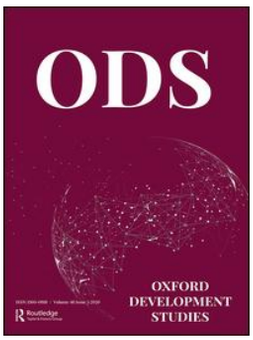

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Sabina Alkire & Usha Kanagaratnam

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Revisions of the global multidimensional poverty index: indicator options and their empirical assessment

Sabina Alkire and Usha Kanagaratnam

[a]Oxford Poverty and Human Development Initiative (OPHI), Department of International Development, University of Oxford

ABSTRACT

This paper examines how normative reasoning was applied to empirical applications of different indicator options in order to revise the global Multidimensional Poverty Index (MPI) indicators in 2018, to better align with the SDGs. Given the emphasis in the SDGs on leaving no one behind, the household surveys used to estimate the global MPI were explored to see which could create individual-level MPIs, however this sharply reduced country coverage by half. Consistent criteria is applied to assess whether 33 potential additional indicators could be added to strengthen the global MPI. A certain set of criteria applied rules out new indicators. Finally, the paper both illustrates and describes the iterative interplay of normative and technical considerations underlying adjustments in three original indicators – child mortality, nutrition, and housing – which involves considering the joint distribution of alternative indicators across twenty trial measures for all countries.

KEYWORDS

Multidimensional poverty; poverty measurement; joint distribution; survey data; normative reasoning; human development

1. Introduction

The measurement of poverty requires normative choices (Anand & Sen, 1997; World Bank, 2017). This does not mean that, smitten by some ethical ideal, measurement analysts are doomed to use data badly (Barro, 1989).[1] On the contrary, part of the normative analysis underlying measurement design entails the scrutiny of empirical options. That is, the finalization of a poverty measure requires an iterative normative analysis of empirical alternatives that have been constructed using different plausible parameters. This 'higher' or coordinating normative reasoning (Alkire et al., 2015, p. 195) adjudicates a 'comprehensive' description of possible measures (Sen, 2009, p. 20), including empirical trials of alternatives. But how is this reasoning applied?

A normative assessment of indicators is essential because global poverty measures, like Don Quixote, harbour an impossible dream. They must be sufficiently accurate measures of poverty for households of multiple sizes, compositions, occupations, locations, ages, and cultures. They must use existing data. They must retain a large sample in order to reduce sampling errors and permit disaggregation. They must reflect the meanings of poverty that different people and groups hold,

CONTACT Sabina Alkire sabina.alkire@qeh.ox.ac.uk Oxford Poverty and Human Development Initiative (OPHI), Oxford Department of International Development (ODID), University of Oxford, 3 Mansfield Road, Oxford, OX1 3TB, United Kingdom

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Supplemental data for this article can be accessed here.

and effectively monitor widespread policy priorities such as the Sustainable Development Goals (SDGs). In addition, they must be relatively robust to alternative specifications of controversial parameters.[2] As in the case of the Man of La Mancha, the quest for a perfect global poverty measure is clearly doomed. Yet a determined search may create a better, if still imperfect, outcome.

This paper shares the empirical observations and normative assessments that undergird the revision of the global Multidimensional Poverty Index (MPI) indicators in 2018 to better align with the SDGs outlined by the UN General Assembly (2015). The paper by Alkire and Jahan (2018) set out the principles for that indicator revision and outlined the chosen indicators. This paper illustrates the normative reasoning that was applied to empirical applications of different indicator options in the course of defining the final revised measure. The global MPI measures acute multidimensional deprivations in over 100 countries, covering 5.7 billion people in 2018, which represents over 90% of the population in lower- and middle-income countries and over three-quarters of the world's population. Originally co-designed and launched in 2010 by the Oxford Poverty and Human Development Initiative (OPHI) at the University of Oxford and the United Nations Development Programme (UNDP) Human Development Report Office (HDRO), the global MPI was jointly revised by both institutions in 2018. The revised global MPI is aligned, insofar as is possible, with the SDGs and recommendations of the World Bank's Atkinson Commission on Monitoring Global Poverty (World Bank, 2017), as well as inputs from experts, online consultations and academic exchanges.[3]

