



OPHI MPI METHODOLOGICAL NOTES 46

The Global Multidimensional Poverty Index (MPI): 2018 Revision

Sabina Alkire, Usha Kanagaratnam and Nicolai Suppa

September 2018

Acknowledgements

The completion of the 2018 global Multidimensional Poverty Index (MPI) project was a large collaborative effort with support and contributions from many team members. We sincerely thank everyone involved.

Data Team: Foremost on this team are the research assistants, consultants, collaborators and colleagues who energetically took to the data preparation and standardization of the global MPI indicators for 105 country datasets. We are extremely grateful to Giuseppe Antonaci, Ivana Benzaquen, Friedrich Bergmann, Dhruva Bhat, Cecilia Calderon, Fedora Carbajal, Agustin Casarini, Mihika Chatterjee, Charles-Alexis Couveur, Rolando Gonzales, Rizwan Ul Haq, Fanni Kovesdi, Saite Lu, Juliana Milovich, Sophie Scharlin-Pettee, Dyah Savitri Pritadrajati, Marco Ranaldi, Carolina Rivera, Monica Pinilla-Roncancio, Dalila de Rosa, Yangyang Shen and Christoph Steinert. Sophie Scharlin-Pettee and Fanni Kovesdi carried out general corrections to the data preparation files before these went through the final quality check. In addition, Hwa Pyung Yoo and Francis Arthur gave committed data management support. Christian Oldiges played an invaluable leadership role in producing and analysing the figures for India with Mihika Chatterjee providing support for the district-level analysis using the Indian data. Bilal Malaeb crafted the online interactive databank, collaborated on the country maps for the global MPI and the quality checks carried out for the Libyan dataset. Our data preparation co-leaders, Corinne Mitchell, Ricardo Nogales and Frank Vollmer, were indispensable in their support of the data team and their intense involvement in the first check of the data preparation files. Adriana Conconi and Ana Vaz carried out the final and authoritative quality check of the data preparation files. The commitment from all six individuals was a critical contribution to the overall project.

Expert Inputs in the Global MPI: We are grateful to a very large number of experts from national statistics offices academia, international agencies and donors, as well as from the amazing teams at each of Demographic Health Surveys (under Sunita Kishor) and Multiple Indicator Cluster Surveys (under Attila Hancioglu) who gave input multiple occasions.

Contributors: Frank Vollmer worked tirelessly on the asset index that, while documented fully in a separate paper, underlies our section on assets. The Human Development Report Office (HDRO) and OPHI teams, especially Milorad Kovacevic, Natalie Quinn, Bilal Malaeb and Monica Pinilla-Roncancio, provided key insights on trial measures. A team of research assistants, consultants and colleagues opened questionnaires from 100 countries, home to 5.5 billion people, and identified some 280 potential new and improved indicators to modify the global MPI. We are grateful to Maarit Kivilo, Saite Lu, Juliana Milovich, Corinne Mitchell, Anders Kirstein Møller, Ricardo Nogales, Rachel Pearson, Conway Reinders, Yangyang Shen, Sophie Song, Catherine Taylor, Santiago Izquierdo Tort and Ana Vaz for carrying out this time-consuming but very illuminating task, which enabled us to see the possibilities and limitations of improving the global MPI and extending it for women and children using existing survey data.

Administration Communication and Publication Teams: Matthew Brack and Cristina Hernandez were key to drawing up contracts for the data team and managing the financial aspects of the project on a tight timeline and budget. Carolina Moreno and Diego Zavaleta, with support from Paddy Coulter and John Hammock, led the global MPI 2018 communications activities. They worked in close collaboration with the United Nations Development Programme (UNDP) communications team in New York, especially Anna Ortubia and Admir Janic. Special thanks go to the publication team for *Global Multidimensional Poverty Index 2018: The Most Detailed Picture to Date of the World's Poorest People*. Corinne Mitchell took a strong and calm leading role (publication coordinator and data analyses and writing), with Ricardo Nogales, Christian Oldiges, Sophie Scharlin-Pettee, Kgaugelo Sebidi and Frank Vollmer (data analyses and writing). The visual layout and design was the work of Maarit Kivilo (publication, graph and map layout, and design), and our text was copy-edited by Ann Barham.

Financial Support: OPHI is grateful for the financial support from multiple sources including the Swedish International Development Cooperation Agency (Sida), the Economic and Social Research Council of the United Kingdom (ESRC) and the UK Department for International Development (DFID). We are grateful to them and for a grant of £9,817 from the University of Oxford's GCRF QR HEFCE fund specifically set up to support 'generating impact from research both within and beyond the sector'.

UNDP Collaborators: The UNDP team has played a crucial role in the global MPI 2018 process. Under the leadership of Achim Steiner, UNDP and OPHI have worked together to revise the indicators and data that are the core of this report and have cemented the collaboration between our institutions for future on-going calculations of the global MPI and their analysis to shape policy. Abdoulaye Mar Dieye, Assistant Secretary-General and Head of the UNDP Bureau for Policy and Programme Support, has also been indispensable in this effort. HDRO, led by Selim Jahan, was pivotal in the conceptual and methodological discussion of this year's MPI, as it has been since the beginning. We are grateful to all the UNDP team for the support and compromise, including Abdoulaye Mar Dieye, Pedro Conceicao, Serge Kapto, Milorad Kovacevic, Anna Ortubia and Admir Jahic. A special mention must go to Cecilia Calderon and Carolina Rivera for their involvement in the data preparation and standardization of the global MPI indicators. Their feedback on the prototype data preparation file was extremely valuable to the team.

Citation: Alkire, S., Kanagaratnam, U. and Suppa, N. (2018). ‘The Global Multidimensional Poverty Index (MPI): 2018 revision’, OPHI MPI Methodological Notes 46, Oxford Poverty and Human Development Initiative, University of Oxford.

Citation For Tables 1-5, and 7: Alkire, S., Kanagaratnam, U. and Suppa, N. (2018). ‘Multidimensional Poverty Index 2018: brief methodological note and results’, OPHI MPI Methodological Notes 46, Oxford Poverty and Human Development Initiative, University of Oxford.

Citation For Tables 5a and 6: Alkire, S., Oldiges, C. and Kanagaratnam, U. (2018). ‘Multidimensional Poverty Index 2018: brief methodological note and results’. OPHI MPI Methodological Notes 46, Oxford Poverty and Human Development Initiative, University of Oxford.

1. Overview

Poverty has traditionally been measured in one dimension, usually monetary poverty using income or consumption-expenditure indicators. In this analysis, a basket of goods and services considered the minimum requirement to live a non-impooverished life is valued at the current prices. People who do not have sufficient monetary resources for that basket are deemed poor.

Monetary poverty measures certainly provide tremendously useful information. Yet poor people themselves define their poverty much more broadly to include lack of education, health, housing, empowerment, employment, personal security and more. No one indicator, such as income, is uniquely able to capture the multiple aspects that contribute to poverty. For this reason, since 1997, the *Human Development Report (HDR)* has measured poverty in ways that differ from traditional income-based measures. The Human Poverty Index (HPI) was the first such measure; the Multidimensional Poverty Index (MPI) succeeded it in 2010.

In 2010, the UNDP Human Development Report Office (HDRO), in collaboration with the Oxford Poverty and Human Development Initiative (OPHI), a research centre at the University of Oxford's Department of International Development, designed a new index of multidimensional poverty. OPHI has computed, and UNDP has published, this global MPI in every subsequent *HDR*. OPHI's website additionally included the consistent sub- and partial indices of the global MPI for all countries, rural-urban areas and subnational decompositions that were possible for each dataset together with special studies, including subnational disaggregation, changes over time for strictly harmonized datasets, ethnic decompositions, destitution, inequality among the poor, child poverty, gender analysis, disaggregation by disability status, and robustness tests.¹

The MPI belongs to the family of measures developed by Alkire and Foster (2007, 2011a; Alkire, Foster, Seth, Santos, Roche and Ballon 2015). In particular, it is an application of the adjusted headcount ratio, M_0 . This methodology requires determining the unit of analysis (i.e. household), identifying the set of indicators in which they are deprived at the same time and summarizing their poverty profile in a weighted deprivation score. They are identified as multidimensionally poor if their deprivation score exceeds a cross-dimensional poverty cutoff. The proportion of poor people and their average deprivation score (i.e. the 'intensity' of poverty or percentage of simultaneous deprivations they experience) become part of the final poverty measure. A more

¹ All documents are available from <https://ophi.org.uk/multidimensional-poverty-index/>

formal explanation of the methodology is presented in Alkire and Santos (2014) and in Alkire and Foster (2011a).

The original MPI (henceforth MPI-O) aligned, insofar as was then possible, with indicators used to track the Millennium Development Goals (MDGs). It was published in every *HDR* subsequently, with minor adjustments that have been documented in the methodological reports.² From 2014, an innovative MPI (henceforth MPI-I) was also developed and published in parallel, in order to explore how to improve the MPI (Kovacevic and Calderon 2014). In 2018, OPHI and UNDP together undertook a joint revision of the global MPI, drawing upon and subsuming the best of the previous MPIs by adjusting five of its ten indicators, and jointly releasing the 2018 global MPI results.

Drawing on the past methodological documents since 2010 for MPI-O and MPI-I, and on the global 2018 revision, this document provides a comprehensive guide to the methodology for estimating and reporting the global MPI in 2018.³ The methodology for the first global MPI by Alkire and Santos (2010) was documented in a working paper co-published by OPHI and HDRO. The underlying methodology, dimensions and number of indicators have remained unchanged since 2010. This document summarizes how the global MPI 2018 is computed. However, before moving to the specifics, we provide a brief intuitive introduction to the MPI and its linked partial and sub-indices, and clarify how a global MPI differs from official national poverty statistics.

2. The MPI, its Partial Indices and Sub-Indices

The MPI is an index designed to measure acute poverty. Acute poverty refers to two main characteristics. First, it includes people living under conditions where they do not reach **the minimum internationally agreed standards in indicators of basic functionings**,⁴ such as being well nourished, being educated or drinking clean water. Second, it refers to people living under conditions where they do not reach the minimum standards in **several aspects at the same time**. In other words, the MPI measures those experiencing **multiple deprivations**, people who, for example, are both undernourished and do not have safe drinking water, adequate sanitation and clean fuel.

² For the methodological reports of the MPI, see Alkire and Santos (2014) and the Methodological Notes for 2011–2017/2018, available at <https://ophi.org.uk/multidimensional-poverty-index/global-mpi-2017/mpi-methodology/>. For the 2014–2017 Innovative MPI methodology, see Kovacevic and Calderon (2014).

³ This document brings together the following: Alkire and Santos (2010, 2014); the 2010 UNDP Primer and OPHI's methodological documents 2011–2017, plus Kovacevic and Calderon (2014).

⁴ In Amartya Sen's capability approach, **functionings** are the valuable beings and doings that a person can achieve.

The MPI is an overall headline indicator of poverty that enables poverty levels to be compared across places and over time in order to see at a glance which groups are poorest and whether poverty has been reduced or has increased. Having one at-a-glance indicator is tremendously useful for communicating poverty comparisons to policy actors and civil society.

The MPI also is a ‘high-resolution lens’ because it can be broken down in different intuitive and policy-relevant ways. The most important breakdowns are **incidence/intensity** and **dimensional composition**.

For incidence/intensity, the MPI combines two key pieces of information to measure acute poverty. The **incidence** of poverty is the proportion of people (within a given population) who are identified as poor based on the multiple deprivations they experience. It is denoted H for **headcount ratio**. The **intensity** of poverty is the average proportion of (weighted) deprivations poor people experience – how *poor* people are, on average. It is denoted A for **average deprivation share**. The MPI is the product of both: $MPI = H \times A$.

Both the incidence and the intensity of these deprivations are highly relevant pieces of information for poverty measurement. To start with, the percentage of people who are poor is a necessary measure. It is intuitive and understandable by anyone. People always want to know how many poor people are in a society as a proportion of the whole population.

Yet, that is not enough. Imagine two countries: in both, 30% of people are poor (incidence). Judged by this piece of information, these two countries are equally poor. However, imagine that in one of the two countries poor people are deprived – on average – in one-third of the dimensions, whereas in the other country, the poor are deprived – on average – in two-thirds. By combining the two pieces of information – the intensity of deprivations and the proportion of poor people – we know that these two countries are not equally poor, but rather that the second is poorer than the first because the intensity of poverty is higher.

With respect to **dimensional composition**, the MPI can be consistently broken down by each of its indicators. One particular number that is of interest is what percentage of people are poor and are deprived in each component indicator (j). This is the censored headcount ratio h_j . The MPI is made by adding up the censored headcount ratios of each indicator, where before adding, each is multiplied by their proportional weight. $MPI = \sum [w_j(h_j)]$ for all j , where w_j add up to 1 (e.g. 1/6 or 1/18 in the case of the global MPI).

Because of its robust functional form and direct measures of acute deprivation, insofar as the indicators are comparable, the MPI can be used for **comparisons** across countries or regions of the world, as well as within-country comparisons between regions, ethnic groups, rural and urban

areas, and other key household and community characteristics.⁵ Furthermore, it enables analysis of **patterns of poverty**: how much each indicator and each dimension contributes to overall poverty.

Before presenting the structure of the global MPI as published in 2018, it may be useful to contrast it with national measures.

3. The Global MPI and National MPIs

The MPI is based on a versatile methodology that can be readily adjusted to incorporate alternative indicators, cutoffs and weights that might be appropriate in different regional, national or subnational contexts.

It is desirable to have two kinds of MPI estimations. One kind are ‘global’ or, at times, regional estimations that can be **compared** to other countries to enable mutual learning and the sharing of best practices. The second are national MPIs, whose design reflects the policy priorities and cultural and climactic **particularities** of each country.

These are already in place for monetary measures. Global measures such as US\$1.90/day and \$3.10/day income poverty measures enable comparisons, global monitoring and so on. However, most countries actually use their own national poverty measures, which are tailored to their own contexts, to guide policy. International documents such as the World Bank’s *World Development Indicators* normally contain both national and global monetary poverty measures. One measure cannot be *both* compared to other countries *and* tailor made for a given country’s context. Therefore, in the same way, we need two kinds of MPIs.

Global Multidimensional Poverty Index: A global assessment of multidimensional poverty would ideally cover all countries, using consistent datasets whereas at present it measures acute multidimensional poverty, using specifications appropriate mainly for higher poverty countries. In the future, the global MPI should include at least two different specifications, an MPI for **acute** poverty and one for **moderate** poverty, to have relevance to countries or regions with different levels of multidimensional poverty.⁶

⁵ The Economic Commission for Latin America and the Caribbean published a regional MPI for Latin America in their *Social Panorama 2014*, which covers 17 countries and measures moderate rather than acute poverty, in ways appropriate for that region. A regional report on Arab poverty was published by UN-Economic and Social Commission for Western Asia (ESCWA).

