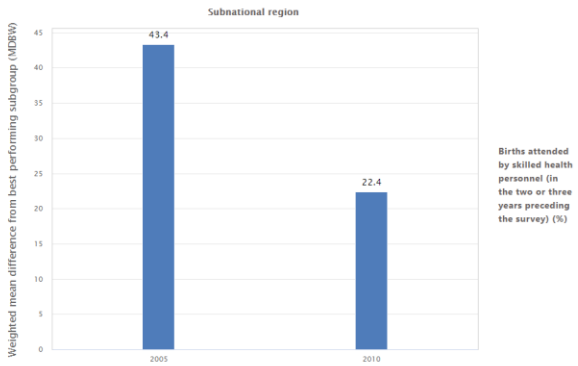
Note that the 95% confidence intervals calculated for MDBW are simulation-based estimates.

Interpretation

MDBW takes only positive values, with larger values indicating higher levels of inequality. MDBW is zero if there is no inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. MDBW quantifies the level of inequality in each year. Figure b shows that absolute subnational regional inequality, as measured by the MDBW, reduced from 43.4 percentage points in 2005 to 22.4 percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region	Figure b. Subnational inequality in births attended by skilled health personnel: mean difference from best performing subgroup (weighted) (MDBW)
	

MEAN DIFFERENCE FROM BEST PERFORMING SUBGROUP (WEIGHTED) (MDBW)

Shows the weighted mean difference between each population subgroup and a reference subgroup.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.10 Mean difference from mean (unweighted) (MDMU)

Definition

MDMU shows the unweighted mean difference between each subgroup and the setting (national) average.

MDMU is an absolute measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. MDMU is missing if at least one subgroup estimate or subgroup population share is missing.[5]

Calculation

MDMU is calculated as the average of absolute differences between the subgroup estimates y_j and the setting (national) average μ, divided by the number of subgroups n:

[5] While MDMU is an unweighted measure, the setting (national) average is calculated as the weighted average of subgroup estimates. Subgroups are weighted by their population share. Therefore, if any subgroup population share is missing, the setting (national) average, and hence MDMU, cannot be calculated.

$$MDMU = \frac{1}{n} * \sum_j |y_j - \mu|$$

Note that the 95% confidence intervals calculated for MDMU are simulation-based estimates.

Interpretation

MDMU takes only positive values, with larger values indicating higher levels of inequality. MDMU is zero if there is no inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. MDMU quantifies the level of inequality in each year. Figure b shows that absolute subnational regional inequality, as measured by the MDMU, reduced from 18.4 percentage points in 2005 to 12.6 percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

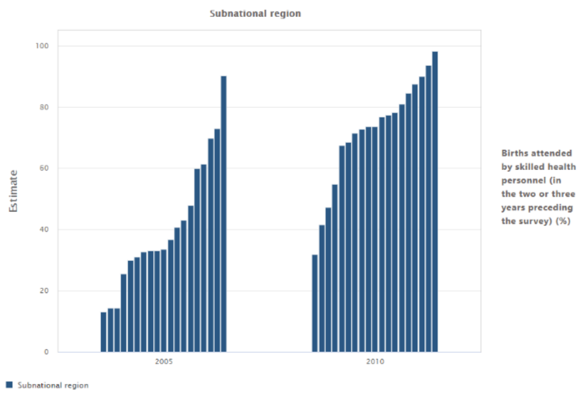
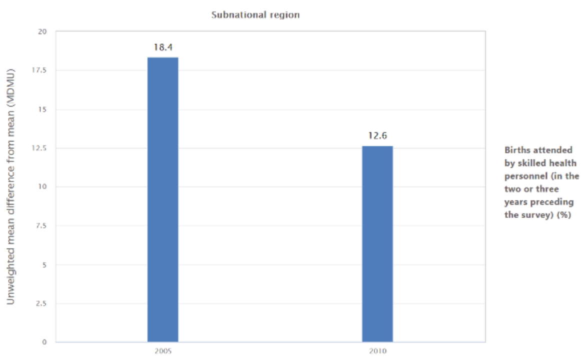


Figure b. Subnational regional inequality in births attended by skilled health personnel: mean difference from mean (unweighted) (MDMU)



MEAN DIFFERENCE FROM MEAN (UNWEIGHTED) (MDMU)

Shows the unweighted mean difference between each population subgroup and the setting (national) average.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality.

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Does not take into account the **population size** of subgroups (unweighted measure)

3.11 Mean difference from mean (weighted) (MDMW)

Definition

MDMW shows the weighted mean difference between each population subgroup and the setting (national) average.

MDMW is an absolute measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. Subgroups are weighted according to their population share. MDMW is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

MDMW is calculated as the weighted average of absolute differences between the subgroup estimates y_j and the setting (national) average μ. Absolute differences are weighted by each subgroup's population share p_j:

$$MDMW = \sum_j p_j |y_j - \mu|$$

Note that the 95% confidence intervals calculated for MDMW are simulation-based estimates.

Interpretation

MDMW takes only positive values, with larger values indicating higher levels of inequality. MDMW is zero if there is no inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. MDMW quantifies the level of inequality in each year. Figure b shows that absolute subnational regional inequality, as measured by the MDMW, reduced from 17.1 percentage points in 2005 to 10.5 percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

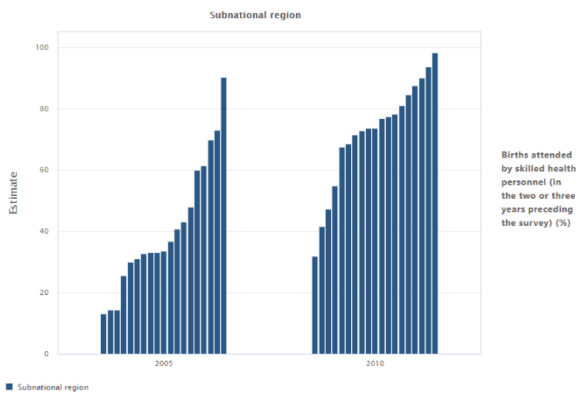
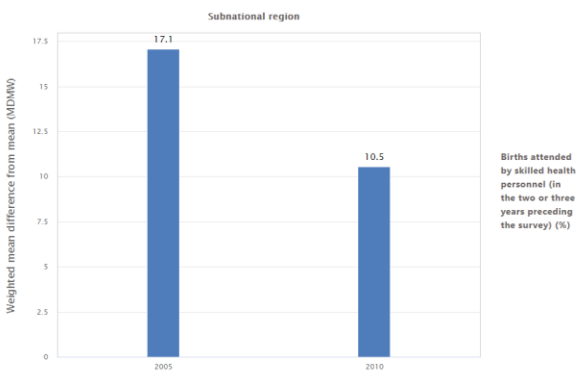


Figure b. Subnational inequality in births attended by skilled health personnel: mean difference from mean (weighted) (MDMW)



MEAN DIFFERENCE FROM MEAN (WEIGHTED) (MDMW)

Shows the weighted mean difference between each population subgroup and the setting (national) average.

Takes only positive values, with larger values indicating higher levels of inequality. Takes the value zero if there is no inequality

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.12 Mean log deviation (MLD)

Definition

MLD is a relative measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. Subgroups are weighted according to their population share. MLD is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

MLD is calculated as the sum of products between the negative natural logarithm of the share of health of each subgroup ($-\ln\left(\frac{y_j}{\mu}\right)$) and the population share of each subgroup (p_j). MLD may be more easily readable when multiplied by 1000:

$$\mathrm{MLD} = \sum_j p_j\left(-\ln\left(\frac{y_j}{\mu}\right)\right) * 1000$$

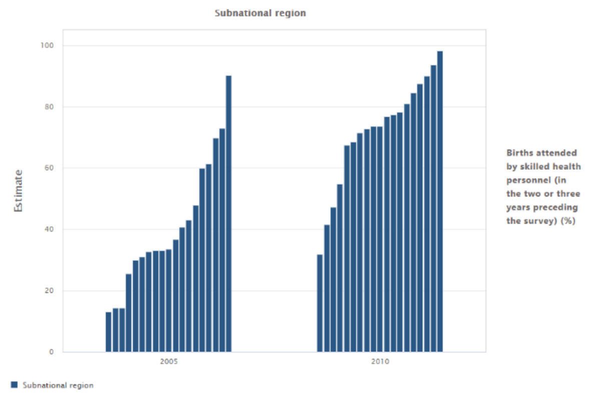
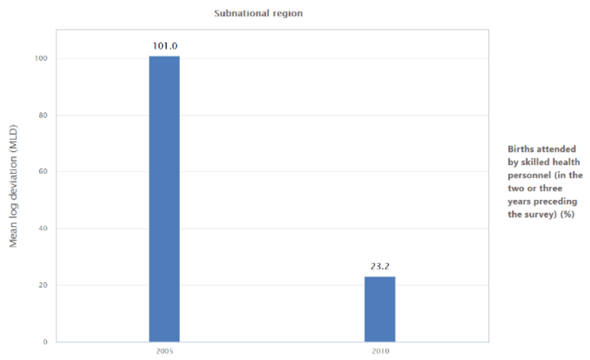
where y_j indicates the estimate for subgroup j, p_j the population share of subgroup j and μ the setting (national) average.