A revision of a global measure must adhere to public and transparent criteria. One principle that governed the 2018 revision is data availability. Indicators must be available from nationally representative household surveys for at least 75 countries and 3.5 billion people. In addition, the need for comparability across countries meant that indicators that carried different meanings across countries needed to be minimised and non-comparabilities transparently explained. To assess data availability, we canvassed the core data sources – the Demographic and Health Survey (DHS) and the Multiple Indicator Cluster Survey (MICS) – to identify potential new indicators with broad comparability and country coverage. Using potential indicators, we empirically implemented and analysed 20 trial MPI specifications, which underlie this analysis.

Despite a vigorous and open-ended quest for new indicators, the revised MPI changes were much less far-reaching than anticipated. The initial plan envisioned a deeper revision, but in the end, only five of the ten indicators were revised. Section 2 addresses an oft-articulated hope that the global MPI be supplemented (or replaced) by MPIs designed at the individual level. Section 3 canvasses core surveys for potential indicators, identifying 33 of these, and then shows why data limitations make more extensive changes impossible. Section 4 introduces the indicator adjustments. As the years of schooling adjustments were straightforward, it describes the empirical considerations underlying normatively justified adjustments in three indicators: child mortality, nutrition, and housing. The assets indicator revision is treated separately (see Vollmer & Alkire, 2020). Section 5 concludes. The selection of indicators for an MPI is a key defining choice. Sharing the methodology and logic of indicator selection will, it is hoped, reinforce in practice the value of pursuing an impossible dream.

2. Individual-level MPIs

While the SDGs regularly call for disaggregation by gender and age cohort, a considerable literature now goes beyond this to call for individual-level global MPIs – for example, separate global MPIs for children, women, and men. Individual poverty measures are technically feasible using counting-based methods and have been estimated empirically by various authors (see Alkire, Ul Haq, & Alim, 2019; Bessell, 2015; Klasen & Lahoti, 2020; Roelen, 2017).

Individual-level MPIs could shed light on gendered or intra-household inequalities, and could illuminate group-specific deprivations. However, individual-level MPIs with different designs for children, women, older persons are difficult to compare across groups. Moreover, data do not

permit the development of a global child or women's MPI for even up to 50 countries (see Table A.1, A2 in Appendix), nor an MPI for older persons. For these reasons, the global MPI retains the household as the unit of identification and shares information across household members to measure deprivations in both education indicators and in nutrition. To illuminate intrahousehold and gendered patterns in individual-level indicators, we suggest linked analysis of the underlying micro-data alongside the household deprivation information as outlined by Alkire et al. (2019).

3. Data possibilities

The global MPI relies on household survey datasets fielded within a given time-frame, which was 2006–2016 in 2018. The 105 datasets included cover 5.7 billion people, aggregated using 2016 population figures (OPHI, 2018). Data from the DHS were used for 52 countries and MICS for 44 countries. Thus, 96 countries' MPIs were built using DHS or MICS data. The common good provided by the DHS and MICS surveys, which make high-quality and clearly documented datasets that can be disaggregated publicly available, is warmly acknowledged. In addition, the global MPI drew on six national surveys and three Pan Arab Project for Family Health (PAPFAM) surveys.[4] Any improvements in the global MPI thus must be grounded in an understanding of data possibilities and constraints.

A natural question is whether these datasets contain additional indicators that could be used to improve the global MPI. We explored this question for 5.7 billion people, using 100 datasets, and shortlisted 33 indicators for further investigation, which are summarised in Table 1.[5] Our first criterion was coverage: it must be possible to generate global MPI indicators from the relevant survey for at least 75 countries and 3.5 billion people. This criterion ruled out many potential additions. Only the six underlined entries in Table 2 passed the coverage test.

The next consideration was whether the data could be used to construct internationally comparable deprivation indicators. Upon further scrutiny, unfortunately, the land and livestock variables could not be used because the response structures and information included was too diverse across the surveys to create a comparable indicator (Vollmer & Alkire, 2020). Of the four remaining indicators, two – bank account and overcrowding – fell short in terms of comparability. In particular, each would be interpreted as a proxy of a further deprivation, but the accuracy varied. For example, in some cases, bank accounts were opened automatically but did not proxy meaningful access to financial services.