⁶ Latin America and the Arab States have each published regional MPIs with specifications more aligned to moderate poverty definitions.

National MPIs: National MPIs are multidimensional poverty measures that have been created by adapting the Alkire-Foster method (upon which the MPI is based) to better address local realities, needs and the data available. These vary in terms of the number and specifications of dimensions and indicators, and have different deprivation cutoffs and poverty cutoffs. Their purpose is to assess multidimensional poverty levels in specific countries or regions in the indicators most relevant and feasible locally. Many governments already publish official national MPIs and use them proactively for policy. The Multidimensional Poverty Peer Network (www.mppn.org) connects many countries who are in the process of considering or designing such official national poverty statistics.

Countries are the custodian agency for Sustainable Development Goal (SDG) indicator 1.2.2, and a number of countries have indicated in their voluntary national reports an intention to report either their national MPI and/or the global MPI or some other multidimensional poverty statistic for that indicator.

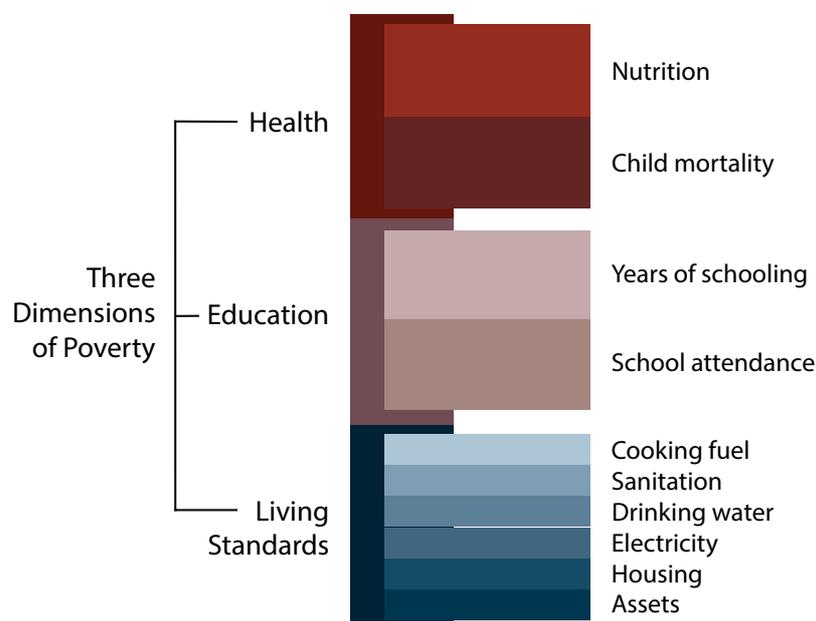
4. The Structure of the Global MPI 2018 Revision

The MPI uses information from ten indicators, which are organised into three equally weighted dimensions: health, education and living standards. These dimensions are the same as those used in the Human Development Index (HDI). The MPI has two indicators for health, two for education and six for living standards. The indicators of the MPI were selected after a thorough consultation process involving experts in all three dimensions. During this process, the ideal indicator definitions had to be reconciled with what was actually possible in terms of data availability and cross-country comparison. The ten indicators finally selected are almost the only set of indicators that could be used to compare over 100 countries.

The MPI begins by establishing a deprivation profile for each person, which shows which of the ten indicators they are deprived in. Each person is identified as deprived or non-deprived in each indicator based on a deprivation cutoff. In the case of health and education, each household member is identified as deprived or not deprived according to available information for household members. For example, if any household member for whom data exists is malnourished, each person in that household is considered deprived in nutrition. Taking this approach – which was required by the data – does not reveal intra-household disparities, but it is intuitive and assumes shared positive (or negative) effects of achieving (or not achieving) certain outcomes. Ideally, the MPI would be complemented with individual-level MPIs for children, adults and elders, which could compare individual-level achievements by gender and age group, for example, and document

intra-household inequalities. Yet because certain variables are not observed for all household members this is rarely feasible.

Figure 1. Composition of the MPI – Dimensions and Indicators



Next, looking across indicators, each person's **deprivation score** is constructed based on a weighted average of the deprivations they experience. The indicators use a nested weight structure: equal weights across dimensions and equal weight for each indicator within a dimension. Finally, a poverty cutoff of 33.33% identifies as multidimensionally poor those people whose deprivation score meets or exceeds this threshold.

The MPI reflects both the **incidence** or headcount ratio (H) of poverty – the proportion of the population who are multidimensionally poor – and the average **intensity** (A) of their poverty – the average proportion of indicators in which poor people are deprived. The MPI is calculated by multiplying the incidence of poverty by the average intensity across the poor ($H \times A$). A person is identified as poor if he or she is deprived in at least one-third of the weighted indicators. Those identified as 'vulnerable to poverty' are deprived in 20% to 33.33% of weighted indicators, and those identified as being in 'severe poverty' are deprived in 50% or more of the dimensions.

Table 1 provides a more precise summary of the dimensions, indicators, thresholds and weights used in the MPI.

Table 1. The Dimensions, Indicators, Deprivation Cutoffs and Weights of the Global MPI 2018

Dimensions of poverty	MPI indicator	Deprived if...	Weight	SDG Indicator
Health	Nutrition	Any person under 70 years of age for whom there is nutritional information is undernourished. ⁺	1/6	SDG 2
	Child mortality	Any child has died in the family in the five-year period preceding the survey.	1/6	SDG 3
Education	Years of schooling	No household member aged ten years or older has completed <u>six</u> years of schooling.	1/6	SDG 4
	School attendance	Any school-aged child ⁺⁺ is not attending school up to the age at which he/she would complete class 8.	1/6	SDG 4
Living standards	Cooking fuel	The household cooks with dung, wood or charcoal.	1/18	SDG 7
	Sanitation	The household's sanitation facility is not improved (according to SDG guidelines) or it is improved but shared with other households.*	1/18	SDG 11
	Drinking water	The household does not have access to improved drinking water (according to SDG guidelines) or safe drinking water is at least a 30-minute walk from home, roundtrip.**	1/18	SDG 6
	Electricity	The household has no electricity.	1/18	SDG 7
	Housing	The household has inadequate housing: the floor is of natural materials or the roof or wall are of rudimentary materials.***	1/18	SDG 11
	Assets	The household does not own more than one of these assets: radio, TV, telephone, computer, animal cart, bicycle, motorbike or refrigerator, and does not own a car or truck.	1/18	SDG 1

Notes

⁺ Adults 20 to 70 years are considered malnourished if their Body Mass Index (BMI) is below 18.5 m/kg². Those 5 to 20 are identified as malnourished if their [age-specific BMI cutoff](#) is below minus two standard deviations. Children under 5 years are considered malnourished if their z-score of either height-for-age (stunting) or weight-for-age (underweight) is below minus two standard deviations from the median of the World Health Organization 2006 reference population. In a majority of the countries, BMI-for-age covered people aged 15 to 19 years, as anthropometric data was only available for this age group; if other data were available, BMI-for-age was applied for all individuals above 5 years and under 20 years.

⁺⁺ Data source for age children start primary school: United Nations Educational, Scientific and Cultural Organization, Institute for Statistics database, Table 1. Education systems [UIS, <http://stats.uis.unesco.org/unesco/TableViewer/tableView.aspx?ReportId=163>].

* A household is considered to have access to improved sanitation if it has some type of flush toilet or latrine, or ventilated improved pit or composting toilet, provided that they are not shared. If survey report uses other definitions of 'adequate' sanitation, we follow the survey report.

** A household has access to clean drinking water if the water source is any of the following types: piped water, public tap, borehole or pump, protected well, protected spring or rainwater, and it is within a 30-minute walk (round trip). If survey report uses other definitions of 'safe' drinking water, we follow the survey report.

*** Deprived if floor is made of mud/clay/earth, sand or dung; or if dwelling has no roof or walls or if either the roof or walls are constructed using natural materials such as cane, palm/trunks, sod/mud, dirt, grass/reeds, thatch, bamboo, sticks, or rudimentary materials such as carton, plastic/ polythene sheeting, bamboo with mud/stone with mud, loosely packed stones, uncovered adobe, raw/reused wood, plywood, cardboard, unburnt brick or canvas/tent.

5. The Data and Preliminaries

The 2018 MPI estimations are based on survey data from 105 countries for which the survey was fielded in a ten-year period from 2006 to 2016/2017 (see Appendix 1). The most recent surveys that were available for Azerbaijan, Djibouti, Somalia and Uzbekistan were carried out in 2006; in Vanuatu it was 2007; in Bolivia, 2008; and in Maldives and Syria, the survey year was 2009. We have made use of these surveys despite the fact that these survey years are rather old. Eighty-six of the countries had surveys that were carried out between 2011 and 2016/7.

The MPI relies on datasets that are publicly available and comparable for developing countries. The two most widely used surveys are the Demographic and Health Surveys (DHS)⁷ and the Multiple Indicators Cluster Surveys (MICS).⁸ For three countries, the source of the data is the Pan Arab Project for Family Health (PAPFAM) Surveys. In the countries for which none of these internationally comparable surveys were available, country-specific surveys that contained information on the MPI indicators were used if high-quality surveys with the same indicators were available, if this was requested and if the data were in the public domain. In 2018, for example, this was done for Brazil, China, Ecuador, Jamaica, Mexico and South Africa.

Policies for Updates

1. Data

The MPI will be updated when new data become available from the following sources:

- a. Full DHS (including Continuous DHS, such as in Peru)
- b. Full MICS.

A Malaria Indicators Survey (MIS) will not generally be used if a recent DHS or MICS is available, due to its exclusion of nutritional variables and school attendance, the fact that years of schooling may not be available for the household roster and its sample size.

⁷ <http://www.measuredhs.com/aboutsurveys/dhs/start.cfm>.

⁸ <http://www.childinfo.org/mics.html>.

2. Labelling of survey year

The survey will be dated according to the year in which fieldwork took place, as detailed in the data report. If the fieldwork took place during two calendar years, the data will be labelled with both years, e.g. 2010/11.

3. Improvements in data sources or survey instruments

Naturally, survey instruments such as DHS and MICS improve over time, for example in the way in which improved water or improved sanitation is measured. The policy is to use the maximum information that is available for the ten indicators and incorporate improvements in the questionnaire in new years. For example, if nutritional information is available only for children in one survey round, for women and children in the next round, and, in the third, for a male subsample as well, then each round of MPI calculations will take advantage of the maximum available information in the given survey. Similarly when data on mobile telephones or any hitherto missing assets become available, this will be incorporated into the asset indicator. As a result, **the MPI estimation for a given year will be the most accurate possible figure with the available data at hand** but may not be comparable across time. Any country-specific treatment of the datasets for the global MPI is detailed in Appendix 1 of this methodological note. Similarly, future country-specific data treatment will be documented in the methodological note.

4. Population-weighted global aggregates.

The population year used for aggregate estimates based on the global MPI are updated by one year, annually. In 2018, the reference year for population figures is 2016. However, data tables include both the population during the year of the survey and those for two comparable years (for example, 2015 and 2016). Section IX comments on the uses of each set of population data.

De Jure and De Facto Household Members

One of the first issues that must be decided before calculating the MPI is which household members' information should be considered for the MPI. The surveys (mainly the DHS) distinguish two types of household members:

- Whether the person is a ***de jure* household member**, i.e., whether the member is a **usual resident of the household**.

- Whether the person is a ***de facto* household member**, i.e., whether the member **slept in the household the previous night**.

The MPI uses data on de jure household members. In principle, only de jure members should be included, as de facto members can be any occasional visitor to the household (national household surveys many times only consider the de jure members). We exclude the information of the de facto members because the education of an occasional visitor could make the household be non-deprived in education, and this would be arbitrary.

Use of Nutritional Subsamples

In some countries, the DHS capture information in nutrition only for a subsample of the eligible population.⁹ In these cases, if the MPI were computed using the full sample, it could underestimate nutritional deprivations. However using a subsample will increase standard errors. To improve the accuracy of the MPI, it is computed based on the subsample when:

- a. the subsample for anthropometrics was designed to be nationally representative, and
- b. the sampling weights were appropriately designed to generate unbiased nationally representative MPI estimates, and
- c. in the case of high missing values, bias analysis shows that there is no statistically significant difference in the remaining MPI indicators between the whole sample and the subsamples.

If the above conditions are not met, then the MPI will be estimated using the full sample and considering all information contained in the survey. If the full sample is used and if nutrition is measured only for a subgroup of the whole sample, the MPI estimations will be a ‘lower bound’, because the assumption will be made that households in which no woman or child has been measured for nutritional status are non-deprived in nutrition.

In 19 of the countries of the MPI 2018, nutritional information is available for a full sample or the same subsample for women and children, as well as for the full sample or for a smaller subsample of men. In this case, the sample is restricted to that for which full data on women and children are

⁹ The eligible population are normally children under five years of age and adults of reproductive age (only women or both genders). When a subsample is taken for anthropometric indicators, only a percentage of eligible households are included for anthropometric measures (usually 50% or 1/3 of the whole national sample). Technically, this subsample is also nationally representative, but it incurs a higher standard error due to its smaller size.

available, and male malnutrition is considered in the households for which data pertain. For example, in seven countries, we retained full data from women and children, and have used information from one-third or one-half of the men. In seven other countries, nutrition information was collected from children under five and women aged 15 to 49 years living in the male subsample households. This allowed us to retain a subsample of households where the data from children, women and men were utilized.

In five of the countries that made up the MPI 2018, nutrition data was available much more widely for children, women and men than had been previously. Zimbabwe was unique in the sense that it was the only DHS survey where nutritional information was available for the all children under five years, women aged 15 to 49 years and men aged 15 to 59 years in the sample. In countries where we have used national surveys (China, Ecuador, Mexico and South Africa), anthropometric information was available for the entire sample population.

Treatment of Missing Indicators

If the dataset is missing any indicator, then of course that indicator cannot be used in the computation of the poverty measure. Weights are re-adjusted accordingly such that each dimension continues to be given a weight of one-third. For example, if one living standards indicator is missing, then while originally each of the living standards indicators received a relative weight of 1/18 (5.56%), they will receive a relative weight of 1/15 (6.66%). If one health or education indicator is missing, the other indicator will receive the full weight of one-third. If both indicators in health or education are missing, the survey does not qualify for computing the MPI.

Dropping Households Who Are Missing Any Indicator

Once each indicator has been constructed, treating missing values as explained below, we only use households that have complete information in all the constructed indicators for the poverty estimates. Households that lack any indicator are dropped from the retained sample (the percentage of the sample that is dropped is reported in Table 1 of the data tables for global MPI 2018 at www.ophi.org.uk/multidimensional-poverty-index).