Interpretation

If there is no inequality, MLD takes the value zero. Greater absolute values indicate higher levels of inequality. MLD is more sensitive to health differences further from the setting (national) average (by the use of the logarithm).

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. MLD quantifies the level of inequality in each year. Figure b shows that relative subnational regional inequality, as measured by the MLD, reduced from 101.0 in 2005 to 23.2 in 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region	Figure b. Subnational inequality in births attended by skilled health personnel: mean log deviation (MLD)
	

MEAN LOG DEVIATION (MLD)

Measures the sum of products between the negative natural logarithm of the share of health of each subgroup and the population share of each subgroup.

Takes the value zero if there is no inequality. The larger the absolute value, the higher the level of inequality.

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.13 Population attributable fraction (PAF)

Definition

PAF shows the potential for improvement in setting (national) average of a health indicator, in relative terms, that could be achieved if all population subgroups had the same level of health as a reference group.

PAF is a relative measure of inequality that takes into account all population subgroups. It is calculated for all inequality dimensions, provided that all subgroup estimates and subgroup population shares are available.

Calculation

PAF is calculated by dividing the population attributable risk (PAR) by the setting (national) average μ and multiplying the fraction by 100:

$$PAF = \frac{PAR}{\mu} * 100$$

Interpretation

PAF takes positive values for favourable health indicators and negative values for adverse health indicators. The larger the absolute value of PAF, the larger the level of inequality. PAF is zero if no further improvement can be achieved, i.e. if all subgroups have reached the same level of health as the reference subgroup.

Example

Figure a shows data on skilled birth attendance disaggregated by economic status (by wealth quintile) for two years (2005 and 2010). For each year, there are five bars – one for each wealth quintile. The graph shows that, overall, coverage increased in all quintiles and inequality between quintiles reduced over time. PAF measures the potential improvement in national coverage of skilled birth attendance that could be achieved if all quintiles had the same level of coverage as quintile 5, i.e. if there was no economic-related inequality. Figure b shows that national average could have been 97.3% higher in 2005 and 28.3% higher in 2010 if there had been no economic-related inequality. PAF decreased between 2005 and 2010 indicating a decrease in relative economic-related inequality.

Figure a. Births attended by skilled health personnel disaggregated by economic status (wealth quintiles)

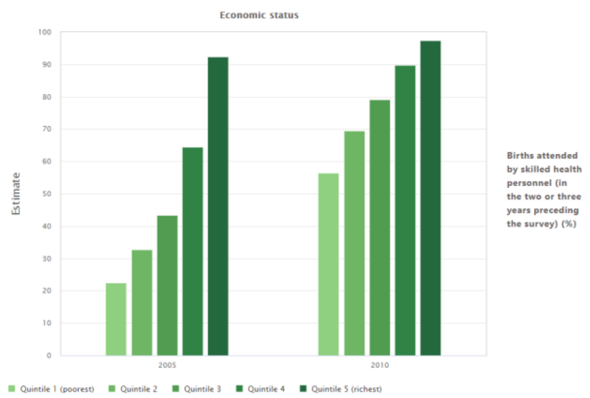


Figure b. Economic-related inequality in births attended by skilled health personnel: population attributable fraction (PAF)

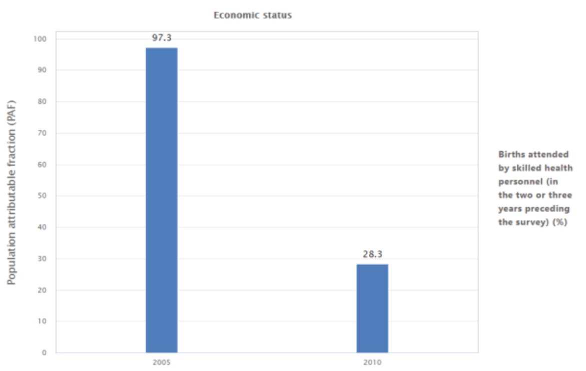


Figure c shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. PAF measures the potential improvement in national coverage of skilled birth attendance that could be achieved if all regions had the same level of coverage as the best performing region, i.e. if there was no subnational regional inequality. Figure d shows that national average could have been 92.6% higher in 2005 and 29.6% higher in 2010 if there had been no subnational regional inequality. PAF decreased between 2005 and 2010 indicating a decrease in relative subnational regional inequality.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

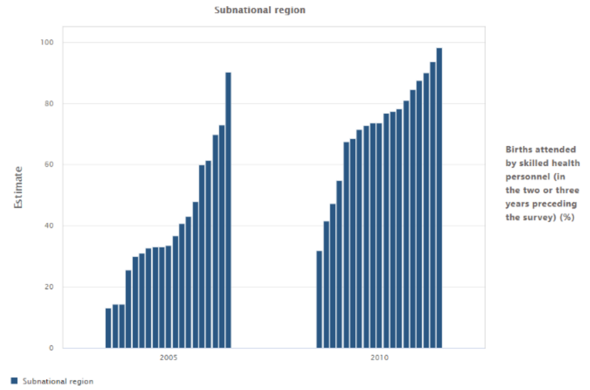
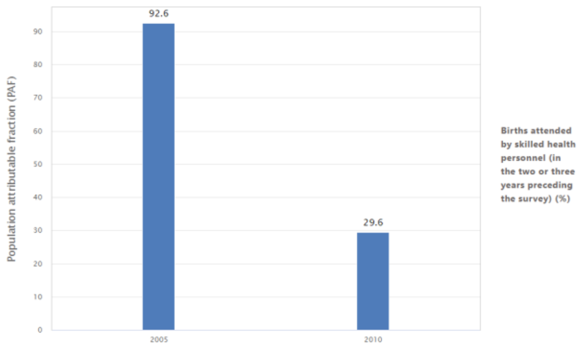


Figure b. Subnational inequality in births attended by skilled health personnel: population attributable fraction (PAF)



POPULATION ATTRIBUTABLE FRACTION (PAF)

Shows the potential for improvement in setting (national) average, in relative terms, that could be achieved if all population subgroups had the same level of health as a reference group.

Takes the value zero if there is no inequality / no further improvement can be achieved. Takes positive values for favourable health indicators and negative values for adverse health indicators. The larger the absolute value, the higher the level of inequality.

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **all inequality dimensions**
- ✓ Takes into account **all population subgroups**
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.14 Population attributable risk (PAR)

Definition

PAR shows the potential for improvement in setting (national) average that could be achieved if all population subgroups had the same level of health as a reference group.

PAR is an absolute measure of inequality that takes into account all population subgroups. It is calculated for all inequality dimensions, provided that all subgroup estimates and subgroup population shares are available.

Calculation

PAR is calculated as the difference between the estimate for the reference subgroup y_{ref} and the setting (national) average μ:

$$PAR = y_{ref} - \mu$$

Note that the reference subgroup y_{ref} depends on the characteristics of the inequality dimension and indicator type, for which PAR is calculated. Table 4 provides an overview of the calculation of PAR in HEAT.

Table 4 Calculation of the Population Attributable Risk (PAR) in HEAT

Dimension type	Reference subgroup selected?	**Indicator type**	
		Favourable indicator	**Adverse indicator**
Binary dimension			
Age	Yes (20–49 years)	20–49 years – μ	20–49 years – μ
	Yes (2-5 years)	2-5 years – μ	2-5 years – μ
Place of residence	Yes (Urban)	Urban – μ	Urban – μ
Sex	Yes* (Female)	Female – μ	Female – μ
Ordered dimension			
Economic status	N/A	Quintile 5 (richest) – μ	Quintile 5 (richest) – μ
		Decile 10 (richest) – μ	Decile 10 (richest) – μ
Education	N/A	Secondary school + – μ	Secondary school + – μ
Non-ordered dimension			
Subnational region	No	Highest / Lowest	Highest / Lowest

* Selections were made based on convenience of data interpretation. In the case of sex, the selection does not represent an assumed advantage of one sex over the other.

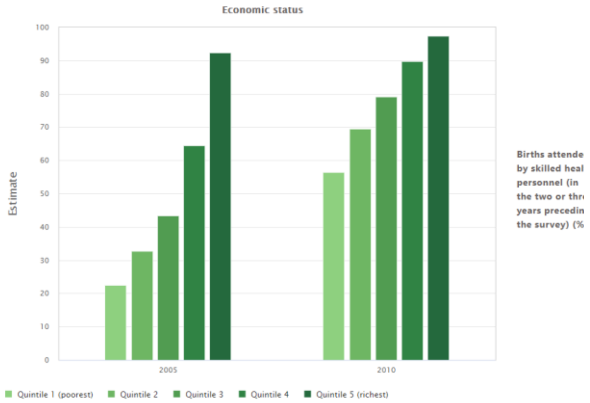
Interpretation

PAR takes positive values for favourable health indicators and negative values for adverse health indicators. The larger the absolute value of PAR, the higher the level of inequality. PAR is zero if no further improvement can be achieved, i.e. if all subgroups have reached the same level of health as the reference subgroup.