Overcrowding was a strong candidate because of its relation to SDG Target 11.1 and to the 'Human Right to Adequate Housing' (art. 25 of the Universal Declaration on Human Rights). With the majority of the world's population now living in urban areas, overcrowding might be expected

Table 1. Summary of 33 potential new indicators to modify the global MPI.

Household-specific indicators (11 indicators)	**Child**-specific indicators (7 indicators)	**Women**-specific indicators (15 indicators)
Information technology	Registration of birth	Anaemia
Small physical assets	Anaemia	Differently abled
Electrical assets	Immunization	Female genital mutilation
Fishing/farming/livestock assets	Differently abled	Regular access to information
Financial transaction	Early childhood development	Asset ownership
Treated mosquito nets	Child vulnerability	Recent migration
Exposure to tobacco	Child labour	Unwanted pregnancy
Overcrowding		Use of contraception
Iodized salt		Antenatal care
Health insurance		Assisted delivery
Waste management		Post-delivery care
		Breastfeeding practises
		Domestic violence
		Informal work
		Decision making

Table 2. Coverage of potential household indicators.

Aim of measure	Indicator to assess	Number of countries with the indicator	Population + 2016 [1] (thousands)
Household has access to information technology	Smartphone or internet access	52	4,204,697
Household has small physical assets	Table	31	1,950,787
	Chair	37	2,412,049
	Bed	32	2,393,180
	Cupboard	26	696,402
	Water pump	15	3,243,944
Household has electrical assets	**Computer or laptop**	83	5,119,665
	Sewing machine	26	2,157,192
	Fan/electric fan	34	2,367,680
	Air conditioner	51	3,950,955
	Water heater	15	523,986
	Washing machine	55	4,205,496
	Generator	30	614,314
Household has motorised and non-motorised fishing/farming/livestock assets	Boat without motor	32	1,085,372
	Boat with motor	68	2,207,158
	Animal drawn cart	77	4,912,304
	Tractor	25	3,378,376
	Land and land size	84	3,985,520
	Livestock/herds/poultry ownership	93	5,530,030
	Number of chickens	85	2,487,874
	Number of cows/buffalo/cattle	83	2,313,449
	Number of horses/donkeys/mules	81	2,282,655
	Number of goats	83	2,390,369
	Number of sheep	81	2,259,689
	Number of camels	16	739,907
	Number of rabbits	21	409,649
	Number of pigs	66	1,624,252
	Number of beehives	7	149,276
Household has access to financial transactions	**Bank account**	82	3,722,974
Household has access to treated mosquito nets	Interior walls of dwellings are sprayed	28	686,600
	Household members sleep under insecticide- or liquid-treated nets	39	918,309
Consumption and exposure to tobacco	Smoking within household (exposure to smoke)	35	2,562,304
	Women smoking more than 4 cigarettes/day	71	4,657,028
	Men smoking more than 4 cigarettes/day	53	4,352,378
Overcrowding within household	**Number of rooms used for sleeping**	94	4,195,858
Household consumption of iodized salt	Presence of iodized salt in household	72	3,096,825
Household members have health insurance	Any household member	15	3,234,688
	Women, 15–49	39	3,877,532
	Men, 15–59	34	3,706,984
Household waste management	Disposal of household waste and trash	19	2,060,470

[a]Own computation using population data from UN DESA (2017).

to increase, in part as a consequence of rapid migration to cities. And yet no standard has been established globally, in part because understandings of overcrowding vary considerably by culture and climate. Also, the data had no information on the size of the sleeping room(s). So, on the basis of expert opinions, this was rejected. The last two indicators – computer and animal cart – were explored and, after empirical assessment, included in the revised assets indicator.

We also explored the possibility of constructing a revised global MPI that could be re-purposed as a child- or women-specific MPI, for example by including individual indicators focused on children's and women's deprivations. We canvassed possible indicators of deprivations experienced by individual children and women that seemed appropriate for individual-level MPIs but which could also reveal the acute multidimensional poverty status of a household for this global revision. However, as shown in Appendix, the coverage of these indicators was insufficient. In the end, rather surprising data constraints converted the quest for new indicators into a quest to improve the existing ten indicators. Hence, we turn now to that task.