6. Applicable and Non-Applicable Populations

Four of the ten indicators are not applicable to all the population. These are as follows:

- (1) **Children's school attendance** is not applicable to households without children of school age. For **children's school attendance**, we create a variable with a value of one if the household has children of school age (we consider an eight-year span from the country's

actual year at which school begins), and we consider non-deprived the households that have no children within that age range. For households that do have children of school age and have missing information, the criterion detailed in Section VII.4 applies.

Four of the ten indicators are not applicable to all the population. These are as follows:

- (1) **Children's school attendance** is not applicable to households without children of school age. For **children's school attendance**, we create a variable with a value of one if the household has children of school age (we consider an eight-year span from the country's actual year at which school begins), and we consider non-deprived the households that have no children within that age range. For households that do have children of school age and have missing information, the criterion detailed in Section VII.4 applies.
- (2) **Children's nutrition** is not applicable to households with no children within the eligibility criteria (under five years old) to be weighed and measured. For **children's nutrition** we use a variable such as that provided by DHS in the household (PR) file (variable hv035), which indicates the number of eligible children, and we consider as non-deprived in child nutrition households that did not have any eligible children. Note that we use the variable provided by the survey itself, rather than creating one, because eligibility criteria may vary from one country to another (in terms of age and some other things such as whether the child was present or not, etc.). This avoids any erroneous definitions of the variable (which will affect the number of households considered non-deprived in this indicator).
- (3) **Adult BMI** is not applicable to households with no eligible women or men.¹⁰ In general, DHS surveys cover women aged between 15 and 49 that are *de facto* members of the household. In some countries such as Egypt, eligibility excludes women who have never been married. In 19 countries of the MPI 2018, male malnutrition is obtained for the full sample or for a subsample. For **women's BMI** we use a variable such as that provided by

¹⁰ **Definition of 'eligible women' from DHS Recode:** 'Eligible women are usually defined to be women aged 15–49 who slept in the household the previous night, irrespective of whether they usually reside in the household or are visiting the household. In early DHS II surveys, the eligibility criteria also required that the members slept the previous night in the household. In later surveys, this criteria was dropped and all usual residents and visitors who slept in the household the previous night were interviewed. Non *de facto* women were later dropped in the analysis and do not appear in the Individual Recode Data File. In some countries an ever-married sample is used for the individual interview, and so the eligibility criteria is further restricted to ever-married women' (pp. 14, 86).

Definition of 'eligible men' from DHS Recode: 'Eligible men are usually defined to be men aged 15–59 (or 15–54 in some cases) who slept in the household the previous night, irrespective of whether they usually reside in the household or are visiting the household. In some countries an ever-married sample is used for the individual interview, and so the eligibility criteria is further restricted to husbands of eligible women' (p. 103).

DHS in the household PR file (variable hv041), which indicates the number of eligible women to be weighed and measured, and we consider as non-deprived in women's BMI households that had no eligible women. Note that, again, we use the variable provided by the survey itself rather than creating one because eligibility criteria may vary from one country to another. This avoids any erroneous definitions of the variable (which will affect the number of households considered non-deprived in this indicator).

- (4) **Child mortality:** When the child mortality indicator is restricted to child deaths in the past five years, it is not applicable to households that did not have a person who provided this information (ordinarily an eligible woman). If no information on the date of death was available then the indicator reflected any child death. In this case information on child mortality was not applicable to households that did not have any eligible member who answered that question.

In particular, for child mortality, we use a variable such as that provided by DHS in the household (PR) file (variable hv010), which indicates the number of eligible women available for interview in the household. We consider as non-deprived (in child mortality) all households having no eligible women available to be interviewed. Note that we use the variable provided by the survey itself rather than creating one because eligibility criteria may vary from one country to another. This avoids any erroneous definitions of the variable (which will affect the number of households considered non-deprived in this indicator).

For 14 countries where we only can construct an age-unrestricted mortality indicator, we use two variables akin to those provided by DHS in the PR file (variable hv117 and hv118), which indicate the number of eligible women and men available for interview in the household, correspondingly. The criterion for women was already stated above. Eligible men are defined above. In some countries only women are interviewed. Households that have no females AND no males eligible for interview are considered non-deprived in this indicator. Note that we use the variable provided by the survey itself rather than creating one because eligibility criteria may vary from one country to another. This avoids any erroneous definitions of the variable (which will affect the number of households considered non-deprived in this indicator).

In general, households that do not have the relevant population are considered as non-deprived in that indicator.

Note also that each of the households with a non-applicable population for the indicator is considered as non-deprived. However, households with an applicable population that had missing values are considered as missing.

7. Indicator Definitions

This section specifies the very particular treatment of indicators beyond the general definitions set out in Table 1.

1. Nutrition

The MPI identifies a person as deprived in nutrition if anyone in their household (for whomever there is information on – children, women or other adults) is undernourished. To be precise, a household is deprived if any adult has a low BMI or any child is stunted or underweight. In 2018, age- and gender-specific BMI codes were introduced for ages 15 to 19; 18.5 was used for all persons aged 20 to 69. If people aged 5 to 19 are included then age-specific BMI is used for all. The *igrownup* .ado stata files were used to identify children who were stunted or underweight because their height-for-age or weight-for-age was two standard deviations below the median of the reference population. We only considered nutritional data for people under the age of 70 (China, Ecuador, Nepal and Mexico are the only datasets that include nutritional information for persons aged 70 and above).

Only if there are eligible populations in the household but both indicators are missing do we consider the household as missing. If we have information on one of the nutrition indicators, we use it to construct the deprivation profile for the household.

It can be helpful to know the precise indicator treatment as regards missing information, so each variable description closes with these particular rules. In the case of nutrition, if the household had no nutritional information available from whatever population was eligible – women, men or children – then the household was coded as missing information. Where an adult was eligible to provide data, but it is missing, and there is child information, we used the child information. And vice versa: if the child information was missing, but an adult had given information, we used the adult's information.

2. Child Mortality

The indicator tracks whether there was a child who died in the household in the five years preceding the date of interview.

For age-restricted variables, it is missing if a woman did not answer, deprived if a woman reported a child's death whose date occurred within five years of the date of the survey interview, and non-deprived if no child's death was reported.

Information from women was missing in up to 10% of households. Thus the final MPI made indirect use of the male information by implementing the following procedure: if the household is missing data on child mortality, but has data from the male questionnaire on child mortality, and if that male questionnaire reports no child mortality, then that household is retained, and coded as non-deprived. If the women's birth history is missing, and the male reports a child death, then the household is coded as missing because we do not know the time of death.

Education

The MPI uses two complementary indicators for education. One looks at completed 'years of schooling' of household members, the other at whether children are attending school. Note that both years of schooling and school attendance are imperfect proxies. They do not capture the quality of schooling, the level of knowledge attained or skills. Yet both indicators are robust and widely available, and provide the closest feasible approximation to levels of education for household members.

In terms of deprivation cutoffs for this dimension, the MPI requires that at least one person in the household has completed **six years** of schooling and that **all children** of school age are attending school up to the age in which they would complete class eight.

3. Years of Schooling

This indicator tracks whether there is at least one household member aged ten years or above who has completed six years of education.

If anyone aged nine years and younger reported having completed six years of schooling, this did not affect the status of the household. Also, if any household member reported having completed 31 or more years of schooling they were recoded as 'missing' as this was more likely to be a data error. Similarly, if any respondents reported completed years of education that exceeded their age, it was recorded as missing.

If there is missing information for some household members, we proceed as follows:

If we observe at least one member with six or more years of education then, regardless of the number of other members with missing information, we classify the household as non-deprived.

Finally, if information on the years of schooling completed was not available for at least two-thirds of household members aged ten years and older, and if none of the persons for whom the information was available reported having completed six years of schooling, then we coded that household as missing. This is because there is insufficient information to determine conclusively that the household is deprived in years of schooling.

4. School Attendance

A person is deprived in the school attendance indicator if there are children of school age in the household who are not attending school up to the age at which they would complete class eight.

If the variable for school attendance is missing for two-thirds or more of the children within the household, and if no measured children were deprived in school attendance, the household is considered missing. But if any child was deprived, then the household is considered deprived in school attendance (even if two-thirds or more of the children lack data). If the household does not have any school-aged children, it is coded as non-deprived.

Living Standards

The MPI considers six indicators for standards of living. It includes three standard SDG indicators that are related to health and living standards, and which particularly affect women: access to clean drinking water, access to improved sanitation and the use of clean cooking fuel. It also includes access to electricity and housing material. Both of these provide some rudimentary indication of the quality of housing. The final indicator covers the ownership of some consumer goods, each of which has a literature surrounding them: radio, television, telephone, computer, bicycle, motorbike, car, truck, animal cart and refrigerator.

The selected deprivation cutoffs for each indicator (except for the one relating to assets) are backed by an international consensus, as they follow the SDG indicators as closely as data permit.

5. Water

A person has access to clean drinking water if the water source is any of the following types: piped water, public tap, borehole or pump, protected well, protected spring or rainwater, and it is within a 30-minute walk (roundtrip). If it fails to satisfy these conditions, then the household is considered deprived in access to water.¹¹ If the survey report has different definitions of deprivations in source of water then we follow the survey report. If time to water is missing, then the person is considered non-deprived or deprived according only to their water source.

6. Sanitation

A person is considered to have access to improved sanitation if the household has some type of flush toilet or latrine, or ventilated improved pit or composting toilet, provided that they are not shared. If the household does not satisfy these conditions, then it is considered deprived in sanitation. Note that flush to 'I don't know where' or to 'somewhere else' are coded as deprived, unless the survey report classifies these otherwise. Also the category 'other' is deprived unless the survey report classifies it otherwise. In a number of countries (Azerbaijan, Barbados, Bosnia and Herzegovina, Guyana, the former Yugoslav Republic of Macedonia, Montenegro, and Trinidad and Tobago), households with missing information on the type of toilet are identified as using a non-improved facility. These country survey reports assume that the lack of information is more likely associated with a lack of toilets. In sum, if the survey report classifies any sanitation form differently from the MDGs, the survey report category is followed.

7. Electricity

A person is considered to be deprived if the household does not have access to electricity.

8. Housing

A person is identified as deprived if the household is deprived in the variables for roof, wall or flooring. They are considered **deprived in the wall** variable if the household has

¹¹ Following the MDGs, improved water sources do not include vendor-provided water, bottled water, tanker trucks or unprotected wells and springs. If bottled water is the main source of drinking water, the household is considered to have improved access to water if the source of non-drinking water is from improved sources.

no walls or if the wall is made of natural, rudimentary or other unidentified materials.¹² A household is identified as **deprived in the roof** variable if the household has no roof or if the roof is made of natural, rudimentary or other unidentified materials.¹³ **Deprivation in flooring** – indicating a natural floor – remains the same as applied in the MPI.¹⁴

If a person lacks information on any materials of their house, they are coded as missing. If they have information on any materials, that information is used. In Egypt and Libya, where the survey only covers flooring, we use flooring only. In Colombia and Brazil, which only have information on two out of the three items, we use the information contained in the survey to assess housing.

9. Cooking Fuel

A person is considered deprived in cooking fuel if the household cooks with dung, charcoal or wood. The category ‘other’ is non-deprived if it is not categorized as solid fuel in the survey report. It should be noted that no survey report, thus far, has identified other fuels as solid fuel, hence this category was consistently identified as non-deprived in the global MPI 2018. Furthermore, if no food is cooked in the household, they are coded as non-deprived in cooking fuel.

10. Assets

The assets indicator considers a household as non-deprived if it has more than one of these items: TV, radio, telephone, computer refrigerator, motorcycle, bicycle or animal cart OR if it has a car/truck. If one of these is missing, then, we implicitly assume that they do not have it. The indicator takes a missing value only if we do not have information for any of the assets.

It should be noted that with more recent surveys, a number of countries have additional information on the various types of durable items such as plasma televisions, smartphones, laptops and tablets. We have taken these into account in order to capture the comprehensive ownership of durable items such as televisions, mobile telephones and

¹² Deprived materials are no walls, cane/palm/trunks, mud/dirt, grass/reeds/thatch, bamboo/sticks/mud, carton/plastic, bamboo with mud, stone with mud, uncovered adobe/bamboo/wood, plywood, cardboard, unburnt brick, canvas/tent, or raw/reused wood.

¹³ Deprived materials are no roof, thatch/palm leaf, mud, sod/mud and grass mixture, plastic/polythene sheeting, rustic mat, palm/bamboo, raw wood planks/timber, unburnt bricks, loosely packed stone, or cardboard.

¹⁴ Deprived floor materials are mud/clay/earth, sand, or dung.

computers. Clearly, all the living standards indicators are means rather than ends; they are not direct measures of functionings. Yet, they have two strengths. In the first place, these are means very closely connected to the end (or the functionings) they are supposed to facilitate. Second, most of the indicators are related to the SDGs, which provide strong grounds for their inclusion in the MPI.

8. Robustness and Bias Analysis

When analysing the MPI estimates there are a number of robustness checks that are worth performing.

Robustness to deprivation cutoffs. Are the rankings between countries, or between regions within a country, robust to changes in the deprivation cutoff? In a basic way, this requires computing the MPI for the set of countries or regions using slightly different deprivation cutoffs, or perhaps different indicators altogether. For example, stunting rather than under-weight may be used for the nutritional indicator for children, or a slightly more demanding criterion may be employed for what is considered ‘adequate sanitation’. Once computed, the rankings are built and then the rank correlation coefficients such as Kendall’s Tau b or Spearman are calculated. For examples and details, see Alkire and Santos (2010, 2014).

Robustness to the poverty cutoff. Are the rankings between countries, or between regions within a country, robust to changes in the poverty cutoff? The rankings may be robust to changes within a certain reasonable range, but not necessarily for every possible cutoff value. At the most basic level, this requires computing the MPI for the set of countries or regions using different poverty cutoffs – not just the one-third cutoff – then building the rankings and computing rank correlation coefficients such as Kendall’s Tau b or Spearman. For examples and details, see Alkire and Santos (2014).

Robustness to weight. Are the rankings between countries, or between regions within a country, robust to changing the indicators’ weights? Rankings may be robust to changes in indicator weights across a reasonable set of weights. At the most basic level, this requires computing the MPI for the set of countries or regions using alternative weighting schemes, building the rankings, and then computing rank correlation coefficients such as Kendall’s Tau b or Spearman. For examples and details, see Alkire and Santos (2010, 2014) and Alkire, Santos et al. (2010).

Bootstrapping and standard errors. MPI estimates, as well as its components H and A, may vary with the sample. A very basic statistical principle is that point estimates are proxies for the true value of the parameter but they are not exactly the true value. Point estimates vary with

changes in the sample. The question is, By how much? The reliability of the point estimate depends upon the variability around it. That is why it is useful to construct confidence intervals around the point estimate to know how much that point estimate can vary. This is done using analytical standard errors or bootstrapping.