Example

Figure a shows data on skilled birth attendance disaggregated by economic status (by wealth quintile) for two years (2005 and 2010). For each year, there are five bars – one for each wealth quintile. The graph shows that, overall, coverage increased in all quintiles and inequality between quintiles reduced over time. PAR measures the potential improvement in setting (national) coverage of skilled birth attendance that could be achieved if all quintiles had the same level of coverage as quintile 5, i.e. if there was no economic-related inequality. Figure b shows that setting (national) average could have been 45.6 percentage points higher in 2005 and 21.4 percentage points higher in 2010 if there had been no economic-related inequality. PAR decreased between 2005 and 2010 indicating a decrease in absolute economic-related inequality.

Figure a. Births attended by skilled health personnel disaggregated by economic status (wealth quintiles)	Figure b. Economic-related inequality in births attended by skilled health personnel: population attributable risk (PAR)



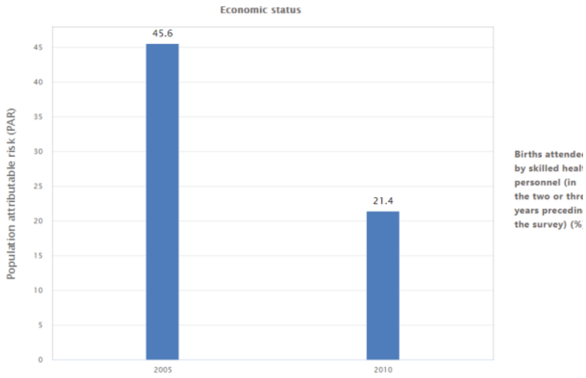
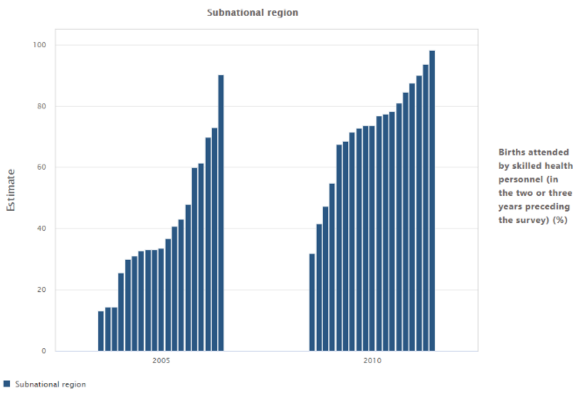
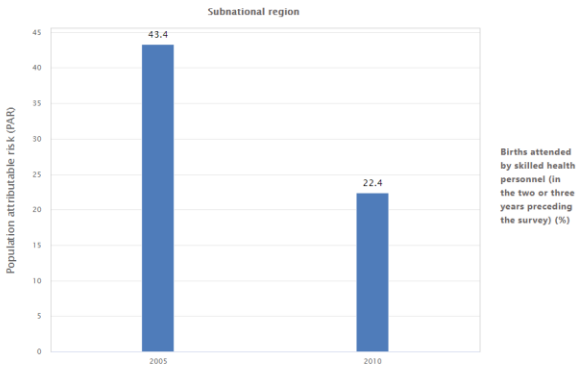


Figure c shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. PAR measures the potential improvement in setting (national) coverage of skilled birth attendance that could be achieved if all regions had the same level of coverage as the best performing region, i.e. if there was no subnational regional inequality. Figure d shows that setting (national) average could have been 43.4 percentage points higher in 2005 and 22.4 percentage points higher in 2010 if there had been no subnational regional inequality. PAR decreased between 2005 and 2010 indicating a decrease in absolute subnational regional inequality.

Figure c. Births attended by skilled health personnel disaggregated by subnational region	Figure d. Subnational regional inequality in births attended by skilled health personnel: population attributable risk (PAR)





POPULATION ATTRIBUTABLE RISK (PAR)

Shows the potential for improvement in setting (national) average that could be achieved if all population subgroups had the same level of health as a reference group.

Takes the value zero if there is no inequality / no further improvement can be achieved. Takes positive values for favourable health indicators and negative values for adverse health indicators. The larger the absolute value, the higher the level of inequality.

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **all inequality dimensions**
- ✓ Takes into account **all population subgroups**
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.15 Ratio (R)

Definition

R is a relative measure of inequality that shows the ratio of two population subgroups. It is calculated for all inequality dimensions, provided that subgroup estimates are available for the two subgroups used in the calculation of R.

Calculation

R is calculated as the ratio of two subgroups:

$$R = y_{high}/y_{low}$$

Note that the selection of y_{high} and y_{low} depends on the characteristics of the inequality dimension and the type of health indicator, for which R is calculated. Table 5 provides an overview of the calculation of R in HEAT.

Table 5 Calculation of the Ratio (R) in HEAT

Dimension type	Reference subgroup selected?	Indicator type: Favourable indicator	Indicator type: Adverse indicator
Binary dimension			
Age	Yes (20–49 years)	20–49 years / 15–19 years	15–19 years / 20–49 years
	Yes (2-5 years)	2-5 years / 0-1 years	0-1 years / 2-5 years
Place of residence	Yes (Urban)	Urban / Rural	Rural / Urban
Sex	Yes* (Female)	Female / Male	Male / Female
Ordered dimension			
Economic status	N/A	Quintile 5 (richest) / Quintile 1 (poorest)	Quintile 1 (poorest) / Quintile 5 (richest)
		Decile 10 (richest) / Decile 1 (poorest)	Decile 1 (poorest) / Decile 10 (richest)
Education	N/A	Secondary school + / No education	No education / Secondary school +
Non-ordered dimension			
Subnational region	No	Highest / Lowest	Highest / Lowest

* Selections were made based on convenience of data interpretation (that is, providing values larger than one for ratio calculations). In the case of sex, the selection does not represent an assumed advantage of one sex over the other.

R is calculated for all dimensions of inequality. In the case of binary and non-ordered dimensions, R is missing if at least one subgroup estimate is missing. In the case of ordered dimensions, R is missing if the estimates for the most-advantaged and/or most-disadvantaged subgroup are missing.

Interpretation

If there is no inequality, R takes the value one. R takes only positive values. The further the value of R from one, the higher the level of inequality. For favourable health indicators, values larger than one indicate a concentration of the indicator in the advantaged subgroup and values smaller than one indicate a concentration in the disadvantaged subgroup (except for subnational region, where R takes only values larger than one). For adverse health indicators, values larger than one indicate a concentration of the indicator in the disadvantaged subgroup and negative values indicate a concentration in the advantaged subgroup (except for subnational region, for which R takes only values smaller than one).

Note that R is displayed on a logarithmic scale. R values are intrinsically asymmetric: a ratio of one (no inequality) is halfway between a ratio of 0.5 (the denominator subgroup having half the value of the numerator subgroup) and a ratio of 2.0 (the denominator subgroup having double the value of the numerator subgroup). On a regular axis, R values would be concentrated at the lower end of the scale, with a few very large outlier values at the upper end of the scale. On a logarithmic axis, these values are equally spaced, making them easier to read and interpret.

Example

Figure a shows data on skilled birth attendance disaggregated by economic status (by wealth quintile) for two years (2005 and 2010). For each year, there are five bars – one for each wealth quintile. The graph shows that, overall, coverage increased in all quintiles and inequality between quintiles reduced over time. The ratio quantifies the level of inequality in each year. Figure b shows that the ratio of quintile 5 to quintile 1 reduced from 4.1 in 2005 to 1.7 in 2010. In 2005, coverage in quintile 5 was about four times higher than in quintile 1, while in 2010, coverage in quintile 5 was less than two times higher than in quintile 1. Relative economic-related inequality decreased between 2005 and 2010.

Figure a. Births attended by skilled health personnel disaggregated by economic status (wealth quintiles)

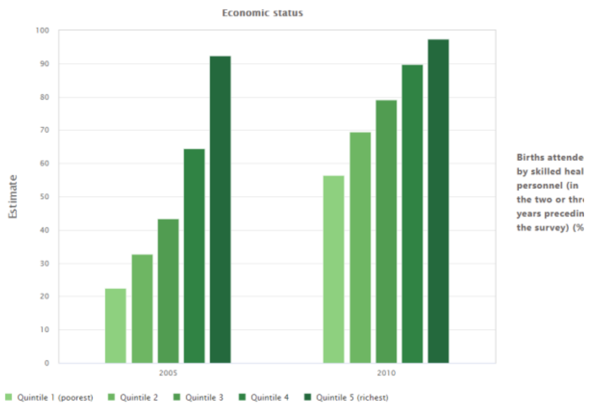


Figure b. Economic-related inequality in births attended by skilled health personnel: ratio (R)