4. Alternative indicator definitions and trial MPIs

Based on the data exploration, improvements were completed in five of the ten indicators. Table 3 presents the original and modified global MPI indicator definitions. First, the deprivation cut-off for the years of schooling indicator was revised from five to six years in order to reflect the international standard duration of primary schooling. Barro and Lee argue that in the developing regions, individuals aged 15 and older are estimated to have an average of six years of schooling (2013). Adjustments in the assets indicator were based on the empirical analysis of 30 potential new household-specific items that revealed the reliability of the original assets items (radio, television, telephone, bicycle, motorbike, refrigerator, and car/truck) with computer and animal cart as additional items in the final revised specification (Vollmer & Alkire, 2020).

In order to assess potential indicator definitions in a counting-based measure, we also explore the joint distribution of deprivations. Thus, a set of 20 global MPIs, each having different indicator specifications, were analysed in all 105 countries. Table 4 summarises the indicator alternatives that were implemented; subsequent sections elaborate these findings.

Table 3. A comparison of the original and modified global MPI indicator definitions.

Dimensions of poverty (weight)	Indicator	**Original global MPI** deprived if living in a household where …	**Modified global MPI** deprived if living in a household where …
Health (1/3)	**Nutrition**	Any child under 5 is **underweight** or any adults under 70 years of age have **low BMI**.	Any child under 5 is **underweight** or **stunted** or persons aged 5 to 19 have **low BMI-for-age** or adults 19 to 70 years have **low BMI**.
	Child mortality	Any **child** has **died** in the family.	Any **child*** has **died** in the family in the **five-year** period preceding the survey.
Education (1/3)	**Years of schooling**	No household member aged 10 years or older has completed **five** years of schooling.	No eligible household member has completed **six** years of schooling.
	School attendance	Any school-aged child is not attending school up to the age at which he/she would complete class 8.	
Living standards (1/3)	Cooking fuel	The household cooks using solid fuel, such as dung, agricultural crop, shrubs, wood, charcoal, or coal.	
	Sanitation	The household has unimproved or no sanitation facility or it is improved but shared with other households.	
	Drinking water	The household's source of drinking water is not safe or safe drinking water is a 30-minute or longer walk from home, roundtrip.	
	Electricity	The household has no electricity.	
	Housing	The household has a dirt, sand, dung, or other unspecified type of **floor**.	The household has inadequate housing materials in any of the three components: the floor is of natural materials or the **roof** or **walls** are of rudimentary materials.
	Assets	The household does not own more than one **radio, TV, telephone, bike, motorbike** or **refrigerator** and does not own a car or truck.	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.

*In 2019, the definition of child mortality was further revised to include age criteria. Households are deprived in child mortality if any child **under 18** died in the last five years.

The five modified indicators are underlined and in bold.

Table 4. Trial measures of the global MPI.