9. Further Methodologies and Specifications

Complementary Information

If the complementary information used to compute the MPI is updated, then the MPI will be computed using the most up-to-date complementary information relevant for the survey year. For example, if the compulsory starting age at which children enter school changes (as reported in the official tables of UNESCO), then the MPI indicator for school attendance will reflect the appropriate compulsory starting age that was in effect during the year(s) of the survey. Similarly, if other standards such as BMI or reference groups for child malnutrition change, the corresponding MPI indicator will change¹⁵

Population Aggregates: Analysing the MPI Internationally Using Population Data

Because the MPI is drawn from different survey years, in order to identify the number of MPI poor in any given country or across countries it is necessary to multiply the MPI incidence or headcount ratio (H) calculated from the sample survey by the population of the country.

$$\text{Number of MPI poor} = H * \text{Total Population}$$

Despite its apparent simplicity, this is not a straightforward exercise. It entails selecting and justifying a particular year for the population figures. There are two basic alternatives, each of which might be appropriate to different exercises: (1) use population data that correspond to the year of the survey, or (2) use population data from a given single year, which may not be the survey year.

As those working with the MPI figures might reasonably adopt either approach, we note briefly the considerations that might inform this choice.

¹⁵ As explained in Alkire and Santos (2010), the nutrition indicator for children is weight-for-age. A child is considered to be underweight if he or she is two or more standard deviations below the median of the reference population. To guarantee strict comparability of the nutrition indicators for children across surveys, they are estimated in all cases (DHS, MICS or other surveys considered in every round) following the algorithm provided by the WHO Child Growth Standards (<http://www.who.int/childgrowth/software/en/>). The reference population from which the median is calculated and the methodology used to construct the growth curves is taken from (WHO 2006).

Population data corresponding to the year of the survey. In this approach, the ‘number’ of MPI poor is calculated by multiplying the MPI headcount ratio by the total population from the year of the survey. So, for example, for Senegal, whose DHS is dated at 2016, the number of MPI poor in Senegal is calculated using 2016 population data, whereas for Bhutan, whose MICS is dated 2010, the number of MPI poor is calculated using 2010 population data.

In this approach, the MPI values and the number of MPI poor all refer to the date of the survey. This has the advantage of consistency: no assumptions are made regarding poverty trends subsequent to the survey. This approach also has limitations: the number of MPI poor cannot be aggregated by regions or other groupings if the surveys for the countries considered refer to different years. This limits the possibility of international comparisons, which are one of the motivations for creating internationally comparable poverty measures. A non-technical but possibly relevant additional consideration refers to the incentive to update poverty data. If population growth rates are strong, there may be a disincentive to update the data or to release new data, because even if the incidence of poverty has declined, the absolute number of MPI poor may have increased.

Population data from a given year, which may not be the year of the survey. In this approach, the ‘number’ of MPI poor is calculated by multiplying the MPI headcount ratio by the total population taken from a given year, which may not be the same year as the survey. So, for example, to use the countries mentioned above, India and Colombia’s headcount ratios would both be multiplied by the total population for a given year, for example the year 2011.

This approach has the important advantage of comparison: it is possible to aggregate across countries to develop regional rankings, to analyse country groupings such as low-income countries, and to aggregate across regions. For example, using this approach we can generate the figure that 23.5% of the inhabitants in the 105 countries are MPI poor. If the year of the survey chosen is after the year of the survey, this approach also provides an incentive for governments to update their poverty data, because the ‘number of poor’ will decline, if poverty rates have gone down, and will do so more steeply in countries that have strong population growth. The approach also has limitations. In using a headcount ratio that is older than (or more recent than) the reference year of the survey, the assumption is being made that the level of poverty in year of the survey and the year of population are identical. This is a strong assumption.

These alternatives point out yet again the importance of increasing the periodicity of data collection.

Decomposition of National MPIs at the Subnational Level

Subnational decompositions of national MPIs are performed if the datasets satisfy the following three criteria:

1. The survey of the country is representative at the subnational level according to the survey metadata regarding the sample design and to basic tabulations in the country survey report.
2. The national incidence of poverty or headcount ratio (H) and the MPI are large enough (H more than 1.5% and MPI greater than 0.05) so that a meaningful subnational analysis can be pursued.
3. The sample size after the treatment of missing data is reasonably high both at the national level and at the subnational level. For borderline cases, we perform additional bias analyses to exclude those cases where the sample reduction leads to statistically significant bias.

We specify the third criterion in three ways. First, the national sample size must be at least 85% of the original sample after missing data are treated. This is because a lower sample size may affect accurate comparability across subnational estimations. Second, every subnational region in a country must have a retained sample size that is at least 75% of the original sample. A smaller sample generates a problem of representativeness for that particular subnational region, which may distort the subnational comparisons. Third, we conduct a bias analysis test for each region whose sample size is 75% and 85% of the original. We identify the major cause of the sample reduction and divide the entire sample into two groups based on this cause and check the headcount ratios of the other indicators across these two groups. If there is a systematic and statistically significant difference (at a significance level of 1%) between the headcount ratios across these two groups, then that region does not satisfy the bias analysis test. If a region with a large population share (more than 20%) within a country does not pass the test, we completely exclude the country from our analysis.

Changes over Time

A strong motivation for computing multidimensional poverty is to track and analyse changes over time. The basic component of poverty comparisons is the absolute pace of change across periods. The **absolute rate of change** is the simple difference in poverty levels between two periods. We denote the initial period by t^1 and the final period by t^2 , and the corresponding achievement matrices for these two periods by X_{t^1} and X_{t^2} , respectively. The same set of parameters – deprivation cutoff vector z , weight vector w and poverty cutoff k – are used in each period.

The **absolute rate of change** (Δ) is the difference in MPIs between two periods and is computed as

$$\Delta MPI = MPI(X_{t^2}) - MPI(X_{t^1}).$$

Similarly, for H and A :

$$\Delta H = H(X_{t^2}) - H(X_{t^1}).$$

$$\Delta A = A(X_{t^2}) - A(X_{t^1}).$$

The absolute rate of change is indifferent to the initial level. For example, a five percentage point reduction of H could mean that H decreased from 75% to 70% or from 10% to 5%. Changes (increases or decreases) in poverty across two time periods are also evaluated using relative rates. The **relative rate of change** is the difference in poverty as a percentage of the initial poverty level. Interpreting the analysis of absolute and relative changes together provides a clear sense of overall progress.

The **relative rate of change** (δ) is computed for the MPI (and similarly for H and A which are not presented) as

$$\delta MPI = \frac{MPI(X_{t^2}) - MPI(X_{t^1})}{MPI(X_{t^1})} \times 100.$$

The absolute and relative changes, however, are not comparable for different countries when the reference periods are of different length. To compare the rates of poverty reduction across countries that have different periods of reference, annualized changes are used. The **annualized absolute rate of change** ($\bar{\Delta}$) is the difference in the MPI between two periods divided by the difference in the two time periods ($t^2 - t^1$) and is computed for the MPI as

$$\bar{\Delta} MPI = \frac{MPI(X_{t^2}) - MPI(X_{t^1})}{t^2 - t^1}.$$

The **annualized relative rate of change** ($\bar{\delta}$) is the compound rate of reduction in the MPI per year between the initial and the final periods, and is computed for the MPI as

$$\bar{\delta} MPI = \left[\left(\frac{MPI(X_{t^2})}{MPI(X_{t^1})} \right)^{\frac{1}{t^2 - t^1}} - 1 \right] \times 100.$$

The same formula can be used to compute and report annualized changes in the other partial indices, namely H , A , censored headcount ratios or per cent contributions.

The reductions in the MPI can be broken down by dimensions. An analysis of changes in the MPI considers both changes in the raw or uncensored headcount ratios (h_j) and in the censored headcount ratios ($h_j(k)$). The changes in censored headcount ratios depict changes in deprivations among the poor.

Changes in the national MPI can be decomposed by subnational regions, ethnic groups or other population subgroups. That is, poverty in each period can be expressed as: $\text{MPI} = \sum_{\ell=1}^m v^{\ell} \text{MPI}(X^{\ell})$, where $\text{MPI}(X^{\ell})$ and $v^{\ell} = n^{\ell}/n$ denote the MPI and the population share of subgroup ℓ , respectively. It can be extremely useful to analyse poverty changes by population subgroups, to see if the poorest subgroups reduced poverty faster than less poor subgroups, and to see the dimensional composition of reduction across subgroups (Alkire and Seth 2013; Alkire and Roche 2013; Alkire, Roche and Vaz 2014). Population shares for each time period must be analysed alongside subgroup trends in order to take into account demographic shifts such as migration or population growth.

References

- Alkire, S., Foster, J.E., Seth, S., Santos, M.E., Roche, J.M. and Ballon, P. (2015). *Multidimensional Poverty Measurement and Analysis: A Counting Approach*, Oxford: Oxford University Press.
- Alkire, S., Conconi, A., and Seth, S. (2014). 'Multidimensional Poverty Index 2014: Brief Methodological Note and Results', OPHI Briefing 19, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S., Conconi, A., and Roche, J.M. (2013). 'Multidimensional Poverty Index 2013: Brief Methodological Note and Results', OPHI Briefing 12, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S., and Foster, J. E. (2011). '[Counting and Multidimensional Poverty Measurement](#)', *Journal of Public Economics*, [95\(7-8\)](#), pp. 476–487.
- Alkire, S., and Robles, G. (2015). 'Multidimensional Poverty Index 2015: Brief Methodological Note and Results,' OPHI Briefing 31, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S., Roche, J. M., Santos, M. E., and Seth, S. (2011). 'Multidimensional Poverty Index 2011: Brief Methodological Note', OPHI Briefing 07, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S. and Santos, M. E. (2010). 'Acute Multidimensional Poverty: A New Index for Developing Countries', OPHI Working Paper 38, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S. and Santos, M.E. (2014). 'Measuring Acute Poverty in the Developing World: Robustness and Scope of the Multidimensional Poverty Index', *World Development*, 59, pp. 251–274.
- Alkire, S., Santos, M. E., Seth, S. and Yalonetzky, G. (2010). 'Is the Multidimensional Poverty Index Robust to Different Weights', OPHI Research in Progress 22a, Oxford Poverty and Human Development Initiative, University of Oxford.
- Economic Commission for Latin America and the Caribbean (ECLAC) (2014). *Social Panorama of Latin America*, Santiago, Chile: ECLAC.
- UNDP (United Nations Development Programme). (2010). *Human Development Report 2010. The Real Wealth of Nations: Pathways to Human Development*, New York: UNDP.

Appendices

Appendix 1: Countries Included in global MPI 2018

Country	Region	Survey	Year
Afghanistan	South Asia	DHS	2015–2016
Albania	Europe and Central Asia	DHS	2008–2009
Algeria	Arab States	MICS	2012–2013
Angola	Sub-Saharan Africa	DHS	2015–2016
Armenia	Europe and Central Asia	DHS	2015–2016
Azerbaijan	Europe and Central Asia	DHS	2006
Bangladesh	South Asia	DHS	2014
Barbados	Latin America and the Caribbean	MICS	2012
Belize	Latin America and the Caribbean	MICS	2015–2016
Benin	Sub-Saharan Africa	MICS	2014
Bhutan	South Asia	MICS	2010
Bolivia, Plurinational State of	Latin America and the Caribbean	DHS	2008
Bosnia and Herzegovina	Europe and Central Asia	MICS	2011–2012
Brazil	Latin America and the Caribbean	PNAD	2015
Burkina Faso	Sub-Saharan Africa	DHS	2010
Burundi	Sub-Saharan Africa	DHS	2016–2017
Cambodia	East Asia and the Pacific	DHS	2014
Cameroon	Sub-Saharan Africa	MICS	2014
Central African Republic	Sub-Saharan Africa	MICS	2010
Chad	Sub-Saharan Africa	DHS	2014–2015
China	East Asia and the Pacific	CFPS	2014
Colombia	Latin America and the Caribbean	DHS	2015–2016
Comoros	Sub-Saharan Africa	DHS-MICS	2012
Congo, Democratic Republic of the	Sub-Saharan Africa	DHS	2013–2014
Congo, Republic of the	Sub-Saharan Africa	DHS	2011–2012
Côte d'Ivoire	Sub-Saharan Africa	MICS	2016
Djibouti	Arab States	MICS	2006
Dominican Republic	Latin America and the Caribbean	MICS	2014
Ecuador	Latin America and the Caribbean	ECV	2013–2014
Egypt	Arab States	DHS	2014
El Salvador	Latin America and the Caribbean	MICS	2014
Eswatini, Kingdom of (Swaziland)	Sub-Saharan Africa	MICS	2014
Ethiopia	Sub-Saharan Africa	DHS	2016
Gabon	Sub-Saharan Africa	DHS	2012
Gambia	Sub-Saharan Africa	DHS	2013
Ghana	Sub-Saharan Africa	DHS	2014
Guatemala	Latin America and the Caribbean	DHS	2014–2015
Guinea	Sub-Saharan Africa	MICS	2016
Guinea-Bissau	Sub-Saharan Africa	MICS	2014
Guyana	Latin America and the Caribbean	MICS	2014

Haiti	Latin America and the Caribbean	DHS	2012
Honduras	Latin America and the Caribbean	DHS	2011–2012
India	South Asia	DHS	2015–2016
Indonesia	East Asia and the Pacific	DHS	2012
Iraq	Arab States	MICS	2011
Jamaica	Latin America and the Caribbean	JSLC	2014
Jordan	Arab States	DHS	2012
Kazakhstan	Europe and Central Asia	MICS	2015
Kenya	Sub-Saharan Africa	DHS	2014
Kyrgyzstan	Europe and Central Asia	MICS	2014
Lao People's Democratic Republic	East Asia and the Pacific	DHS-MICS	2011–2012
Lesotho	Sub-Saharan Africa	DHS	2014
Liberia	Sub-Saharan Africa	DHS	2013
Libya	Arab States	PAPFAM	2014
Macedonia, The former Yugoslav Republic of	Europe and Central Asia	MICS	2011
Madagascar	Sub-Saharan Africa	DHS	2008–2009
Malawi	Sub-Saharan Africa	DHS	2015–2016
Maldives	South Asia	DHS	2009
Mali	Sub-Saharan Africa	MICS	2015
Mauritania	Sub-Saharan Africa	MICS	2015
Mexico	Latin America and the Caribbean	ENSANUT	2016
Moldova, Republic of	Europe and Central Asia	MICS	2012
Mongolia	East Asia and the Pacific	MICS	2013
Montenegro	Europe and Central Asia	MICS	2013
Morocco	Arab States	PAPFAM	2010–2011
Mozambique	Sub-Saharan Africa	DHS	2011
Myanmar	East Asia and the Pacific	DHS	2015–2016
Namibia	Sub-Saharan Africa	DHS	2013
Nepal	South Asia	DHS	2016
Nicaragua	Latin America and the Caribbean	DHS	2011–2012
Niger	Sub-Saharan Africa	DHS	2012
Nigeria	Sub-Saharan Africa	MICS	2016–2017
Pakistan	South Asia	DHS	2012–2013
Palestine, State of	Arab States	MICS	2014
Paraguay	Latin America and the Caribbean	MICS	2016
Peru	Latin America and the Caribbean	DHS-Cont.	2012
Philippines	East Asia and the Pacific	DHS	2013
Rwanda	Sub-Saharan Africa	DHS	2014–2015
Saint Lucia	Latin America and the Caribbean	MICS	2012
Sao Tome and Principe	Sub-Saharan Africa	MICS	2014
Senegal	Sub-Saharan Africa	DHS	2016
Serbia	Europe and Central Asia	MICS	2014
Sierra Leone	Sub-Saharan Africa	DHS	2013
Somalia	Arab States	MICS	2006
South Africa	Sub-Saharan Africa	NIDS	2014–2015