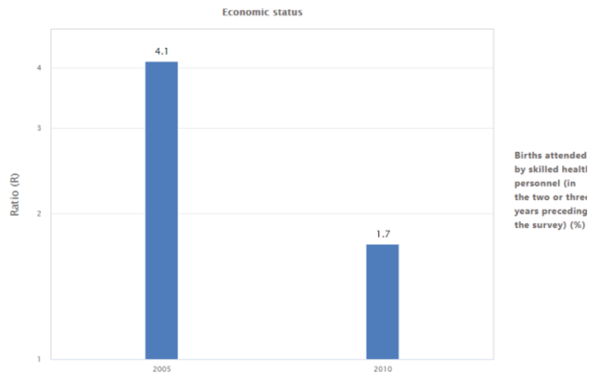


Figure c shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. The ratio quantifies the level of inequality in each year. Figure d shows that the ratio of the best to the worst performing region reduced from 6.9 in 2005 to 3.1 in 2010. In 2005, coverage in the best performing region was almost seven times higher than in the worst performing region, while in 2010, coverage in the best performing region was about three times higher than in the worst performing region. Relative economic-related inequality decreased between 2005 and 2010.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

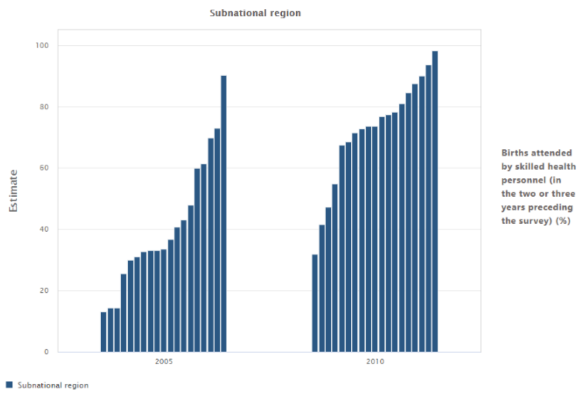
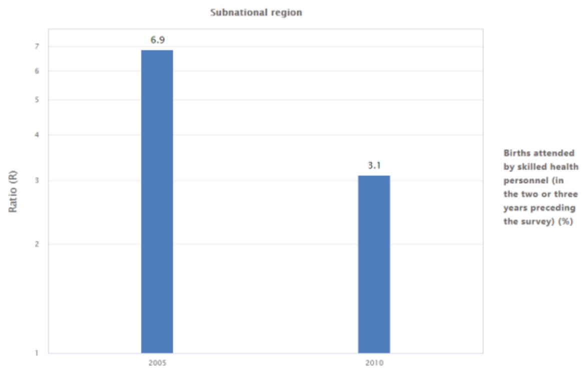


Figure b. Subnational inequality in births attended by skilled health personnel: ratio (R)



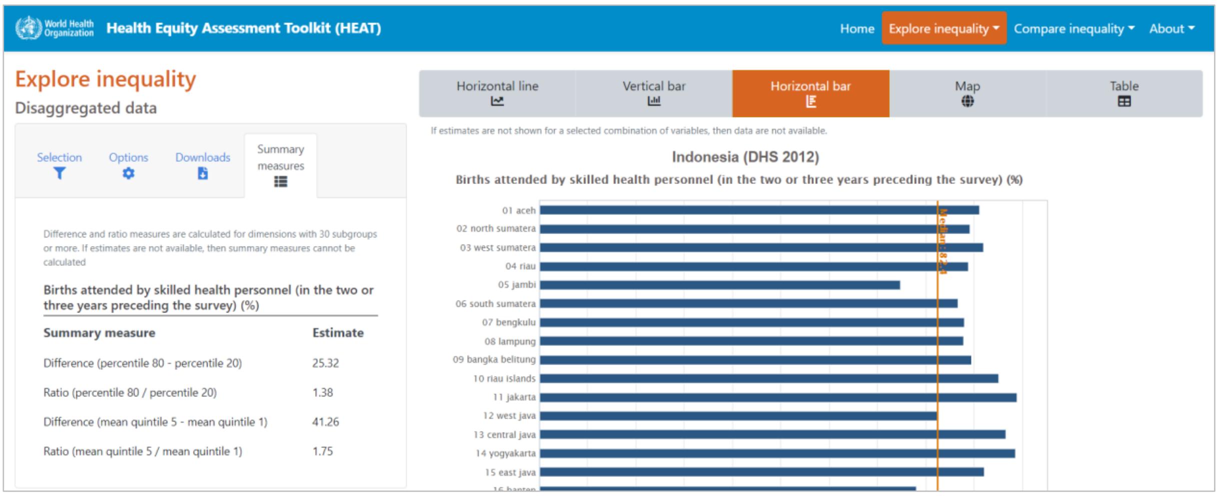
Other ratio measures

In addition to the ratio measure described above, variations of the ratio are calculated for non-ordered inequality dimensions with many subgroups, such as subnational region. The following ratio measures are calculated for countries with more than 30 subnational regions:

- **Ratio of percentile 80 to percentile 20.** The ratio of percentile 80 to percentile 20 is calculated by identifying the subgroups that correspond to percentiles 20 and 80 and dividing the estimate for percentile 80 by the estimate for percentile 20: $R_{p80p20} = y_{p80}/y_{p20}$

- **Ratio of mean estimates in quintile 5 to quintile.** The ratio of mean estimates in quintile 5 to quintile 1 is calculated by dividing subgroups into quintiles, determining the mean estimate for each quintile and dividing the mean estimate in quintile 5 by the mean estimate in quintile 1: $R_{q5q1} = y_{q5}/y_{q1}$

These measures may be a more accurate reflection of the level of geographic inequality than measuring the ratio of the maximum and minimum values using the (range) ratio, as they avoid using possible outlier values. They are displayed in the 'Summary measures' tab of the selection menu for horizontal bar graphs showing disaggregated data under the 'Explore inequality' component of the tool.



RATIO (R)

Measures the ratio of two population subgroups.

Takes the value one if there is no inequality. Takes only positive values (larger or smaller than one). The further the value from one, the higher the level of inequality. For favourable health indicators, values larger than one indicate a concentration among the advantaged and values smaller than one among the disadvantaged subgroup. For adverse health indicators, it's the other way around: positive values indicate a concentration among the disadvantaged and negative values among the advantaged subgroup.

Variations of the ratio are calculated for non-ordered inequality dimensions with many subgroups, including the ratio of percentiles 80 and 20 and the ratio of mean estimates in quintiles 5 and 1. These measures avoid using possible outlier values.

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **all inequality dimensions**
- ✓ Takes into account **two population subgroups** (simple measure)
- ✓ Does not take into account the **population size** of subgroups (unweighted measure)

3.16 Relative concentration index (RCI)

Definition

RCI shows the health gradient across population subgroups, on a relative scale. It indicates the extent to which a health indicator is concentrated among disadvantaged or advantaged subgroups.

RCI is a relative measure of inequality that takes into account all population subgroups. It is calculated for ordered dimensions with more than two subgroups, such as economic status. Subgroups are weighted according to their population share. RCI is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

RCI is calculated by dividing the absolute concentration index (ACI) by the setting (national) average μ and multiplying the fraction by 100:

$$RCI = \frac{ACI}{\mu} * 100$$

Interpretation

RCI is bounded between -100 and +100 and takes the value zero if there is no inequality. Positive values indicate a concentration of the indicator among the advantaged, while negative values indicate a concentration of the indicator among the disadvantaged. The greater the absolute value of RCI, the higher the level of inequality.

Example

Figure a shows data on skilled birth attendance disaggregated by economic status (by wealth quintile) for two years (2005 and 2010). For each year, there are five bars – one for each wealth quintile. The graph shows that, overall, coverage increased in all quintiles and inequality between quintiles reduced over time. RCI quantifies the level of inequality in each year. Figure b shows that relative economic-related inequality, as measured by the RCI, reduced from 28.2 in 2005 to 11.1 in 2010.

Figure a. Births attended by skilled health personnel disaggregated by economic status (wealth quintiles)

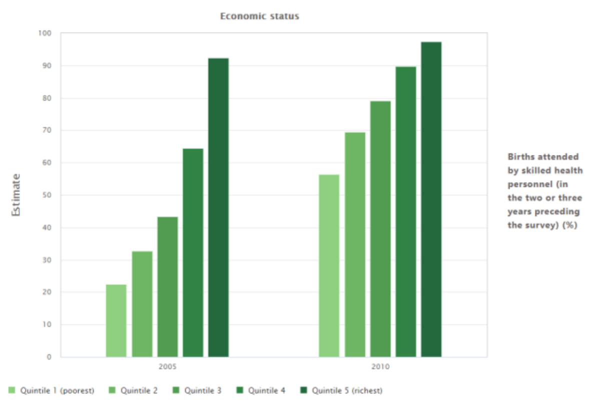
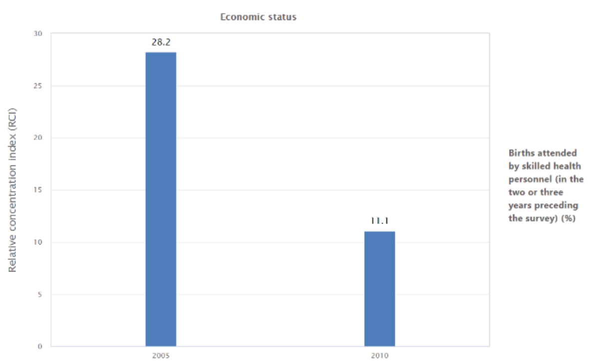


Figure b. Economic-related inequality in births attended by skilled health personnel: relative concentration index (RCI)



RELATIVE CONCENTRATION INDEX (RCI)

Measures the extent to which a health indicator is concentrated among disadvantaged or advantaged population subgroups, in relative terms.