	Years of schooling	Child mortality	Nutrition	Housing	Assets
Trials	Deprived if no one in the HH completed:	Deprived if child mortality occurred:	Deprived if child is:	Deprived if HH has:	Deprived if HH does not own:
Original MPI	5 years	Anytime	underweight	low-quality floor	> than 1 of 6 small assets
1	6 years	Anytime	underweight	low-quality floor	> than 1 of 6 small assets
2	6 years	last 5 years for women OR anytime for men	underweight	low-quality floor	> than 1 of 6 small assets
3	6 years	Anytime	stunting	low-quality floor	> than 1 of 6 small assets
4	6 years	last 5 years for women OR anytime for men	stunting	low-quality floor	> than 1 of 6 small assets
5	6 years	Anytime	stunting for child under 2 & underweight for child 24–59 months	low-quality floor	> than 1 of 6 small assets
6	6 years	last 5 years for women OR anytime for men	stunting for child under 2 & underweight for child 24–59 months	low-quality floor	> than 1 of 6 small assets
7	6 years	Anytime	stunting OR underweight	low-quality floor	> than 1 of 6 small assets
8	6 years	last 5 years for women OR anytime for men	stunting OR underweight	low-quality floor	> than 1 of 8 small assets
9	6 years	Anytime	stunting	low-quality floor OR wall OR roof	> than 1 of 8 small assets
10	6 years	last 5 years for women OR anytime for men	stunting	low-quality floor OR wall OR roof	> than 1 of 8 small assets
11	6 years	Anytime	stunting	any 2 of the 3 components (floor, roof or walls) are of low-quality	> than 1 of 8 small assets
12	6 years	Anytime	stunting for child under 2 & underweight for child 2 to 4	low-quality floor OR wall OR roof	> than 1 of 8 small assets
13	6 years	last 5 years for women OR anytime for men	stunting for child under 2 & underweight for child 2 to 4	low-quality floor OR wall OR roof	> than 1 of 8 small assets
14	6 years	Anytime	stunting for child under 2 & underweight for child 2 to 4	any 2 of the 3 components (floor, roof or walls) are of low-quality	> than 1 of 8 small assets
15	6 years	Anytime	stunting OR underweight	low-quality floor OR wall OR roof	> than 1 of 8 small assets
16	6 years	last 5 years only for women	stunting	low-quality floor OR wall OR roof	> than 1 of 8 small assets
17	6 years	Anytime	stunting OR underweight	any 2 of the 3 components (floor, roof or walls) are of low-quality	> than 1 of 8 small assets
18	6 years	last 5 years only for women	stunting OR underweight (Note: no BMI)	low-quality floor OR wall OR roof	> than 1 of 8 small assets
19	6 years	Anytime	stunting OR underweight	low-quality floor OR wall OR roof	> than 1 of 8 small assets OR land ≥10 ha

(*Continued*)

Table 4. (Continued).

Trials	Years of schooling Deprived if no one in the HH completed:	Child mortality Deprived if child mortality occurred:	Nutrition Deprived if child is:	Housing Deprived if HH has:	Assets Deprived if HH does not own:
20	6 years	last 5 years only for women	stunting OR underweight	low-quality floor OR wall OR roof	> than 1 of 8 small assets

4.1. Nutrition

The nutrition indicator of the global MPI measures undernutrition. This, we argue, is in line with a measure of acute poverty. In the revised global MPI, adults aged 20 to 70 years of age are considered undernourished if their BMI is below 18.5 kg/m^2. Age- and gender-specific BMI cut-offs from the World Health Organization are applied to persons 15 to 19 years of age. Children aged 0 to 5 are considered undernourished 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 reference population. The analytical work that underlies this final indicator design sought to address two questions, discussed in the following sub-sections.

4.1.1. Should adult nutrition be included in the global MPI or only child nutrition?

The global MPI seeks to be as comparable as possible. This criterion raises a question regarding the inclusion of nutritional data for persons over five. The original MPI used any nutrition data that was available in the survey. The reason for this was that the surveys had mutually exclusive indicators. The World Health Surveys (WHS), which were used when the global MPI was launched in 2010, exclusively contained adult undernutrition data. But in 2018, anthropometric data for children under 5 years of age were available in all surveys with nutrition data (97 of the 105 country surveys covered in the global MPI 2018). Data on women's undernutrition is available in only 46 of the country surveys, while 18 of these countries include at least some male undernutrition data, of which only four cover all men.[6]

Hence, a core question was whether to exclude nutrition data for persons aged five and above, in order to improve comparability, as MICS surveys in the global MPI are usually limited to nutritional data for children under five. Trial 18 implements the MPI using nutritional data only for children under five. There are three reasons this route was not chosen. First, undernutrition is a core element of multidimensional poverty on which participatory studies, SDGs, and normative arguments are not limited to children. Second, it did not solve the comparability problem. If the MPI considered only under-five nutrition and not nutritional information for others, then many households would be coded non-deprived in nutrition automatically, even if measured adult undernutrition was evident, simply because that household did not include a child under the age of five. Yet the percentage of households that include a child under five varies across countries, creating a new incomparability. Third, there were usually higher missing values in child undernutrition than in the combined undernutrition indicator, which could have introduced a bias or compromised disaggregation. Including all nutritional data improves the accuracy of the MPI, especially among households without children under the age of five; surveys without adult data will provide at best a lower bound of nutritional deprivations.