South Sudan	Sub-Saharan Africa	MICS	2010
Sudan	Arab States	MICS	2014
Suriname	Latin America and the Caribbean	MICS	2010
Syrian Arab Republic	Arab States	PAPFAM	2009
Tajikistan	Europe and Central Asia	DHS	2012
Tanzania, United Republic of	Sub-Saharan Africa	DHS	2015–2016
Thailand	East Asia and the Pacific	MICS	2015–2016
Timor-Leste	East Asia and the Pacific	DHS	2016
Togo	Sub-Saharan Africa	DHS	2013–2014
Trinidad and Tobago	Latin America and The Caribbean	MICS	2011
Tunisia	Arab States	MICS	2011–2012
Turkmenistan	Europe and Central Asia	MICS	2015–2016
Uganda	Sub-Saharan Africa	DHS	2016
Ukraine	Europe and Central Asia	MICS	2012
Uzbekistan	Europe and Central Asia	MICS	2006
Vanuatu	East Asia and the Pacific	MICS	2007
Viet Nam	East Asia and the Pacific	MICS	2014
Yemen	Arab States	DHS	2013
Zambia	Sub-Saharan Africa	DHS	2013–2014
Zimbabwe	Sub-Saharan Africa	DHS	2015

Appendix 2: Country-specific considerations on data availability and treatment.

This section comments on methodological issues in the 105 country datasets revised and updated in September 2018. All table and page numbers refer to the survey report for each country's dataset.

Afghanistan (DHS 2015-16): No anthropometric measure was collected. Child mortality information is provided by ever married, eligible women, aged 15 to 49, living in any of the households sampled, and eligible men aged 15 to 59 living in a household selected for male questionnaires. Table 2.2 (p.16) establishes that traditional dry vault toilets and eco-sanitation are not improved sources of sanitation and the MPI considers the same category as unimproved sanitation; Table 2.1 (p.15) states that all instances of bottled water are considered an improved water source. Survey estimates are disaggregated by rural and urban areas and 34 provinces.

Albania (DHS 2008-09): Anthropometric information was collected among all eligible children under 5 and all women aged 15 to 49; a sub-sample of men aged 15 to 49 were also measured. Table 2.10 (p.31) states that the use of bottled water as the main source of drinking water was classified as improved or unimproved, depending on the main source of water used for cooking

and washing (improved or unimproved). Survey estimates are disaggregated by rural and urban areas and four regions.

Algeria (MICS 2012-13): Anthropometric information was collected among all eligible children under 5 years old. Some 9% of children under 5 years had missing information on either height or weight. As a result, this affects the size of missing observations for the final nutrition indicator. Some 3.6% of the individuals live in households where there is missing nutrition data. The use of bottled water as the main source of drinking water was classified as improved or unimproved, depending on the main source of non-drinking water.

Angola (DHS 2015-16): The DHS country report states that anthropometric information was collected only from children under 5 in 50% of the households that were not selected for adult male interviews (p.4). The nutrition information that was collected only from children has very high missing values (close to 14%). Some 13% of the missing sample is from the province of Luanda. Table 2.3 of the DHS report (p.19) indicates that ‘flush’ toilets are considered improved no matter where the flushed material goes and all others are unimproved toilets. As such, the category ‘flush to open pit (ditch or river)’ is coded as improved in this estimation. Table 2.1 of the DHS report (p.18) classifies ‘public fountain’ as safe drinking water, and it is also considered as such for the MPI. On the other hand, Table 2.1 (p.18) classifies drinking water that is delivered using a ‘three-wheel-motorcycle’ as deprived, and the MPI does the same. The DHS report states (p.7) that the subnational data is representative for the 18 provinces in Angola. As such, in the context of Angola, MPI estimates are disaggregated by rural and urban areas, and by the 18 provinces. This MPI was first published in January 2018.

Armenia (DHS 2015-16): The DHS report establishes that anthropometric measures were collected from all eligible women aged 15 to 49 years and children under 5 years (p.5). Table 2.3 (p.14) indicates that ‘flush/pour flush not to sewer/septic tank/pit latrine’ are unimproved sources of sanitation, and these are also considered as such in this MPI estimation. Table 2.1 (p.13) indicates ‘bottled water’ was not an option for the questionnaires, nor was ‘no food cooked in the household’ (Table 2.4, p.15). MPI estimates are disaggregated by rural and urban areas. The report states that many indicators can be estimated at the regional (*marz*) level (there are 11 regions), but these estimates are not representative (p.5). As such, MPI estimates are not disaggregated by subnational regions for Armenia.

Azerbaijan (DHS 2006): Anthropometric data was collected for all eligible children under 5 years, women aged 15 to 49 years and a sub-sample of men aged 15 to 59 years. Table 2.7 (p.21) states

that the use of bottled water as the main source of drinking water was classified as improved or unimproved, depending on the main source of water used for cooking and washing (improved or unimproved). Following the MDG definition, ‘flush/pour to somewhere else’ is considered unimproved. However, in the DHS report for Azerbaijan, this particular category is identified as improved sanitation facilities (Table 2.8, p.22). For the purpose of the global MPI, we have followed the report. Furthermore, in Azerbaijan, the report assumes missing toilet information as unimproved. We have followed the report. Survey estimates are disaggregated by rural and urban areas, as well as Baku and eight other economic regions – nine in total (p.7).

Bangladesh (DHS 2014): Nutritional information was collected for every eligible child under 5 and ever married women aged 15 to 49 years old; there were 60 children not listed on the household roster, but they were considered part of the household because they have a valid anthropometric measure. ‘Other’ toilet facility is not classified in the report, but the MPI considers it as deprived. Table 2.1 (p.10) states all types of bottled water are considered as an improved water source. Survey estimates are disaggregated by rural and urban areas and seven administrative regions. It should be noted that some 6% of individuals were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household only.

Barbados (MICS 2012): Nutritional information was collected for every child under 5. No information on child mortality was collected. According to the MICS country report, all household sanitation facilities are considered as improved, except other facilities. In addition, the report assumes ‘missing’ toilet information to mean unimproved (p.48). This estimation follows the report. Furthermore, the report considers the category ‘open defecation’ as neither improved nor unimproved. But we consider it as unimproved as this is clearly a deprived standard. Table WS.1 (p.44) of the report establishes that bottled water is an unimproved source of water if the source of water for other purposes was ‘protected spring’, ‘other’ or ‘missing,’ and MPI estimation followed such an approach. The MPI is disaggregated at the subnational level into four strata, as well as into urban and rural areas (p.17).

Belize (MICS 2015-16): The MICS conducts anthropometric measures for all children under 5, including those whose mothers may have died or are living elsewhere. Bottled water is considered an improved water source only if the household is using an improved water source for other purposes, such as hand washing and cooking (Table WS.1, pp.70–71). Survey estimates are

disaggregated by urban and rural areas and by seven regions. This MPI was first published in September 2018.

Benin (MICS 2014): Anthropometric measurements were collected for all eligible children under 5 years. Bottled water is considered an improved water source only if the household is using an improved water source for other purposes, such as hand washing and cooking (p.165). Following the MDG definition, the sanitation facility categorised as ‘flush to don’t know where’ is usually considered to be unimproved. However, in Benin, this particular category is identified as an improved sanitation facility (p.176). This estimation follows the report. Survey estimates are disaggregated by urban and rural areas and by twelve regions. This MPI was first published in September 2018.

Bhutan (MICS 2010): Anthropometry was collected from all eligible children under 5 years. In the case of Bhutan, child mortality information was collected from women aged 15 to 49 years, but there is no birth-history data. This means, there is no information on the date of death of children who have died. As such we are able to identify all child mortality that occurred in the household but unable to identify whether the death(s) occurred within five years of the survey’s date. The MPI favours using all available information, thus this MPI estimation constructed the child mortality indicator using all children’s deaths reported by women. In the case of Bhutan, the category ‘flush to unknown place’ is identified as an improved sanitation facility, while the category ‘flush to somewhere else’ is identified as an unimproved facility (Table WS.5, p.88). This MPI estimation follows the report. However, everyone who reported ‘flush to unknown place’ was using a shared facility, hence by this criterion, they were considered to have an unimproved sanitation facility. Furthermore, the report considers the category ‘open defecation’ as neither improved nor unimproved. But we consider it as unimproved as this is clearly a deprived standard. Bottled water is considered an improved water source only if the household is using an improved water source for other purposes, such as hand washing and cooking (p.75). Survey estimates are disaggregated by rural and urban areas and by 20 districts (*Dzongkhags*). However, due to a smaller sample size, two of the districts were merged, resulting in subnational estimations for 19 *Dzongkhags*.

Bolivia, Plurinational State of (DHS 2008): Anthropometry was collected for all eligible children under 5 and women aged 15 to 49 (p.7). Households using bottled water for drinking are classified

as using an improved or unimproved source according to their water source for non-drinking activities. Survey estimates are disaggregated by rural and urban areas and by nine regions.

Bosnia and Herzegovina (MICS 2011-12): Anthropometric measures are available for all children under 5, including those whose mothers may have died or are living elsewhere. There is no information on child mortality in the dataset. Following the MDG definition, 'flush to unknown place/not sure/do not know where' are considered as unimproved. However, in Bosnia and Herzegovina, the sanitation facilities in this particular category are identified as improved (p.54). In addition, in Bosnia and Herzegovina, the report categorises 'missing' toilet information as unimproved. This MPI estimation followed the report. Furthermore, the report considers the category 'open defecation' as neither improved nor unimproved. But we consider it as unimproved as this is clearly a deprived standard. Bottled water is considered an improved water source only if the household is using an improved water source for other purposes, such as hand washing and cooking (p.47). The sample design for Bosnia and Herzegovina MICS 2011-12 allows for statistically reliable estimates at the national level, for urban/rural areas and for two of the three administrative unit clusters: FBiH and RS (p.150). However, estimates are not representative for BD – the third administrative unit. BD represents 2% of the total national population. Given this limitation, the global MPI estimates are limited to the national level and are disaggregated by rural and urban areas only. There are no subnational estimates.

Brazil (PNAD 2015): This survey lacks information on the variables for nutrition, floor and bicycle in the household. Child mortality information is provided by all women aged 10 and above, but this MPI calculation considers only occurrences of child mortality among women aged 15 to 49 years old, in order to maintain comparability with other survey estimations in the global MPI. In Brazil, we are not able to identify whether the reported child mortality occurred in the last five years. This is because the data lacks information on the child's death date. The report specifies that adequate sanitation is having a toilet that is 'piped to the general sewage net or septic tank' that is linked to the general collection net, and this definition guided the coding of responses for this MPI estimation. Furthermore, the category 'rudimentary toilet' is considered as unimproved. The country report specifies that adequate water means that it is piped or comes from the general network, and this definition guided the coding of responses for this MPI estimation. The time needed to fetch water is not available, and so we are not able to identify the time household members would have spent to obtain drinking water, if the source of water is outside of their home. In Brazil, the indicator for housing was only constructed using information on the wall and roof variables as the

survey did not collect data on floor. Survey estimates are disaggregated by rural and urban areas and by units of the federation. This MPI was first published in September 2018.

Burkina Faso (DHS 2010): Anthropometry was collected for a sub-sample of children under 5 years and women aged 15 to 49 (p.195). Bottled water is coded as an improved source (Table 2.1, p.17). MPI estimates are disaggregated by rural and urban areas and by 13 administrative districts.

Burundi (DHS 2016-17): Anthropometry was collected for all eligible women aged 15 to 49 and all eligible children under 5 years, for half the households (those selected for the men's survey) in the sample (p. 2). Bottled water is considered an improved water source only if the household is using an improved water source for other purposes, such as hand washing and cooking (Table 2.1, p.18). Survey estimates are disaggregated by rural and urban areas and by 18 administrative districts. This MPI was first published in September 2018.

Cambodia (DHS 2014): The DHS report establishes that anthropometric measures were collected from children under 5 and women aged 15 to 49 years old in two-thirds of the sampled households (pp. 7–8). Table 6.2 on page 19 considers sources of water in both wet and dry seasons, and establishes that 70% of households use the same source of water in both seasons. Similarly, data on the time needed to fetch drinking water is available for the dry season and wet season. Some 30% of the households use a different source of water for the dry and wet season. As such, the drinking water indicators were constructed using information from the dry and wet seasons. A household is identified as deprived in drinking water if its members had used an unimproved source of drinking water in either the dry or wet season or if they walked 30 or more minutes to fetch water in either season. Survey estimates are disaggregated by rural and urban areas and 19 subnational units.

Cameroon (MICS 2014): Anthropometric measures are available for all children under 5. Following the MDG definition, 'flush to don't know where' is considered to be an unimproved sanitation facility. However, in Cameroon, this particular category is identified as an improved sanitation facility (p. 108). This MPI estimation follows the report. Survey estimates are disaggregated by rural and urban areas and by 12 subnational regions. This MPI was first published in September 2018.

Central African Republic (MICS 2010): This represents a country in the MPI database that had been reported in 2010 and 2011 but was dropped in 2013 because its data were from 2000. Anthropometric measures are available for all children under 5. Child mortality information was

collected from women aged 15 to 49 years but there is no birth history data. This means there is no information on the dates of death for children. As such we are able to identify all child mortality that occurred in the household but unable to identify whether the death(s) occurred within five years of the survey's date.. The MPI favours using all available information, so this MPI estimation constructed the child mortality indicator using all child death(s) reported by women. The survey report identifies households with missing information on the source of drinking water as deprived (p. 140). This MPI estimation follows the report. The survey is representative at the national level, for urban/rural areas and for 16 of the prefectures. However, one additional prefecture, Vakaga (1% of the total population of the country), is not representative due to safety issues. Subnational figures for this particular region exist but must be interpreted with caution.