Takes the value zero if there is no inequality. Takes values between -100 and +100. Positive values indicate a concentration among advantaged, negative values among disadvantaged subgroups. The larger the absolute value, the higher the level of inequality.

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **ordered inequality dimensions**, such as economic status (ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.17 Relative index of inequality (RII)

Definition

RII represents the ratio of estimated values of a health indicator of the most-advantaged to the most-disadvantaged (or vice versa for adverse health indicators), while taking into account all the other subgroups – using an appropriate regression model.

RII is a relative measure of inequality that takes into account all population subgroups. It is calculated for ordered dimensions with more than two subgroups, such as economic status. Subgroups are weighted according to their population share. RII is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

To calculate RII, 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. According to the definition currently used in HEAT, the health indicator of interest is then regressed against this midpoint value using a generalized linear model with logit link, and the predicted values of the health indicator are calculated for the two extremes (rank 1 and rank 0).

For **favourable health indicators**, the ratio of the estimated values at rank 1 (v_1) to rank 0 (v_0) (covering the entire distribution) generates the RII value:

$$RII = v_1/v_0$$

For **adverse health indicators**, the calculation is reversed and the RII value is calculated as the ratio of the estimated values at rank 0 (v_0) to rank 1 (v_1) (covering the entire distribution):

$$RII = v_0/v_1$$

Interpretation

If there is no inequality, RII takes the value one. RII takes only positive values. The further the value of RII from one, the higher the level of inequality. For favourable health indicators, values larger than one indicate a concentration of the indicator among the advantaged and values smaller than one indicate a concentration of the indicator among the disadvantaged. For adverse health indicators, values larger than one indicate a concentration of the indicator among the disadvantaged and values smaller than one indicate a concentration of the indicator among the advantaged.

Note that RII is displayed on a logarithmic scale. RII values are intrinsically asymmetric: a ratio of one (no inequality) is halfway between a ratio of 0.5 (the denominator subgroup having half the value of the numerator subgroup) and a ratio of 2.0 (the denominator subgroup having double the value of the numerator subgroup). On a regular axis, RII values would be concentrated at the lower end of the scale, with a few very large outlier values at the upper end of the scale. On a logarithmic axis, these values are equally spaced, making them easier to read and interpret.

Example

Figure a shows data on skilled birth attendance disaggregated by economic status (by wealth quintile) for two years (2005 and 2010). For each year, there are five bars – one for each wealth quintile. The graph shows that, overall, coverage increased in all quintiles and inequality between quintiles reduced over time. RII quantifies the level of inequality in each year. Figure b shows that relative economic-related inequality, as measured by the RII, reduced from 7.7 in 2005 to 2.2 in 2010. In 2005, coverage in quintile 5 was nearly 8 times higher than in quintile 1, but this reduced to coverage in quintile 5 being just over twice as high than in quintile 1 in 2010.

Figure a. Births attended by skilled health personnel disaggregated by economic status (wealth quintiles)

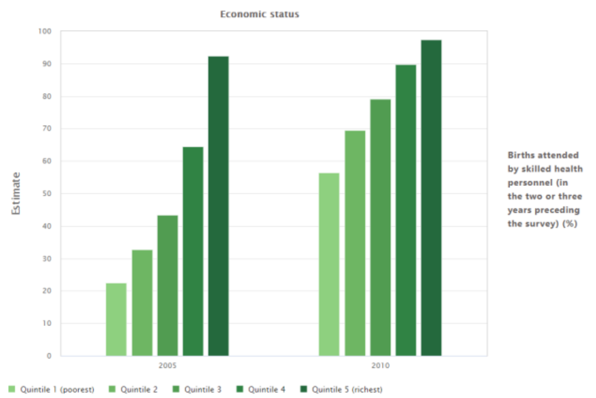
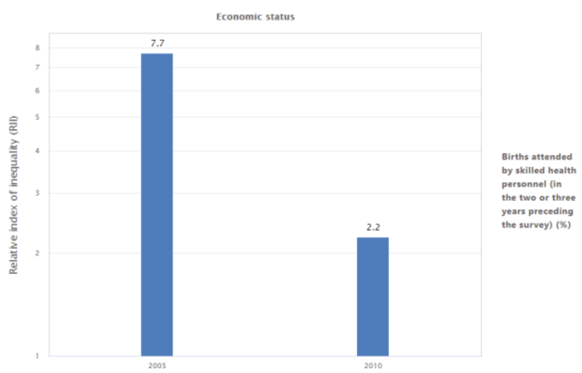


Figure b. Economic-related inequality in births attended by skilled health personnel: relative index of inequality (RII)



RELATIVE INDEX OF INEQUALITY (RII)

Represents the ratio of estimated values of a health indicator of the most-advantaged to the most-disadvantaged (or vice versa for adverse health indicators), while taking into account all other subgroups.

Takes the value one if there is no inequality. Takes only positive values (larger or smaller than one). The further the value from one, the higher the level of inequality. For favourable health indicators, values larger than one indicate a concentration among the advantaged and values smaller than one among the disadvantaged. For adverse health indicators, it's the other way around: positive values indicate a concentration among the disadvantaged and negative values among the advantaged.

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **ordered inequality dimensions**, such as economic status (ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.18 Slope index of inequality (SII)

Definition

SII represents the difference in estimated values of a health indicator between the most-advantaged and most-disadvantaged (or vice versa for adverse health indicators), while taking into consideration all the other subgroups – using an appropriate regression model.

SII is an absolute measure of inequality that takes into account all population subgroups. It is calculated for ordered dimensions with more than two subgroups, such as economic status. Subgroups are weighted according to their population share. SII is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

To calculate SII, 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. According to the definition currently used in HEAT, the health indicator of interest is then regressed against this midpoint value using a generalized linear model with logit link, and the predicted values of the health indicator are calculated for the two extremes (rank 1 and rank 0).

For **favourable health indicators**, the difference between the estimated values at rank 1 (v_1) and rank 0 (v_0) (covering the entire distribution) generates the SII value:

$$SII = v_1 - v_0$$

For **adverse health indicators**, the calculation is reversed and the SII value is calculated as the difference between the estimated values at rank 0 (v_0) and rank 1 (v_1) (covering the entire distribution):

$$SII = v_0 - v_1$$

Interpretation

If there is no inequality, SII takes the value zero. Greater absolute values indicate higher levels of inequality. For favourable health indicators, positive values indicate a concentration of the indicator among the advantaged and negative values indicate a concentration of the indicator among the disadvantaged. For adverse health indicators, positive values indicate a concentration of the indicator among the disadvantaged and negative values indicate a concentration of the indicator among the advantaged.

Example

Figure a shows data on skilled birth attendance disaggregated by economic status (by wealth quintile) for two years (2005 and 2010). For each year, there are five bars – one for each wealth quintile. The graph shows that, overall, coverage increased in all quintiles and inequality between quintiles reduced over time. SII quantifies the level of inequality in each year. Figure b shows that absolute economic-related inequality, as measured by the SII, reduced from 74.3 percentage points in 2005 to 52.6 percentage points in 2010.

Figure a. Births attended by skilled health personnel disaggregated by economic status (wealth quintiles)

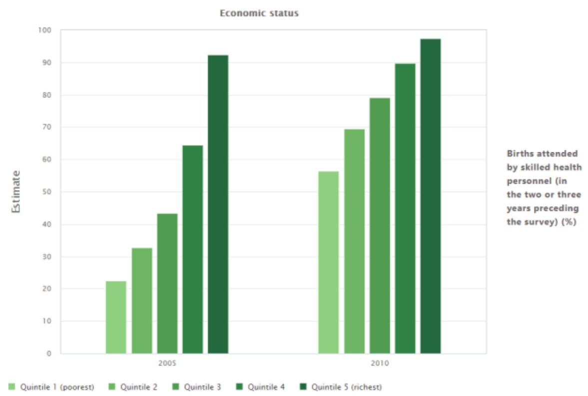
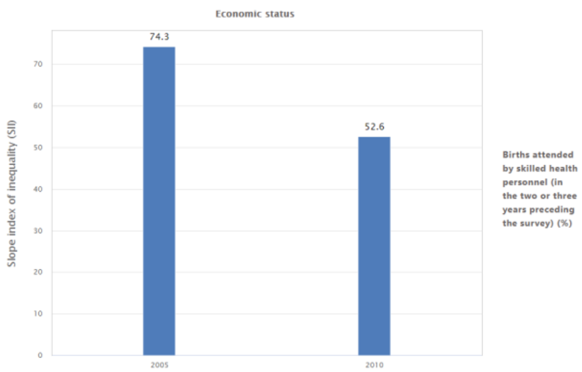


Figure b. Economic-related inequality in births attended by skilled health personnel: slope index of inequality (SII)



SLOPE INDEX OF INEQUALITY (SII)

Represents the difference in estimated values of a health indicator between the most-advantaged and the most-disadvantaged (or vice versa for adverse health indicators), while taking into account all other subgroups.