Empirically, across the 51 countries that have both adult and child malnutrition data, the number of persons sharing their household with an undernourished person rises from 930 million (16.2%) to 1.53 billion (26.7%) people if we consider the nutrition of persons above the age of five. That is, over 600 million people share their household only with a nutritionally deprived person who is not under the age of five. These people would be considered non-deprived in nutrition if the MPI focused only on the nutritional status of children under five years of age.

Including adult nutrition for some but not all countries creates the need to consider which nutritional data are covered when interpreting global MPI comparisons, but, in the absence of adult nutrition data, interpretations would need to consider demographic differences in the share of households lacking children under five, which is at least as complex to explain. The global MPI methodological note (Alkire, Kanagaratnam, & Suppa, 2018) transparently documents the undernutrition data used for each country. Hence, the revised global MPI continues to include adult undernutrition.

Given the magnitude of people and households who are considered undernourished if we include persons above five years of age, it is absolutely necessary to assess how the introduction of non-comparable nutritional information affects country rankings. Thus, we estimated a trial MPI measure using the same indicators as the global MPI, but restricting the nutrition information exclusively to child malnutrition data. The rank robustness of the 105 countries was analysed to see how the rankings for measures with alternative nutritional specifications changed. In fact, the Kendall tau-b rank correlation of 105 countries between the global MPI 2018 and the child nutrition-only MPI is 0.9696. Thus, the improved information that is obtained by including adult nutrition seems justified, but the distribution of countries in both cases is not very different. This being said, knowing the cost and skill required to obtain anthropometric data, it would still be greatly valued if MICS surveys might include additional nutritional data, and also if both major surveys extended the age range to include persons up to 70 years of age.

4.1.2. What indicator(s) should be used to indicate a deprivation in child nutrition?

It might seem elementary to define child undernutrition, but there are significant and important intricacies. Given the data sources, it was possible to include stunting, underweight, or wasting. Initially stunting and wasting were considered as these are both SDG indicators. However, wasting was not implemented because expert consultations and the literature agreed that it is known to be seasonally volatile (Hillbruner & Egan, 2008; Kinyoki, 2017) and is significantly more sensitive to the growth phases of the child (O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008). Recall that in an MPI or any other counting-based measure, each indicator must accurately depict deprivation in the required period at the individual level. Thus, if a person or household is deprived in an indicator and another household is not, one presumes the latter is nutritionally better off. However, this comparison breaks down if an indicator is volatile, as is the case for wasting. Further, although the SDG indicators do not include underweight, in the online consultation about the child undernutrition indicators, national government experts often preferred undernutrition to stunting.

The empirical trials thus focused on four candidate indicators. In all cases the threshold considered is two standard deviations below the median for the reference group, following international conventions. A child is deprived in nutrition if the child is:

1. Underweight: (weight-for-age),
2. Stunted (height-for-age),
3. Both Underweight and Stunted.

Some studies argue that stunting is difficult to change after some time – that it was a stock indicator. Furthermore, the MPI consultations revealed an active concern among policy actors that it would be hard to improve the stunting indicator across a three- to five-year period, because a cohort of children who were stunted before the age of two (for example) would rarely improve their status before they turned five. We therefore explored one additional strategy, which varied according to the child's age:

4. Stunted (if under 2 years of age) or underweight (if aged 2–5).

Table 5 presents the number of people who share their households with a malnourished adult, or with a child, regardless of poverty status. To assess the stability or sensitivity of each indicator option to changes over time, and particularly to assess the articulated concern that stunting will rarely decrease, we calculated trends using the 2005/6 and 2015/16 datasets for India, because India alone accounted for 32% of total uncensored nutritional deprivations across the 105 countries.

Table 5. Total number of people deprived because any adult is undernourished or any child under five according to different indicators of child nutrition.