Chad (DHS 2014-15): Height and weight information was collected for children under 5 and women aged 15 to 49 years old who were not living in households selected for the male or HIV questionnaire, the latter represented one-third of the total sample. This MPI estimation is based on two-thirds of the samples with anthropometric information. The survey report (Table 2.1, p.15) states that all instances of bottled water are considered as an improved water source. Survey estimates are disaggregated by rural and urban areas, 20 districts and the capital city.

China (CFPS 2014): Anthropometric information was recorded for all individuals aged 0 to 98 years. This departs from the usual DHS surveys that tend to collect anthropometric data from adults up to the age of 59 years. Following the global MPI principle of using all available information, we have constructed the nutrition indicator using data from individuals up to the age of 70 years. The CFPS only collects information on child mortality that occurred within the household in the last five years. School age for children is defined as 7 to 15 years old. Years of schooling was derived from the highest level of education attained by a household member. Information on the main source of water used for cooking was considered to be the main source of drinking water, and rain and cellar water were considered to be unimproved. CFPS 2014 lacks information on whether the toilet is shared; the travel time to the source of drinking water; and ownership of a radio, landline telephone and animal cart. This suggests that the indicators related to sanitation, drinking water and assets have limitations in terms of comparability with other country datasets. In addition, there is no housing information, that is, data on floor, roof and walls was not collected as part of the survey.

Colombia (DHS 2015): This survey lacks information on nutrition. Child mortality information is provided by women aged 15 to 49 and men aged 15 to 59. The toilet categories in the Colombian dataset do not follow the standard DHS categories. According to the report (pp. 91–92), the most

suitable types of sanitary service are those connected to sewer lines and septic tanks. Households with less adequate systems of disposal of excreta are those that use sanitary facilities without a connection to a sewer line or septic tank, latrines, cesspools, pits, or, lastly, those that have no sanitation facilities at all. This MPI estimation follows the reports' grouping of toilet categories into improved and unimproved. The category 'propane gas' reflects clean cooking fuel, and this MPI estimation follows that categorisation for cooking fuel. Furthermore, the Colombian survey has combined 'charcoal and firewood' under a single category of cooking fuel, which is identified as deprived. In Colombia, the housing indicator was only constructed using information on floor and roof variables as the survey did not collect data on walls. MPI estimates are disaggregated by rural and urban areas, as well as by 16 subnational regions. Some 3% of individuals were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household only. This MPI was first published in September 2018.

Comoros (DHS-MICS 2012): A previous MPI estimation for Comoros dated from 2000, and it was not reported in 2013 and 2014 due to being outdated. All women aged 15 to 49 and children younger than 5 years old were eligible for anthropometric measures. The DHS-MICS report considers rainwater as an unimproved source of drinking water (p. 10) and so does this estimation of MPI. MPI estimates are disaggregated by rural and urban areas and for each of the three main islands of the country.

Congo, Democratic Republic of the (DHS 2013-14): Anthropometric measures were gathered from 50% of eligible women aged 15 to 49 years old and their children aged younger than 5. The MPI estimation is based on this sub-sample. Page 20 of the DHS report considers 'no facility/bush/field' as an ambiguous category, but this MPI estimation considers it to be unimproved. MPI estimates are disaggregated by rural and urban areas and for 11 subnational regions.

Congo, Republic of the (DHS 2011-12): Anthropometric measures were gathered from 50% of eligible women aged 15 to 49 years old and their children aged younger than 5 who were not living in households selected for the male questionnaire. The MPI estimation is based on this sub-sample. MPI estimates are disaggregated by rural and urban areas and for 12 subnational regions. It should be noted that some 4% of individuals were dropped from the dataset because they were identified

as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household only.

Côte d'Ivoire (MICS 2016): Anthropometric data was collected for all children under 5 years and a sub-sample of women aged 15 to 49. This is the first MICS data that has nutrition data for adults. All prior MICS datasets only carried anthropometric data for children under 5. The country report identifies water in a sachet as an unimproved source of drinking water and the category 'flush to don't know where' as an improved sanitation facility (p.79). This MPI estimation follows the report. Furthermore, the report considers the category 'open defecation' as neither improved nor unimproved. We follow the standard set in the MDGs, where this is clearly deprived. Survey estimates are disaggregated by rural and urban areas and by 11 subnational regions. This MPI was first published in September 2018.

Djibouti (MICS 2006): Anthropometric data was collected from all eligible children under 5 years. Child mortality information was collected from women aged 15 to 49 years, but there is no birth history data. As such, we are able to identify all child mortality that occurred in the household but not whether the death(s) occurred within five years of the survey's date. The MPI favours using all available information, thus, this MPI estimation constructed the child mortality indicator using all child death(s) reported by women. It should be noted that the toilet categories in the data do not match the ones presented in the report and some of the categories that are present in the dataset are not mentioned in the report. It could be the case that these categories have been combined and renamed in the report. Thus, it is difficult to assert if 'flush to somewhere else' and 'flush to unknown place' are considered unimproved sanitation facilities. Following the MDG benchmark, these categories are identified as unimproved. Survey estimates are disaggregated by rural and urban areas and by two major regions – the Autres (other) districts and the Djibouti district.

Dominican Republic (MICS 2014): This survey lacks information on nutrition. The country report indicates that the category 'flush to don't know where' is considered to be an improved sanitation facility (p.120). This MPI estimate followed the report. Survey estimates are disaggregated by rural and urban areas and ten health areas.

Ecuador (ECV 2013–14): The survey collected anthropometric information from every individual aged 0-98 years. In this estimation, BMI of household members aged between 20 and 70 years was considered. In addition, we computed the BMI-for-age of household members aged between 5 and under 20 years old, as well as identified children under 5 who are either stunted or underweight.

The survey collected information on the total number of children ever born and the number of those who are still alive among women aged 12 - 49 years old who have ever been pregnant, and the indicator of child mortality is formed as the difference between these two numbers. The indicator of children's schooling considers enrolment rather than attendance. The indicator of electricity considers solar panel as an improved source of electricity. From page 23 of the ECV country report, it may be inferred that individuals in the higher income quintile are more likely to get their drinking water from piped sources (public network and other pipes). Following this, we assume that other categories including water drawn from a well is considered as unimproved. The report (p.24, footnote 24) specifies that toilets with sewer, septic tank and other flush systems are improved. This suggests that all other categories are non-improved, including the category identified as latrine. The indicator of television considers colour, plasma, LCD and black/white TV. The indicator of radio considers both radio and sound equipment. The assets indicator constructed for this estimate lacks information on use of animal carts. Usual residents are defined as all members who were reported as relatives living in the household. Survey estimates are disaggregated by rural and urban areas and by 24 subnational regions.

Egypt (DHS 2014): The questionnaire collected information from all ever married women age 15-49 who were usual or de facto residents and all never married children under 20 years. The survey has information on flooring but lacks information on walls and roofing. As such, the housing indicator is constructed using information related to flooring rather than the combination of floor, roof and walls. No information on cooking fuel was collected in the survey. Page 15 of the survey report considers the following as non-improved sources of sanitation and so did this MPI estimation: 'flush to pit latrine / to pipe connected to canal / groundwater' and 'flush, don't know where'. Survey estimates are disaggregated by rural and urban areas and by 25 subnational regions. Some 2% of individuals were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household only.

El Salvador (MICS 2014): Anthropometric information was collected for all children under five. Some 6.2% of children under 5 years have either missing info on height or weight. As a result, this affected the size of missing observations for the final nutrition indicator. Some 4 percent of the individuals live in households where there is missing nutrition data. Table WS5 on page 159 says that a toilet that 'flushes to unknown place' is improved sanitation and those that 'flush to

somewhere else' are non-improved sources of sanitation. This estimation follows the report. Survey estimates are disaggregated by rural and urban areas, and for 14 regions in the country.

eSwatini, Kingdom of (Swaziland) (MICS 2014): In all previous MPI publications, eSwatini was identified as Swaziland. Anthropometric measures are available for all children under five. The MDG definition identifies 'flush don't know where' as a non-improved sanitation facility. However, this particular category is identified as improved sanitation facilities in the country report (p. 85). This estimation follows the report. The report considers the category 'open defecation' as neither improve nor non-improved. This estimation considers it as non-improved. The estimates are disaggregated for urban and rural areas and four administrative regions of the country.

Ethiopia (DHS 2016): As stated in page 4 of the DHS report, anthropometric measures were collected in all households from women aged 15-49 years, men aged 15-59 years and children under the age of 5. MPI estimates for Ethiopia are disaggregated by rural and urban areas, nine geographical regions and two administrative cities. Some 2% of individuals were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household only.

Gabon (DHS 2012): Anthropometrics were collected from eligible women 15-49 years and children under 5 living in two thirds of the sampled households. The MPI estimation is based on this subsample. The categories 'Village hydraulics' were considered as improved sources for drinking water, while spring water is considered a non-improved source of drinking water (p. 14). In addition, the DHS country report identifies households using 'sawdust' or 'wood chips' as solid fuel as deprived in cooking fuel. This estimate follows the report. Some 2% of individuals were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household only. Survey estimates are disaggregated by rural and urban areas and for each of the nine provinces and the grouped cities of Libreville and Port-Gentil.

Gambia (DHS 2013): Anthropometric information were recorded for eligible children age 0-59 months (p. 6) and eligible women aged 15-49 (p.5) living in half of the sampled households. Survey estimates are disaggregated by rural and urban areas and for each of the eight governing units of the country.

Ghana (DHS 2014): Anthropometric information were recorded for all eligible women 15-49, men 15-59, and children 0-5 living in half of the sampled households (p.6). The MPI estimation is

based on this subsample. Table 2.1, footnote 1 on p. 13 mentions that 2014 Ghana DHS did not collect information on the secondary source of water, and the quality of bottled/sachet water is not known, but they consider this source of water as improved to ensure consistency with 2008 GDHS. Survey estimates are disaggregated by rural and urban areas and 10 administrative regions.

Guatemala (DHS 2014–15): Height and weight information was collected for all children under five and women aged 15 to 49 years old in the sampled household. Table 2.3 on page 20 establishes that toilets that ‘flush to somewhere else/do not know where’ are not improved sources of sanitation, and this estimation of MPI follows the report. Table 2.2 on page 19 states that a public fountain or tank, mechanical or manual well and bottled water are non-improved drinking water sources, and this MPI estimation followed such an approach. Table 2.1 on page 17 of the report does not consider ‘other’ responses to reflect inadequate clean cooking fuel, and this MPI estimation follows that categorization for cooking fuel. Survey estimates are disaggregated by rural and urban areas and 22 departments.

Guinea (MICS 2016): Anthropometric data was collected only from all children under 5. The MICS country report indicate the category ‘flush do not where’ as improved sanitation facility. This estimation follows the report. Survey estimates are disaggregated by rural and urban areas and each of the eight administrative regions.

Guineau-Bissau (MICS 2014): Anthropometric information was collected for all children under five. Page 203 of the report establishes six as the age to start primary education. Plasma televisions were considered as part of the small assets of the household. Survey estimates are disaggregated by rural and urban areas, and for nine regions in the country.

Guyana (MICS 2014): Anthropometric information was collected for all children under five. The report considers the category open defecation as neither improved nor non-improved (p. 157). We follow the standard set in the MDGs where this is clearly a deprived standard. Furthermore, the report considers missing information on sanitation as non-improved (p. 157), which this estimation has followed. In addition, households with missing information on source of drinking water are identified as deprived (Table WS.1, p.148). We have followed the MICS country report. Page 166 of the report establishes six as the age to start primary education. Survey estimates are disaggregated by rural and urban areas, and by coastal and interior areas.

Haiti (DHS 2012): In a subsample of two out of three households, a sample of men aged 15-59 were eligible to be surveyed. In this subsample, all women as well as all children under five were

eligible to be measured and weighed to assess their nutritional status (p.5). Do note that anthropometric data were not collected from men within this subsample - just women and children. This estimation is based on those households that are included in the nutritional subsample (i.e. two thirds of the households). Following the country survey report, the category 'sales company of water' was considered as an improved source of water. Similarly, 'Mobile chemical toilet' was considered a non-improved sanitation facility (p. 15). This estimate follows the report. Individuals living in camps and tents are identified as deprived in housing. Survey estimates are disaggregated by rural and urban areas, and by 10 subnational regions.

Honduras (DHS 2011–12): Anthropometric information were recorded for all eligible children born since 2006 (age 0-59 months) and all eligible women aged 15-49 (p.5). There is no information on access to electricity. Table 10.8 in the report indicates that any type of flush toilet is considered improved. This would imply that the categories 'flush toilet do not know connection' and flush toilet with connection to open water are considered as improved sanitation. The table on page 38 indicates that while all types of flush toilet (including 'don't know where' and 'to open water') are considered as improved sanitation, a pit latrine is considered as a non-improved facility. This estimation follows the DHS country report. Survey estimates are disaggregated by rural and urban areas, and by 18 subnational regions. Some 3% of individuals were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household only.

India (DHS 2015–16): Anthropometric data were collected for all eligible children under 5 years, all women aged 15 to 49 years and a sub-sample of men aged 15 to 59 years. These men, who lived in one-third of the sampled households, were selected for the state module questionnaire (p.4). The weight and height of children under 5 were measured regardless of whether their mothers were interviewed in the survey (p.290). The anthropometric data from women aged 15 to 49 excluded pregnant women and those who had given birth in the last two months of the survey (p.298). In the India DHS 2015-16 survey report, sanitation facilities described as 'open defecation' are identified as neither improved nor unimproved. However, following the MDG guidelines, open defecation is a clear standard of deprivation and was treated as such in this MPI estimation. According to the country report, because the quality of bottled water is not known, households using bottled water are classified as using an unimproved source in accordance with the practice of the WHO-UNICEF Joint Monitoring Programme for Water Supply and Sanitation (p. 24). The category for source of drinking water entitled 'community RO plant' is listed as an improved source in the country report. This MPI estimation follows the report. Furthermore, the category

‘other water sources’ is neither listed as improved or unimproved in the country report (Table 2.1, p.24). As such, this estimation followed the MDG standard where ‘other drinking sources’ is listed as an unimproved source. Survey estimates are disaggregated by rural and urban areas, as well as by 36 states/union territories and 157 districts. It should be noted that some 3% of individuals (or close to 93,000 observations) were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household. The final analytical sample for India 2015-16 covered 2.8 million individuals. This MPI was first published in September 2018.