Takes the value zero if there is no inequality. For favourable health indicators, positive values indicate a concentration among the advantaged and negative values among the disadvantaged. For adverse health indicators, it's the other way around: positive values indicate a concentration among the disadvantaged and negative values among the advantaged. The larger the absolute value, the higher the level of inequality.

- ✓ Measures **absolute inequality** (absolute measure)
- ✓ Suitable for **ordered inequality dimensions**, such as economic status (ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

3.19 Theil index (TI)

Definition

TI is a relative measure of inequality that takes into account all population subgroups. It is calculated for non-ordered dimensions with more than two subgroups, such as subnational region. Subgroups are weighted according to their population share. TI is missing if at least one subgroup estimate or subgroup population share is missing.

Calculation

TI is calculated as the sum of products of the natural logarithm of the share of health of each subgroup ($\ln\frac{y_j}{\mu}$), the share of health of each subgroup ($\frac{y_j}{\mu}$) and the population share of each subgroup (p_j). TI may be more easily interpreted when multiplied by 1000:

$$TI = \sum_j p_j \frac{y_j}{\mu} \ln\frac{y_j}{\mu} * 1000$$

where y_j indicates the estimate for subgroup j, p_j the population share of subgroup j and μ the setting (national) average.

Interpretation

If there is no inequality, TI takes the value zero. Greater absolute values indicate higher levels of inequality. TI is more sensitive to health differences further from the setting (national) average (by the use of the logarithm).

Example

Figure a shows data on skilled birth attendance disaggregated by subnational region for two years (2005 and 2010). For each year, there are multiple bars – one for each region. The graph shows that, overall, coverage increased in all regions and inequality between regions reduced over time. TI quantifies the level of inequality in each year. Figure b shows that relative subnational regional inequality, as measured by the TI, reduced from 94.6 in 2005 to 20.5 in 2010. In 2010, the level of inequality was one fifth of the level in 2005.

Figure a. Births attended by skilled health personnel disaggregated by subnational region

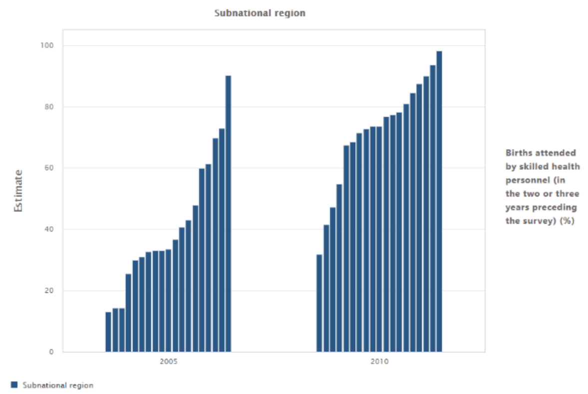
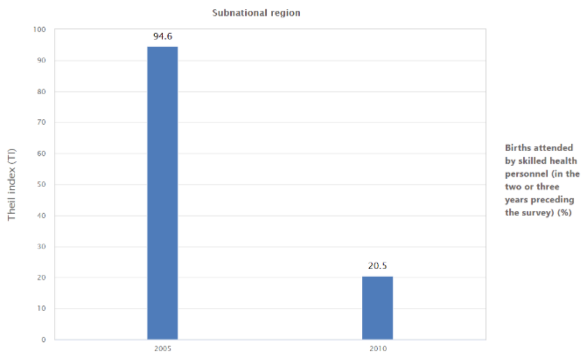


Figure b. Subnational inequality in births attended by skilled health personnel: theil index (TI)



THEIL INDEX (TI)

Measures the sum of products of the natural logarithm of the share of health of each subgroup, the share of health of each subgroup and the population share of each subgroup

Takes the value zero if there is no inequality. The larger the absolute value, the higher the level of inequality.

- ✓ Measures **relative inequality** (relative measure)
- ✓ Suitable for **non-ordered inequality dimensions**, such as subnational region (non-ordered measure)
- ✓ Takes into account **all population subgroups** (complex measure)
- ✓ Takes into account the **population size** of subgroups (weighted measure)

Annex

Annex 1 Study countries, data sources and map availability

Country	ISO3 country code	Data source(s) and year(s)	WHO region	Country income group*	Notes on map availability (DHS surveys only)
Afghanistan	AFG	MICS 2010, DHS 2015	Eastern Mediterranean	Low income	
Albania	ALB	MICS 2000, RHS 2002, MICS 2005, DHS 2008, DHS 2017	European	Upper middle income	
Algeria	DZA	MICS 2000, MICS 2006, MICS 2012	African	Upper middle income	
Angola	AGO	MICS 1996, DHS 2015	African	Lower middle income	
Argentina	ARG	MICS 2011	Americas	Upper middle income	
Armenia	ARM	DHS 2000, DHS 2005, DHS 2010, DHS 2015	European	Upper middle income	
Azerbaijan	AZE	MICS 2000, DHS 2006	European	Upper middle income	
Bangladesh	BGD	DHS 1993, DHS 1996, DHS 1999, DHS 2004, MICS 2006, DHS 2007, DHS 2011, MICS 2012, DHS 2014	South-East Asia	Lower middle income	
Barbados	BRB	MICS 2012	Americas	High income	
Belarus	BLR	MICS 2005, MICS 2012	European	Upper middle income	
Belize	BLZ	RHS 1991, MICS 2006, MICS 2011, MICS 2015	Americas	Upper middle income	
Benin	BEN	DHS 1996, DHS 2001, DHS 2006, DHS 2011, MICS 2014, DHS 2017	African	Low income	
Bhutan	BTN	MICS 2010	South-East Asia	Lower middle income	
Bolivia (Plurinational State of)	BOL	DHS 1994, DHS 1998, DHS 2003, DHS 2008	Americas	Lower middle income	DHS 1998 and 2003: Several regions cannot be displayed in maps due to regions being combined in DHS shapefiles
Bosnia and Herzegovina	BIH	MICS 2000, MICS 2006, MICS 2011	European	Upper middle income	
Botswana	BWA	MICS 2000	African	Upper middle income	
Brazil	BRA	DHS 1996	Americas	Upper middle income	
Burkina Faso	BFA	DHS 1992, DHS 1998, DHS 2003, MICS 2006, DHS 2010	African	Low income	
Burundi	BDI	MICS 2000, MICS 2005, DHS 2010, DHS 2016	African	Low income	
Cabo Verde	CPV	RHS 1998	African	Lower middle income	
Cambodia	KHM	DHS 2000, DHS 2005, DHS 2010, DHS 2014	Western Pacific	Lower middle income	DHS 2000: Several regions cannot be displayed in maps due to regions being combined in DHS shapefiles
Cameroon	CMR	DHS 1991, DHS 1998, DHS 2004, MICS 2006, DHS 2011, MICS 2014, DHS 2018	African	Lower middle income	
Central African Republic	CAF	DHS 1994, MICS 2000, MICS 2006, MICS 2010	African	Low income	
Chad	TCD	DHS 1996, MICS 2000, DHS 2004, MICS 2010, DHS 2014	African	Low income	DHS 1996: No DHS subnational shapefile available. DHS 2014: Data not displayed in map due to subnational regions not matching DHS shapefiles.
Colombia	COL	DHS 1995, DHS 2000, DHS 2005, DHS 2010, DHS 2015	Americas	Upper middle income	
Comoros	COM	DHS 1996, MICS 2000, DHS 2012	African	Lower middle income	Maps not available
Congo	COG	DHS 2005, DHS 2011, MICS 2014	African	Lower middle income	
Costa Rica	CRI	RHS 1992, MICS 2011	Americas	Upper middle income	
Cuba	CUB	MICS 2006, MICS 2010, MICS 2014	Americas	Upper middle income	
Côte d'Ivoire	CIV	DHS 1994, DHS 1998, MICS 2006, DHS 2011, MICS 2016	African	Lower middle income	DHS 1994 and DHS 1998: No DHS subnational shapefile available.
Democratic Republic of the Congo	COD	MICS 2001, DHS 2007, MICS 2010, DHS 2013	African	Low income	
Djibouti	DJI	MICS 2006	Eastern Mediterranean	Lower middle income	
Dominican Republic	DOM	DHS 1991, DHS 1996, DHS 1999, MICS 2000, DHS 2002, DHS 2007, DHS 2013, MICS 2014	Americas	Upper middle income	DHS 2007: No DHS shapefile
Ecuador	ECU	RHS 1994, RHS 1999, RHS 2004	Americas	Upper middle income	