Alternative indicators of child nutrition	Number of people deprived by each [a]	Change in India 2005/6 to 2015/16 [a]
Child is underweight	1.32 billion	174 million
Child is stunted	1.43 billion	196 million
A child under 2 years of age is stunted, or a child aged 24–59 months is underweight	1.29 billion	192 million
Any child is stunted or underweight	1.53 billion	178 million

[a]Own calculations based on the proportion of people who experience deprivations in each of the indicators, also known as the uncensored headcount. This was computed by multiplying the uncensored headcount by 2016 population data (UN DESA, 2017).

Table 5 also shows that 196 million fewer Indians live in households where a child under five is stunted. This suggests the reduction of stunting over a ten-year period was not insignificant. So the indicator clearly shows progress across a ten-year period, although in shorter time periods it may arguably be less sensitive. However, we also found that underweight children were present in households where no children were stunted. In India 2015/16, 35 million people live with an underweight (but not stunted) child, whereas in 2005/6 it was only 17.7 million people. Also, the reduction in both underweight and stunting indicators when considered jointly was 18 million less than the reduction in stunting alone. This trial suggests that these indicators measure different underlying phenomena and may not move together. Thus, the final indicator of child undernutrition identifies a child as deprived if he or she is stunted or underweight or both.

4.2. Child mortality

The revised global MPI seeks to identify deprivations for each household according to whether they have experienced the death of a child under 18 years of age in the last five years. The DHS and MICS both seek to obtain birth histories from all eligible women aged 15 to 49 living in the household. It is acknowledged that household surveys may underestimate child mortality. First, women may selectively omit births that did not survive from their birth histories leading to an underestimation. Second, an error (by the mother or the enumerator) in reporting the date of the death may affect whether the child death is calculated to have occurred in the last five years. Third, if the mother was not available to respond, has left the household, or died, then any child deaths of that mother will not be included. Thus, data on child mortality must be interpreted as a lower bound.

In 14 countries,[7] it is not possible to ascertain the date when the child perished. These 14 countries' combined population is 413 million of the 5.73 billion people, of whom 23 million are poor. As a result, the MPI estimates in these 14 countries will be incomparably higher than countries that limit deprivations to mortality in the last five years. Additionally, seven countries housing 137 million people of which 8.4 million are MPI poor lack data on child mortality, so nutrition carries the full weight of the health dimension.[8] Nonetheless, 93.7% of the total population covered, and 98.4% of MPI poor people, live in countries that have information on child deaths in the last five years, where a child is defined as being under 18 years of age at the time of death.

To provide an intuition regarding how this indicator change affected the distribution of MPI across countries, we computed the Kendall tau-b rank correlation between the global MPI 2018 and an MPI using the previous global MPI child mortality indicator, which was not restricted to deaths within the last five years. Kendall tau b is 0.9462, showing a strong convergence between the distributions.

In 2010, there was concern that the original child mortality indicator was a 'stock' indicator (Alkire & Santos, 2014) or will show slow improvement. For example, if a woman aged 20 lost a child, it would effectively identify that household as deprived (in the original indicator) for the next 29 years, even if her health situation improved greatly. But harmonised studies of changes over

time found that child mortality did indeed go down (Alkire, Jindra, Robles Aguilar, & Vaz, 2017a; Alkire, Roche, & Vaz, 2017b; Alkire & Seth, 2015). Using data in India from 2005/6 to 2015/16, if reductions using the two indicator definitions are compared, one finds that, in relative terms, the proportion of the population with any child mortality was cut by 49% (from 26% in 2005/6 to 13.3% in 2015/16), whereas the proportion who had experienced child mortality in the last five years was cut by 42% (from 5.1% in 2005/6 to 2.9% in 2015/16). So 'all mortality' was not a stock indicator, and, at least in the case of India, the MPI using 'all child mortality' actually reduced faster in absolute terms than the age-restricted child mortality. The reduction may be due to a combination of demographic change (the women aged 39 to 49 in 2005/6 would not be eligible to be interviewed in 2015/16, and these women probably experienced higher child mortality) and reductions in the frequency of child mortality. But what is of interest in policy terms is the more recent reductions in child mortality; hence, the restricted indicator is preferred.