In the global MPI 2018, we also harmonised data from India DHS 2005–06 allowing for comparison with the 2015-16 data. Similar to DHS 2015-16, anthropometric data was collected for all eligible children under 5 years, all women aged 15 to 49 years and a sub-sample of men aged 15 to 59 years in DHS 2005-06. We have identified households as using an unimproved source of water if they used bottled water. The decision was not consistent with the 2005-06 country report. However, this decision was compatible with the decision made in the India DHS 2015-16, allowing for comparable estimates between both survey periods. Survey estimates are disaggregated by rural and urban areas, and 29 states. It should be noted that some 3% of individuals (or close to 18,000 observations) were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household. The final analytical sample for India 2005-06 covered slightly more than half a million individuals.

Indonesia (DHS 2012): There is no information on nutrition for any member of the households. In Indonesia, seven is the official age to start primary education. The wall and roof materials listed in the data differ from the standard materials that is usually listed in other DHS surveys. Following the categorisation applied in the questionnaire (p. 394), households are identified as deprived if the wall is made of bamboo and wood stem, and deprived if the roof is made of thatch/palm leaf/sod or wood/sirap and bamboo. The data lack information on ownership of computers. Survey estimates are disaggregated by rural and urban areas, and by 33 subnational regions. Some 3% of individuals were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household.

Iraq (MICS 2011): Anthropometric measures are available for all children under five, including those whose mothers may have died or are living elsewhere. ‘Reverse osmosis’ was considered as

an improved source of water. Survey estimates are disaggregated by rural and urban areas, and by 18 governorates.

Jamaica (JSLC 2014): The JSLC survey report confirms that anthropometric information were recorded for a subsample of one third of all eligible children aged 0-59 months and eligible women aged 15-49 (p.4). Information on child mortality was absent from the survey. In Jamaica, the National Water Commission (NWC) and the Ministry of Health restrict the definition of improved drinking water sources to only treated water, that is, household connection (piped into yard/dwelling) and public standpipe. The country report (p.84) adds bottled water and trucked water (from NWC) to the definition of improved drinking water sources. Furthermore, the report identifies trucked water from private companies as an unimproved source of drinking water because of the difficulty in determining the safety of the drinking water from the multiple private companies. The country report summarises that untreated sources of drinking water are: rainwater tank, well, river/lake/spring/pond or water trucked from private company (p. 84). This estimate follows the report. In addition, distance to water is provided in kilometers / meters / miles / yards / chains. For the purpose of the global MPI, we have converted these distances to meters. Every 1000 metres represents 30 minutes round trip to the water source. The housing indicator was only constructed using information on wall, as the survey did not collect data on floor and roof. The country report included only walls made of concrete block and steel in the housing quality index. The report states that these types of wall have durability for withstanding the weather and for providing occupants with a greater level of security (p. 78); Table 5.5, p. 83). Following the country report, we identified only walls made of concrete block and steel as non-deprived. All other wall materials including wood, stone, brick, concrete nog, wattle/adobe and others were identified as non-improved. The data lacks information on ownership of animal carts. Survey estimates are disaggregated by rural and urban areas, and by 14 subnational regions. Some 4% of individuals were dropped from the dataset because they were identified as non-usual residents. The global MPI estimates are based on usual or permanent residents of a household. This MPI was first published in September 2018.

Jordan (DHS 2012): Anthropometrics were collected from eligible women 15-49 years and children under 5 living in two thirds of the sampled households. This MPI estimation is based on this subsample. Coal and wood as sources of cooking fuel are grouped together in the same category, so both are considered as solid fuels for MPI. The data lacks information on ownership of bicycle and motorbike. Survey estimates are disaggregated by rural and urban areas only.

Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Kazakhstan (MICS 2015): Anthropometric information was collected from all children under five. School age is considered to be from 7 years old onwards, according to the survey report. The MDG definition identifies 'flush to unknown place/not sure/do not know where' as non-improved sanitation facilities. However, this particular category is identified as improved by the MICS country report (p. 81). This estimation follows the report. Furthermore, the report considers the category open defecation as neither improved nor non-improved. We consider it as non-improved as this is clearly a deprived standard. Survey estimates are disaggregated by rural and urban areas only. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Kenya (DHS 2014): Anthropometric measures are available for children under five and women aged 15 to 49 living in 50% of the households interviewed, so this MPI estimation is based on that subsample. Table 2.1 on p. 12 does not consider 'other' sources of water as improved nor non-improved, but the MPI considers it as non-improved. All types of bottled water are considered as an improved water source in the report. Information is disaggregated at urban, rural and eight subnational regions.

Kyrgyzstan (MICS 2014): Anthropometric measures are available for all children under five and the presence of oedema was considered as severe malnutrition. Education beyond 'basic secondary' was assumed to be preceded by 9 years of schooling, according to communication with the country survey team. The survey report assumes missing toilet information as non-improved (p. 84). This estimation followed the report. The estimate is disaggregated at urban and rural level, and nine subnational regions.

Lao People's Democratic Republic (DHS-MICS 2011–12): Anthropometric measures are available for all children under five, including those whose mothers may have died or are living elsewhere. The MPI results is disaggregated at urban and rural level, and 17 subnational regions.

Lesotho (DHS 2014): Anthropometric information was recorded for a subsample of all eligible children aged 0-59 months, eligible women aged 15-49, and eligible men aged 15-59 (p.2) living in one half of the sampled households. Some 21% of the people in the survey were non-usual members of households, which is not the population of interest to the MPI. Page 11 of the DHS country report confirms that 21% of eligible men and women listed in the household schedule

were not usual members of households. We also found that some non-usual residents of those households selected for anthropometric measures were not eligible for measurement based on the eligibility variables hv117, hv118, and hv120. These two criteria defined the sample from which the MPI was calculated. As a result, we are left with 62% (60% unweighted cases) of the initial sample, a large reduction in sample size compared to other surveys. We did not consider this loss of sample in our bias analysis as it is not the result of missing information from usual residents. Table 2.2 on page 17 does not specify whether a composting toilet is an improved source of sanitation or not, so this MPI estimation considers a composting toilet as improved following the MDG guidelines. All bottled water is considered as improved on Table 2.1 of page 16. Survey estimates are disaggregated by rural and urban areas and ten districts (subnational areas).

Liberia (DHS 2013): Anthropometrics were collected from eligible women (aged 15-49), men (aged 15-49) and children (0-59 months) living in 50% of the sampled households. The survey does not include information on access to landline telephone, so access to mobile telephone was used to assess ownership to telephone. The MPI result is disaggregated at urban and rural level, and by 15 subnational regions.

Libya (PAPFAM 2014): Anthropometric data were collected from children 0-6 years. Following the principles of global MPI, BMI-for-age was computed for all children between the age of 5-6 years. The nutritional condition of children under 5 were assessed using the stunting and underweight indicators. Libya only has information on flooring, with no information on walls and roofing. As such the housing indicator is constructed using only flooring. The Libya PAPFAM 2014 show that some 4,000 individuals have missing data for flooring. This is because the data was not collected from households if their type of dwelling was hut, tent, temporary shelter or other. Given the precarious conditions of these dwellings, the flooring of these dwellings were coded as non-improved rather than treating it as 'missing'. The MPI result is disaggregated at urban and rural level, and by 21 subnational regions. This MPI was first published in September 2018.

Macedonia, The former Yugoslav Republic of (MICS 2011): Anthropometric measures are available for all children under five, including those whose mothers may have died or are living elsewhere. There is no information on child mortality available at the national level. Thus, the MPI was computed based on the remaining nine indicators. The MDG definition identifies 'flush to unknown place/not sure/do not know where' as non-improved. However, the country report identifies this particular category as improved sanitation facilities (p.57). For the purpose of the global MPI, we have followed the report. Furthermore, the report considers the category open defecation as neither improved nor non-improved. But we consider it as non-improved as this is

clearly a deprived standard. In addition, in Macedonia, the report assumes missing toilet information as non-improved. This estimate followed the report. The MPI result is disaggregated at urban and rural level, and by eight subnational regions.

Madagascar (DHS 2008–09): In a subsample of 50% of selected households, all men aged 15-59 were interviewed. It is also in this subsample of households that anthropometric measurements were collected from children under 5 and women aged 15-49 years, but not from men (p. 7). The MPI results is disaggregated at urban and rural level, and by 22 subnational regions.

Malawi (DHS 2015–16): Height and weight information were collected for children under five and women aged 15 -49 years who were living in households selected for a male questionnaire. This MPI estimation is based on such samples with anthropometric information. Survey estimates are disaggregated by rural and urban areas and 28 districts.

Maldives (DHS 2009): Anthropometrics data were collected from children aged 6-59 months and of ever-married women aged 15-49 (p .6). Some 29% of the women for whom nutrition data should have been collected had no nutrition data. The report does not treat this group as a missing value. Instead, the missing group were excluded from the analysis (see Table 11.8, p.130). Some 39% of children under 5 who should have been measured had missing nutrition information. The report does not treat this group as a missing value. Instead, the missing group was excluded from the analysis (see Table 11.1, p.118). This resulted in high missing observations for the final nutrition indicator. Subnational figures are not reported because the final number of observations used to estimate the MPI was below 85% of the total observations in the analytical sample.

Mali (MICS 2015): Anthropometric information was collected for children under 5. Table WS.5 of the survey report (p. 161) indicate that 'flush somewhere else' is an improved toilet facility. This estimation followed the report. Survey estimates are disaggregated by rural and urban areas and eight subnational regions. This MPI was first published in September 2018.

Mauritania (MICS 2015): Anthropometric information was collected for children under 5. Child mortality information was collected only from ever-married women 15-49 years old. In Mauritania 'flush to unknown place/not sure/do not know where' is considered as improved sanitation (Table WS.5, p.144). This estimation followed the report. Furthermore, the report considers the category open defecation as neither improved nor non-improved. We follow the standard set in the MDGs

where this is clearly a deprived standard. Survey estimates are disaggregated by rural and urban areas and 13 subnational regions. This MPI was first published in September 2018.

Mexico (ENSANUT 2016): Anthropometric information was recorded for all individuals aged 0-99 years. This departs from the usual DHS surveys that tend to collect anthropometric data from adults up to the age of 59 years. Following the global MPI principle of using all available information, we have constructed the nutrition indicator using data from individuals up to the age of 70 years. ENSANUT 2016 lacks information on the time it takes to collect drinking water if it is outside of the household premise. The assets indicator constructed for this estimate lacks information on use of a bicycle and animal carts. Survey estimates are disaggregated by rural and urban areas and four major geographical regions of the country. This MPI was first published in September 2018.

Moldova, Republic of (MICS 2012): Anthropometric information was collected for all children under 5 years of age. Following the MDG definition, 'flush to unknown place/not sure/do not know where' is considered as non-improved. However, in the country report, this particular category is identified as improved sanitation facilities (p.56). For the purpose of the global MPI, we have followed the report. Furthermore, the report considers the category open defecation as neither improved nor non-improved. We consider it as non-improved as this is clearly a deprived standard. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Mongolia (MICS 2013): Anthropometric information was collected from all children under five years. Type of toilet and water were defined in terms of their definition in the report instead of international standards. Public water kiosks and designated water trucks are classified as improved water sources because the tanker trucks and tanks in the kiosks are cleaned regularly, as stated on p. 42 of the report. Page 47 of the report states that a pit latrine with a slab is classified as unimproved as it often does not meet international standards. Finally, the report differentiated between households living in gers/yurts/tents. In Mongolia, households living in gers are considered deprived if the floor is natural or made from other materials. Households living in gers are considered deprived if the walls are single-layered and non-deprived if the walls are double-layered, in line with the survey report. Households living in gers are considered deprived if the

roofs are single-layered and non-deprived if the roofs are double-layered, in line with the survey report. The MPI result is disaggregated for urban and rural areas and for five subnational regions.

Montenegro (MICS 2013): All children under 5 were eligible for anthropometric measures. The report considers the category open defecation as neither improved nor non-improved. We consider it as non-improved as this is clearly a deprived standard. In addition, the report, assumes missing toilet information as non-improved. We followed the report. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Morocco (PAPFAM 2011): Anthropometric data were collected from children aged 0-6 years. Following the principles of global MPI, BMI-for-age was computed for all children between the age of 5-6 years. The nutritional condition of children under 5 were assessed using the stunting and underweight indicators. The survey considers information on education (last level and grade attended) only for ever-married women aged 15-49. For the remaining members of the household, the only information available was on the highest level of education completed. It was assumed that the highest level of education conveys information on the minimum number of years of schooling attained. The housing indicator is constructed using information on floors and roofing, but lacks information on walls as this is not present in the data. The dataset does not contain information on the presence of a bicycle or animal cart in the household. The MPI result is disaggregated for urban and rural areas and for 14 subnational regions.

Mozambique (DHS 2011): Anthropometric measures were collected for all children under 5 years and women aged 15-49 years. The MPI results is disaggregated for urban and rural areas and for 11 subnational regions.

Myanmar (DHS 2015–16): Height and weight information was collected for children under five and women aged 15 to 49 years in all households sampled. The report establishes five as the age to start primary education. Table 2.1 on page 16 states that bottled water is considered an improved water source, and the MPI follows the report. Survey estimates are disaggregated by rural and urban areas and 15 subnational regions.

Namibia (DHS 2013): Anthropometric measures were collected in a subsample of half of the survey households from all women and men aged 15-64 years and from all children younger than five. Survey estimates are disaggregated by rural and urban areas and 13 subnational regions.

Nepal (DHS 2016): Nutrition data was collected from all adults aged 15 years and older living in half of the sampled households. The report (p.1) indicates that the data allowed calculation of key

demographic indicators, particularly fertility and under-5 mortality rates at the national level, for urban and rural areas, and for the country's seven provinces. In September 2015, Nepal's Constituent Assembly approved that Nepal is administratively divided into seven provinces. The provinces are labelled as Province 1-7. Following this, MPI estimates are disaggregated by rural and urban areas and the seven provinces.

Nicaragua (DHS 2011–12): Every woman aged 15-49 was eligible but only one of them per household was randomly selected for an interview and anthropometrics. In turn, every child under 5 born from interviewed women is eligible for anthropometrics. In the dataset, there is no direct question on whether the household has electricity. As such, we have used a closely related question, which is 'what is the main source of lighting for this house'. The answers for this question are: electric grid, power plant or generator, solar panel, car battery, kerosene, candle, other or do not have light. For the purpose of the global MPI, and in line with the objective of this indicator, we identify households as having electricity if the lighting is powered by electric grid or power plant or generator. All other categories, including solar panel is identified as deprived. MPI estimates are disaggregated by rural and urban areas and by 17 subnational regions.

Niger (DHS 2012): Anthropometric information was recorded for women 15-49 years, as well as all children under the age of five, who were measured and weighed in one out of every two households (p. 8). The country survey report does not list the category water vendor (63) as improved or non-improved. We consider it as non-improved given that there is no clarification on whether the vendors supply clean drinking water. MPI estimates are disaggregated by rural and urban areas and by eight subnational regions.