Country	ISO3 country code	Data source(s) and year(s)	WHO region	Country income group*	Notes on map availability (DHS surveys only)
Egypt	EGY	DHS 1992, DHS 1995, DHS 2000, DHS 2005, DHS 2008, DHS 2014	Eastern Mediterranean	Lower middle income	Data not displayed in maps due to subnational regions not matching DHS shapefiles
El Salvador	SLV	RHS 1993, RHS 1998, RHS 2002, RHS 2008, MICS 2014	Americas	Lower middle income	
Equatorial Guinea	GNQ	MICS 2000	African	Upper middle income	
Eritrea	ERI	DHS 2002	African	Low income	
Eswatini	SWZ	MICS 2000, DHS 2006, MICS 2010, MICS 2014	African	Lower middle income	
Ethiopia	ETH	DHS 2000, DHS 2005, DHS 2011, DHS 2016	African	Low income	
Gabon	GAB	DHS 2000, DHS 2012	African	Upper middle income	
Gambia	GMB	MICS 2000, MICS 2005, MICS 2010, DHS 2013	African	Low income	Maps not available
Georgia	GEO	MICS 2005	European	Upper middle income	
Ghana	GHA	DHS 1993, DHS 1998, DHS 2003, MICS 2006, DHS 2008, MICS 2011, DHS 2014, MICS 2017	African	Lower middle income	
Guatemala	GTM	DHS 1995, DHS 1998, RHS 2002, RHS 2008, DHS 2014	Americas	Upper middle income	
Guinea	GIN	DHS 1999, DHS 2005, DHS 2012, MICS 2016, DHS 2018	African	Low income	
Guinea-Bissau	GNB	MICS 2000, MICS 2006, MICS 2010, MICS 2014	African	Low income	
Guyana	GUY	MICS 2000, MICS 2006, DHS 2009, MICS 2014	Americas	Upper middle income	
Haiti	HTI	DHS 1994, DHS 2000, DHS 2005, DHS 2012, DHS 2016	Americas	Low income	Maps not available
Honduras	HND	RHS 1991, RHS 1996, RHS 2001, DHS 2005, DHS 2011	Americas	Lower middle income	
India	IND	DHS 1992, DHS 1998, DHS 2005, DHS 2015	South-East Asia	Lower middle income	Maps not available
Indonesia	IDN	DHS 1994, DHS 1997, DHS 2002, DHS 2007, DHS 2012, DHS 2017	South-East Asia	Lower middle income	
Iraq	IRQ	MICS 2000, MICS 2006, MICS 2011, MICS 2018	Eastern Mediterranean	Upper middle income	
Jamaica	JAM	MICS 2005, MICS 2011	Americas	Upper middle income	
Jordan	JOR	DHS 1997, DHS 2002, DHS 2007, DHS 2012, DHS 2017	Eastern Mediterranean	Upper middle income	
Kazakhstan	KAZ	DHS 1995, DHS 1999, MICS 2006, MICS 2010, MICS 2015	European	Upper middle income	DHS 1995: No DHS subnational shapefile available.
Kenya	KEN	DHS 1993, DHS 1998, MICS 2000, DHS 2003, DHS 2008, DHS 2014	African	Lower middle income	
Kyrgyzstan	KGZ	DHS 1997, MICS 2005, DHS 2012, MICS 2014, MICS 2018	European	Lower middle income	
Lao People's Democratic Republic	LAO	MICS 2000, MICS 2006, MICS 2011, MICS 2017	Western Pacific	Lower middle income	
Lesotho	LSO	MICS 2000, DHS 2004, DHS 2009, DHS 2014, MICS 2018	African	Lower middle income	
Liberia	LBR	DHS 2007, DHS 2013	African	Low income	
Madagascar	MDG	DHS 1992, DHS 1997, DHS 2003, DHS 2008, MICS 2018	African	Low income	
Malawi	MWI	DHS 1992, DHS 2000, DHS 2004, MICS 2006, DHS 2010, MICS 2013, DHS 2015	African	Low income	
Maldives	MDV	DHS 2009, DHS 2016	South-East Asia	Upper middle income	Maps not available
Mali	MLI	DHS 1995, DHS 2001, DHS 2006, MICS 2009, DHS 2012, MICS 2015, DHS 2018	African	Low income	DHS 1995 and DHS 2001: Several regions cannot be displayed in maps due to regions being combined in DHS shapefiles.
Mauritania	MRT	DHS 2000, MICS 2007, MICS 2011, MICS 2015	African	Lower middle income	
Mexico	MEX	MICS 2015	Americas	Upper middle income	
Mongolia	MNG	MICS 2000, MICS 2005, MICS 2010, MICS 2013, MICS 2018	Western Pacific	Lower middle income	
Montenegro	MNE	MICS 2005, MICS 2013	European	Upper middle income	
Morocco	MAR	DHS 1992, DHS 2003	Eastern Mediterranean	Lower middle income	
Mozambique	MOZ	DHS 1997, DHS 2003, MICS 2008, DHS 2011, DHS 2015	African	Low income	
Myanmar	MMR	MICS 2000, DHS 2015	South-East Asia	Lower middle income	
Namibia	NAM	DHS 1992, DHS 2000, DHS 2006, DHS 2013	African	Upper middle income	DHS 1992: Several regions cannot be displayed in maps due to regions being combined in DHS shapefiles.

Country	ISO3 country code	Data source(s) and year(s)	WHO region	Country income group*	Notes on map availability (DHS surveys only)
Nepal	NPL	DHS 1996, DHS 2001, DHS 2006, MICS 2010, DHS 2011, MICS 2014, DHS 2016	South-East Asia	Low income	
Nicaragua	NIC	RHS 1992, DHS 1997, DHS 2001, RHS 2006	Americas	Lower middle income	
Niger	NER	DHS 1992, DHS 1998, MICS 2000, DHS 2006, DHS 2012	African	Low income	DHS 1992: Several regions cannot be displayed in maps due to regions being combined in DHS shapefiles.
Nigeria	NGA	DHS 1999, DHS 2003, MICS 2007, DHS 2008, MICS 2011, DHS 2013, MICS 2016, DHS 2018	African	Lower middle income	
North Macedonia	MKD	MICS 2005, MICS 2011	European	Upper middle income	
Pakistan	PAK	DHS 2006, DHS 2012, DHS 2017	Eastern Mediterranean	Lower middle income	Maps not available
Panama	PAN	MICS 2013	Americas	High income	
Paraguay	PRY	RHS 1995, RHS 1998, RHS 2004, RHS 2008, MICS 2016	Americas	Upper middle income	
Peru	PER	DHS 1991, DHS 1996, DHS 2000, DHS 2004, DHS 2005, DHS 2006,DHS 2007, DHS 2008, DHS 2009, DHS 2010, DHS 2011, DHS 2012, DHS 2013, DHS 2014, DHS 2015, DHS 2016, DHS 2017, DHS 2018	Americas	Upper middle income	DHS 2012 shapefile has been used to display 2013-2018 survey data.
Philippines	PHL	DHS 1993, DHS 1998, DHS 2003, DHS 2008, DHS 2013, DHS 2017	Western Pacific	Lower middle income	
Qatar	QAT	MICS 2012	Eastern Mediterranean	High income	
Republic of Moldova	MDA	RHS 1997, DHS 2005, MICS 2012	European	Lower middle income	
Rwanda	RWA	DHS 1992, DHS 2000, DHS 2005, DHS 2010, DHS 2014	African	Low income	
Saint Lucia	LCA	MICS 2012	Americas	Upper middle income	
Sao Tome and Principe	STP	MICS 2000, DHS 2008, MICS 2014	African	Lower middle income	Maps not available
Senegal	SEN	DHS 1992, DHS 1997, MICS 2000, DHS 2005, DHS 2010, DHS 2012, DHS 2014, DHS 2015, DHS 2016, DHS 2017	African	Lower middle income	DHS 2015 and DHS 2016: Data not displayed in map due to subnational regions not matching DHS shapefiles.
Serbia	SRB	MICS 2005, MICS 2010, MICS 2014	European	Upper middle income	
Sierra Leone	SLE	MICS 2000, MICS 2005, DHS 2008, MICS 2010, DHS 2013, MICS 2017	African	Low income	
Somalia	SOM	MICS 2006	Eastern Mediterranean	Low income	
South Africa	ZAF	DHS 1998, DHS 2003, DHS 2016	African	Upper middle income	
South Sudan	SSD	MICS 2010	African	Low income	
Sudan	SDN	MICS 2010, MICS 2014	Eastern Mediterranean	Lower middle income	
Suriname	SUR	MICS 1999, MICS 2006, MICS 2010, MICS 2018	Americas	Upper middle income	
Syrian Arab Republic	SYR	MICS 2006	Eastern Mediterranean	Low income	
Tajikistan	TJK	MICS 2005, DHS 2012, DHS 2017	European	Low income	
Thailand	THA	MICS 2005, MICS 2012, MICS 2015	South-East Asia	Upper middle income	
Timor-Leste	TLS	DHS 2009, DHS 2016	South-East Asia	Lower middle income	
Togo	TGO	DHS 1998, MICS 2006, MICS 2010, DHS 2013, MICS 2017	African	Low income	
Trinidad and Tobago	TTO	MICS 2000, MICS 2006, MICS 2011	Americas	High income	
Tunisia	TUN	MICS 2011, MICS 2018	Eastern Mediterranean	Lower middle income	
Turkey	TUR	DHS 1993, DHS 1998, DHS 2003, DHS 2008, DHS 2013	European	Upper middle income	DHS 2008 and DHS 2013: No DHS subnational shapefiles available.
Turkmenistan	TKM	MICS 2006, MICS 2015	European	Upper middle income	
Uganda	UGA	DHS 1995, DHS 2000, DHS 2006, DHS 2011, DHS 2016	African	Low income	
Ukraine	UKR	RHS 1999, MICS 2000, MICS 2005, DHS 2007, MICS 2012	European	Lower middle income	
United Republic of Tanzania	TZA	DHS 1991, DHS 1996, DHS 1999, DHS 2004, DHS 2010, DHS 2015	African	Low income	DHS 1999: No DHS subnational shapefile available.
Uruguay	URY	MICS 2012	Americas	High income	
Uzbekistan	UZB	DHS 1996, MICS 2006	European	Lower middle income	
Vanuatu	VUT	MICS 2007	Western Pacific	Lower middle income	
Viet Nam	VNM	DHS 1997, MICS 2000, DHS 2002, MICS 2006, MICS 2010, MICS 2013	Western Pacific	Lower middle income	