Nigeria (MICS 2016–17): Anthropometric data were collected for all children under 5 years. The survey report identifies 'flush to unknown place' as improved sanitation facilities (p.118). This estimation followed the report. MPI estimates are disaggregated by rural and urban areas and by 37 subnational regions.

Pakistan (DHS 2012–13): One in three households in the survey was selected for a male survey. Measurements of height and weight were obtained from children born in the five years preceding the survey in the subsample of households selected for the male survey. Similarly, height and weight measurements among women aged 15-49 were collected from every third household that was selected for a male interview (p.180). Following the survey report, 'hand pump' and 'filtration

plant' are both considered as improved sources of water. MPI estimates are disaggregated by rural and urban areas and by six subnational regions.

Palestine, State of (MICS 2014): Anthropometric measures were collected from all children under five. Some 12 percent of children under 5 years have either missing info on height or weight. As a result, this affects the size of missing observations for the final nutrition indicator. Some 5% of the individuals live in households where there is missing nutrition data. Two categories for sources of drinking water, 'purchased gallons' and 'protected spring', were considered in the report as non-improved. The dataset does not contain information on the presence of bicycles or motorcycles in the household. MPI estimates are disaggregated by rural and urban areas. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Paraguay (MICS 2016): Anthropometric measures are collected from all children under five. The country report for Paraguay indicated the category 'flush do not know where' as an improved sanitation facility. In this estimation, we followed the report. MPI estimates are disaggregated by rural and urban areas and by nine subnational regions.

Peru (DHS 2012): Anthropometric information was collected from all eligible children under 5 years and from all eligible women aged 15-49 (p.4). The country report does not specify whether drinking water that is sourced from a well inside the dwelling is improved or non-improved. Since there is lack of information on the quality of water drawn from the well in the dwelling, we have identified this particular category as non-improved. MPI estimates are disaggregated by rural and urban areas and by 25 subnational regions.

Philippines (DHS 2013): This survey did not gather information on school attendance and nutrition, and these indicators have been omitted from the estimation. As a result, estimates are based on 8 of the 10 global MPI indicators. The report also establishes that a public toilet is neither improved nor non-improved. Households with access to a public toilet are classified as non-improved because the facility is shared with other households. The report considers 'semi-protected well' as a source of improved drinking water (p.8) and so does the MPI estimation. MPI estimates are disaggregated by rural and urban areas and by 17 subnational regions.

Rwanda (DHS 2014-15): Anthropometric information was recorded for all eligible children aged 0-59 months and eligible women aged 15-49 living in in a subsample of 50 percent of the households not selected for the men's survey (p.1, p.165). In addition, height and weight

information was also collected from eligible men in half of households selected for male survey (p.9). As such we retained 100% of the sample because in half of the households sampled information on nutrition will come from eligible women and children, while the other half of the households, the information is exclusively from eligible adult men. MPI estimates are disaggregated by rural and urban areas and by five subnational regions.

Saint Lucia (MICS 2012): Anthropometric measures are available for all children under five. The survey did not gather information on child mortality, and this indicator has been omitted from this estimation. According to the country report (p.53), the category 'flush to unknown place/not sure/do not know where' is an improved sanitation facility. This estimation followed the report. The dataset lacked information on ownership of a bicycle, motorbike and animal cart. The data is representative only at the national level.

Sao Tome and Principe (MICS 2014): Anthropometric information was collected from all children under five years. According to the report, the category 'dry pit without toilet/open pit' is unimproved. In addition, households with missing information on sanitation facility is identified as deprived. We followed the standards set in the report. Furthermore, the report considers the category open defecation as neither improved nor non-improved (Table WS.5, p.52). We follow the standard set in the MDGs, where this is clearly a deprived standard. The MPI result is disaggregated for urban and rural areas and for four regions, although the report states that Principe is not a domain of this survey.

Senegal (DHS 2016): Anthropometric measures were collected from all children under 5 years. Some 5.5% of eligible children under 5 years have missing anthropometric information, that is, data on either weight or height. As such, when the nutrition results was aggregated to the household level, we found that close to some 5% of the population lived in households with missing nutrition information. Table 2.2 of the report (p.17) indicates that the only unimproved toilets are traditional latrines or no toilet/nature. The report considers the category other toilet as neither improved nor non-improved. However, in this estimation, other toilet is considered as non-improved. Senegal has 14 administrative regions, but the data is representative by four grands regions, as defined on page 7 of the report. As such, subnational estimates were calculated by these four grands regions

Serbia (MICS 2014): Anthropometric information was collected from all children younger than 5 years. Some 13 percent of children under 5 years have either missing info on height or weight. The country report confirms the high missing value by stating that overall only 87% of children had

both their weights and heights measured (p.34). As a result, this affected the size of missing observations for the final nutrition indicator. Some 6 percent of the individuals live in households where there is missing nutrition data. Child mortality information was collected from women aged 15 to 49 years, but there is no birth-history data. This means that there is no information on the date of death of children who have died. As such we are able to identify all child mortality that occurred in the household but unable to identify whether the death(s) occurred within five years of the survey's date. The MPI favours using all available information, thus this MPI estimation constructed the child mortality indicator using all children's deaths reported by women. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Sierra Leone (DHS 2013): Anthropometric measures were gathered for eligible women (aged 15-49), men (aged 15-59) and children younger than 5 in 50% of households selected for interview. MPI estimates are disaggregated by rural and urban areas and by 14 subnational regions.

Somalia (MICS 2006): Anthropometric data was collected only for children under 5 years. Some 8 percent of children under 5 years have either missing info on height or weight. As a result, this affected the size of missing observations for the final nutrition indicator. Some 5.4 percent of the individuals live in households where there is missing nutrition data. The country report identifies Koranic schools as the basic system of instruction in religion in Somalia for children usually between the ages of 5-14. The report further states that compared to other education sub-sectors, Koranic schools teach the greatest number of students across the country and remain the only system available for nomadic children. Page 25 of the report compares Koranic schooling with other formal education. This suggest that the religious schooling system is an informal system. As such, for the purpose of the global MPI, we identify all individuals with Koranic schooling qualification as having 0 years of formal schooling. The survey lacks information on ownership of a motorcycle. MPI estimates are disaggregated by rural and urban areas and by three major subnational regions.

South Africa (NIDS 2014–15): Anthropometric information is available for children under 15 and men and women aged 15 to 70 years old; all of this information was considered in constructing the nutrition indicator. In South Africa, some 16 percent of children aged 7 (who are eligible to attend school) had missing information on school attendance. Distance to water source was available in kilometres so the threshold of one kilometre or more was established for assessing deprivation in the water source indicator. Solar energy was considered an improved source of

cooking fuel, but 'other' sources of fuel were considered as non-improved fuel. Due to the sample loss, this estimation cannot be disaggregated at the subnational level.

South Sudan (MICS 2010): Nutritional information was collected from all children under 5. Some 37% of children under 5 have either missing info on height or weight. The country report confirmed the high missing anthropometric information (p.27). The report further stated that the unusual high missing values may be because of the failure of enumerators to patiently collect the required information from children under 5 (p.9). As a result, this affected the size of missing observations for the final nutrition indicator. Some 23 percent of the individuals live in households where there is missing nutrition data. As such, subnational figures are not reported because the final number of observations used to estimate the MPI was below 85% of the total observations in the analytical sample.

Sudan (MICS 2014): Anthropometric measures are available for all children under five. Up to some 14% of children under 5 have either missing info on height or weight. The country report confirmed the high missing anthropometric information (p. 299-300). As a result, this affected the size of missing observations for the final nutrition indicator. Some 7 percent of the individuals live in households where there is missing nutrition data. However, bias in these values was not concentrated uniquely among those deprived in the remaining indicators allowing for subnational disaggregation. The MPI result is disaggregated for urban and rural areas and for 18 states.

Suriname (MICS 2010): Anthropometric measures are available for all children under five. Some 21.2% of children under 5 years have either missing info on height or weight. As a result, this affect the size of missing observations for the final nutrition indicator. Some 8 percent of the individuals live in households where there is missing nutrition data. The MDG definition identifies 'flush don't know where' as non-improved. However, the survey report identified this category as improved sanitation facilities (p.82). This estimation followed the report. In addition, the report considers the category open defecation as neither improved nor non-improved but we consider it as non-improved. The MPI result is disaggregated for urban and rural areas and for 10 states.

Syrian Arab Republic (PAPFAM 2009): Anthropometric data were collected for all children aged between 0-72 months. However, the global MPI's child nutrition indicators (malnutrition and stunting) specify child under 5. In other words, the global focus is only on children aged between 0-59 months. To be consistent with the global MPI criteria, we have computed BMI-for-age for children from 60-72 months old. The toilet categories listed in the data are different from the standardised version found in DHS and MICS. The categories of public toilet, open air and other

are coded as non-improved sanitation. MPI results is disaggregated for urban and rural areas and for 14 subnational regions.

Tajikistan (DHS 2012): Anthropometric information were recorded for a full sample of eligible children aged under 5 years and all eligible women aged 15-49 in the interviewed households (p.147). The MPI result is disaggregated for urban and rural areas and for five subnational regions.

Tanzania, United Republic of (DHS 2015–16): Height and weight information was collected for all children under five and women aged 15-49 years in the sampled households. Survey estimates are disaggregated by rural and urban areas and nine regional zones.

Thailand (MICS 2015-16): Anthropometric information was collected from all children under five. The indicator of television considers colour, plasma and LCD TV. The indicator of mobile-phone considers smartphone. The assets indicator constructed for this estimate lacks information on use of animal carts. Survey estimates are disaggregated by rural and urban areas and five major subnational regions. This MPI was first published in September 2018.

Timor-Leste (DHS 2016): All women aged 15-49 and children aged 0-59 months were eligible for anthropometric measurements. In one-third of the sampled households, men aged 15-49 were eligible for anthropometric measurements. Survey estimates are disaggregated by rural and urban areas and 13 major subnational regions. This MPI was first published in September 2018.

Togo (DHS 2013–14): All women aged 15-49 and children aged 0-59 months living in one half of the sampled households were eligible for anthropometric measurements. Some 21% of the individuals who were non-usual residents were dropped from the sample. This figure is huge. However, further checks reveal that most of these individuals were not part of the anthropometric subsample whom we have retained for the global MPI computation. To be precise, within the subsample, which is of our interest, the non-usual residents who were excluded was close to 2% of the retained sample. Survey estimates are disaggregated by rural and urban areas and six major regions.

Trinidad and Tobago (MICS 2011): Anthropometric data was collected from all children under 5 years. Some 10% of eligible children under 5 years have missing info on weight and height. As such, when the result was aggregated to the household level, we found that some 3% of the population lived in households with missing nutrition information. Following the MDG definition, the sanitation facility categorised as ‘flush to don’t know where’ is usually considered to be unimproved. However, in Trinidad and Tobago, this particular category is identified as an

improved sanitation facility (p.70). This estimation followed the report. The report considers the category open defecation as neither improved nor non-improved (p. 70). We follow the standard set in the MDGs where this is clearly a deprived standard. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005. This MPI was first published in September 2018.

Tunisia (MICS 2011–12): Anthropometric measures are available for all children under five. Following the MDG definition, 'flush don't know where'. However, in Tunisia, 'flush don't know where' is identified as improved sanitation facilities (Table WS.5, p.68). So in this case we have followed the country report. In addition, the report considers the category open defecation as neither improved nor non-improved. We follow the standard set in the MDGs where this is clearly a deprived standard. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Turkmenistan (MICS 2015–16): Anthropometric information was collected from all children under five. Information on child mortality was collected from women aged 15-49. Page 28 of the report warns about the estimation of child mortality, as the data suggest potential underreporting of deaths among those surveyed. This MPI estimation could then be considered as a lower bound of multidimensional poverty for the country. The assets indicator constructed for this estimate lacks information on use of an animal cart. Information is disaggregated for urban and rural areas. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Uganda (DHS 2016): Anthropometric measures were gathered for eligible women (aged 15 to 49), men (aged 15 to 59) and children younger than 5 in one third of households selected for interview. MPI estimates are disaggregated by rural and urban areas and by 15 subnational regions. This MPI was first published in September 2018.

Ukraine (MICS 2012): The survey did not gather information on nutrition, and this indicator has been omitted from the estimation. Subnational figures are not reported because the multidimensional headcount ratio for the entire country is smaller than 0.005.

Uzbekistan (MICS 2006): Anthropometric measures was collected from all children under five. Following the MDG definition, households that receive their drinking water by tanker trucks are

identified as unimproved. Survey estimates are disaggregated by rural and urban areas and six major regions.

Vanuatu (MICS 2007): Anthropometry was collected from all eligible children under 5 years. Child mortality information was collected from women aged 15 to 49 years, but there is no birth-history data. This means, there is no information on the date of death of children who have died. As such we are able to identify all child mortality that occurred in the household but unable to identify whether the death(s) occurred within five years of the survey's date. The MPI favours using all available information, thus this MPI estimation constructed the child mortality indicator using all children's deaths reported by women. Five percent of people in Vanuatu live in houses with coral flooring. Survey estimates are disaggregated by rural and urban areas.

Viet Nam (MICS 2014): This survey lacks information on nutrition. The report identifies all flush toilet including flush to somewhere else and flush to unknown place are identified as improved sanitation facility (p.122). This estimation followed the report. The MPI is disaggregated at rural and urban level and for six regions.

Yemen (DHS 2013): Anthropometric information was gathered among all eligible women and their children. The report warns that the proportion of children with complete anthropometric data was only 87%. However, given the fact that the nutrition indicator is aggregated at household level and is formed by both child and adult malnutrition, the missing information on child nutrition in the household may be complemented by other household members' nutrition information. In this case, the nutrition indicator was considered of good quality as taking all household members together it has only 1.4% of missing values at national level. Table 5.4 on p. 45 establishes that information on child mortality was not gathered from never-married women who are assumed to have 0 events of child mortality. This calculation of MPI assumes the same premise. The country report (Table 2.1, p.8) summarise that spring and protected surface water are unimproved sources of drinking water. Generally these are identified as improved sources. However, in the context of Yemen, if the water is fetched from a source that is not immediately accessible to the household, it may be contaminated during transport or storage. Hence following the report, we have also identified these sources as non-improved drinking water. In Yemen, roofing material made of

metal plates or a combination of metal plates with mud are identified as non-improved materials. MPI estimates are disaggregated by rural and urban areas and by 21 governorates.

Zambia (DHS 2013–14): Anthropometric information was collected from all children under five and women aged 15-49. MPI estimates are disaggregated by rural and urban areas and by 10 governorates.

Zimbabwe (DHS 2015): Height and weight information was collected for all children under five and women aged 15 to 49 and men aged 15 to 54 years old in the sampled households. Survey estimates are disaggregated by rural and urban areas and ten provinces.