Country	ISO3 country code	Data source(s) and year(s)	WHO region	Country income group*	Notes on map availability (DHS surveys only)
Yemen	YEM	DHS 1991, DHS 1997, MICS 2006, DHS 2013	Eastern Mediterranean	Low income	Maps not available
Zambia	ZMB	DHS 1992, DHS 1996, MICS 1999, DHS 2001, DHS 2007, DHS 2013, DHS 2018	African	Lower middle income	
Zimbabwe	ZWE	DHS 1994, DHS 1999, DHS 2005, MICS 2009, DHS 2010, MICS 2014, DHS 2015, MICS 2019	African	Lower middle income	

DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey; RHS = Reproductive Health Survey.

* Country income group was determined using the current World Bank classification released in July 2020, which is based on the 2018 gross national income per capita, calculated using the Atlas method (available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups, accessed 02 July 2020).

Annex 2 Summary measures: overview

Summary measure (abbreviation)	Formula	Absolute/ Relative	Simple/ Complex	Weighted/ Unweighted	Ordered/ Non-ordered	Unit	Value of no inequality	Interpretation
Absolute concentration index (ACI)	$ACI = \sum_j p_j(2X_j - 1)y_j$	Absolute	Complex	Weighted	Ordered	Unit of indicator	Zero	Positive (negative) values indicate a concentration of the indicator among the advantaged (disadvantaged). The larger the absolute value of ACI, the higher the level of inequality.
Between-group standard deviation (BGSD)	$BGSD = \sqrt{\sum_j p_j(y_j - \mu)^2}$	Absolute	Complex	Weighted	Non-ordered	Unit of indicator	Zero	BGSD takes only positive values with larger values indicating higher levels of inequality.
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 with larger values indicating higher levels of inequality.
Coefficient of variation (COV)	$COV = \frac{BGSD}{\mu} * 100$	Relative	Complex	Weighted	Non-ordered	Unit of indicator	Zero	COV takes only positive values with larger values indicating higher levels of inequality.
Difference (D)	$D = y_{high} - y_{low}$	Absolute	Simple	Unweighted	Ordered/ Non-ordered	Unit of indicator	Zero	The larger the absolute value of D, the higher the level of inequality.
Index of disparity (unweighted) (IDIS)	$IDIS = \frac{\frac{1}{n} * \sum_j \lvert y_j - \mu \rvert}{\mu} * 100$	Relative	Complex	Unweighted	Non-ordered	No unit	Zero	IDIS takes only positive values with larger values indicating higher levels of inequality.
Index of disparity (weighted) (IDISW)	$IDISW = \frac{\sum_j p_j \lvert y_j - \mu \rvert}{\mu} * 100$	Relative	Complex	Weighted	Non-ordered	No unit	Zero	IDISW takes only positive values with larger values indicating higher levels of inequality.
Mean difference from best performing subgroup (unweighted) (MDBU)	$MDBU = \frac{1}{n} * \sum_j \lvert y_j - y_{ref} \rvert$	Absolute	Complex	Unweighted	Non-ordered	Unit of indicator	Zero	MDBU takes only positive values with larger values indicating higher levels of inequality.
Mean difference from best performing subgroup (weighted) (MDBW)	$MDBW = \sum_j p_j \lvert y_j - y_{ref} \rvert$	Absolute	Complex	Weighted	Non-ordered	Unit of indicator	Zero	MDBW takes only positive values with larger values indicating higher levels of inequality.
Mean difference from mean (unweighted) (MDMU)	$MDMU = \frac{1}{n} * \sum_j \lvert y_j - \mu \rvert$	Absolute	Complex	Unweighted	Non-ordered	Unit of indicator	Zero	MDMU takes only positive values with larger values indicating higher levels of inequality.
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 with larger values indicating higher levels of inequality.
Mean log deviation (MLD)	$\mathrm{MLD} = \sum_j p_j(-\ln\left(\frac{y_j}{\mu}\right)) * 1000$	Relative	Complex	Weighted	Non-ordered	No unit	Zero	The larger the absolute value of MLD, the higher the level of inequality.
Population attributable fraction (PAF)	$PAF = \frac{PAR}{\mu} * 100$	Relative	Complex	Weighted	Ordered/ Non-ordered	No unit	Zero	PAF takes only positive values for favourable indicators and only negative values for adverse indicators. The larger the absolute value of PAF, the larger the level of inequality.
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. The larger the absolute value, the higher the level of inequality.
Slope index of inequality (SII)	$SII = v_1 - v_0$ for favourable indicators; $SII = v_0 - v_1$for adverse indicators	Absolute	Complex	Weighted	Ordered	Unit of indicator	Zero	For favourable (adverse) indicators, positive values indicate a concentration among the advantaged (disadvantaged) and negative values indicate a concentration among the disadvantaged (advantaged). The larger the absolute value of SII, the higher the level of inequality.
Ratio (R)	$R = y_{high}/y_{low}$	Relative	Simple	Unweighted	Ordered/ Non-ordered	No unit	One	R takes only positive values. The further the value of R from 1, the higher the level of inequality.
Relative concentration index (RCI)	$RCI = \frac{ACI}{\mu} * 100$	Relative	Complex	Weighted	Ordered	No unit	Zero	RCI is bounded between -100 and +100. Positive (negative) values indicate a concentration of the indicator among the advantaged (disadvantaged). The larger the absolute value of RCI, the higher the level of inequality.
Relative index of inequality (RII)	$RII = v_1/v_0$ for favourable indicators; $RII = v_0/v_1$ for adverse indicators	Relative	Complex	Weighted	Ordered	No unit	One	RII takes only positive values. For favourable (adverse) indicators, values>1 indicate a concentration among the advantaged (disadvantaged) and values<1 values indicate a concentration among the disadvantaged (advantaged). The further the value of RII from 1, the higher the level of inequality.
Theil index (TI)	$TI = \sum_j p_j \frac{y_j}{\mu} \ln \frac{y_j}{\mu} * 1000$	Relative	Complex	Weighted	Non-ordered	No unit	Zero	The larger the absolute value of TI, the greater the level of inequality.

$\boldsymbol{y_j}$ = Estimate for subgroup j.

$\boldsymbol{y_{high}}$ = Estimate for subgroup high. For favourable indicators, y_{high} refers to 20–49 years, 2-5 years, quintile 5 (richest), quintile 10 (richest), secondary school +, urban and female. For adverse indicators, y_{high} refers to 15–19 years, 0-1 years, quintile 1 (poorest), decile 1 (poorest), no education, rural and male. For subnational region, y_{high} refers to the subgroups with the highest estimate, regardless of the indicator type.

$\boldsymbol{y_{low}}$ = Estimate for subgroup low. For favourable indicators, y_{low} refers to 15–19 years, 0-1 years, quintile 1 (poorest), decile 1 (poorest), no education, rural and male. For adverse indicators, y_{low} refers to 20–49 years, 2-5 years, quintile 5 (richest), decile 10 (richest), secondary school +, urban and female. For subnational region, y_{low} refers to the subgroups with the lowest estimate, regardless of the indicator type.

$\boldsymbol{y_{ref}}$ = Estimate for reference subgroup. y_{ref} refers to 20–49 years, 2-5 years, quintile 5 (richest), decile 10 (richest), secondary school +, urban and female. For subnational region, y_{ref} refers to the subgroup with the highest estimate for favourable indicators and the subgroup with the lowest estimate for adverse indicators. Note that reference subgroups were selected based on convenience of data interpretation. In the case of sex, this does not represent an assumed advantaged of one sex over the other.

$\boldsymbol{p_j}$ = Population share for subgroup j.

$\boldsymbol{X_j = \sum_j p_j - 0.5p_j}$ = Relative rank of subgroup j.

$\boldsymbol{\mu}$ = Setting (national) average.

$\boldsymbol{v_0}$= Predicted value of the hypothetical person at the bottom of the social-group distribution (rank 0).

$\boldsymbol{v_1}$= Predicted value of the hypothetical person at the top of the social-group distribution (rank 1).

$\boldsymbol{n}$ = Number of subgroups.