In redesigning the global MPI 2018, an intermediary specification combined information from the men's recode with the women's. Note that if both respondents referred to the same death, it had already been combined in the DHS and MICS surveys, so male recodes only included 'new' child deaths. However, using the male data introduces further complications. First, the male birth history data does not include the date of death, so it is impossible to know if the child had died within the last five years. Second, there is no information on the child's household. The male could have fathered a child who was born alive and later died, but who was never part of the sampled household. Including data from the male recode increased measured child mortality but also introduced these inaccuracies whose size was not known. It was decided not to use the male data directly because it obscured comparability between countries in two ways:

a) The proportion of child deaths that were reported by women versus men (hence without a known date of death) varied greatly across countries. This created an incomparability between the final child mortality statistics that was not transparent. For example, in India's 2005/6 DHS, the date of death could not be obtained for 66% of child deaths, whereas in 2015/16 it was 33%. Thus, the child mortality in 2005/6 would probably be incomparably high compared to 2015/16 because all child mortality of male respondents would be counted but only child mortality in the last five years for women, and in 2005/6 there were proportionally more male respondents than in 2015/16. So a trend over time would have non-sampling measurement errors.

b) Furthermore the extent to which the male data referred to children who were living outside the household of interest cannot be assumed to be constant across cultures. So including information on child deaths, when a varying proportion of these occurred outside the household would also reduce the comparability of MPI estimates.

For these reasons, child mortality from the male recode was only used in one particular situation: if the household lacked information from the women's birth history, but did have information from the male data file, and that data indicated that no child had died, then that household was considered non-deprived in child mortality.

To document the effect of this change transparently, we compare the global MPI 2018 specifications with a global MPI constructed with the previous indicator that included child mortality from any time. Overall, the number of people identified as multidimensionally poor fell markedly from 1.52 billion to 1.33 billion in the revised MPI – a decrease of 190 million people. If we examine both definitions, we found, across the 105 countries (not considering any poverty cut-off), 776 million people lived in a household that had a lost a child of any age, at any time, and that 208 million lived in a household that had lost a child under the age of 18 in the last five years.

Examining child mortality among those identified as poor, we find that 626 million people were deprived in child mortality at any time, and 17 4million of those had lost a child in the last five years (Table 6). The restricted child mortality indicator improved the censoring somewhat: 81% of persons who had ever lost a child of any age, at any time, were identified as multidimensionally

Table 6. Comparison of old and revised child mortality indicators.

	Total deprived [a]	Deprived & poor [b]	Percentage contribution of child mortality indicator to MPI poverty	Percentage contribution of health dimension to MPI poverty
Death of child ever and of any age	776 million	626 million	18.50%	41.30%
Death of child <18 in last 5 years	208 million	174 million	8.20%	32.10%

[a]This was computed by multiplying the proportion of people who experience deprivations in each of the indicators (also known as uncensored headcount) by 2016 population data (UN DESA, 2017).
[b]This was computed by multiplying the proportion of people who are *MPI poor* and experience deprivations in each of the indicators (also known as censored headcount) by 2016 population data (UN DESA, 2017).

poor, compared with 84% of those who lost a child under 18 in the last five years. This suggests that the revised child mortality indicator is slightly more focused on poor households.

This section shared the empirical insights that informed the revision of the child mortality indicator, which had a major impact on the magnitude of the global MPI. This change also had a visible structural impact: the contribution of child mortality to overall deprivations, fell, on aggregate, from 18.5% to 8.2%; thus, the percentage contribution of the health dimension to the overall MPI fell to 32.1%, on average. Nutritional deprivations now dominate the health dimension in the global MPI – a feature that may need to be rebalanced in the next decadal revision.

4.3. Housing

The 2010 MPI only included flooring materials as an indicator of housing quality because no other variables were available for over 100 countries. By 2018, information on the roof, walls, and floor of a house were available for every country except China, Egypt, and Libya. The flooring indicator had been criticised – for example, because in certain climates the roofing material was far more important than flooring. There were two steps to incorporating roofs and walls into a new housing indicator:

a.identifying which roof, wall, and floor materials were inadequate and

b.identifying the deprivation cut-off(s): whether people should be deprived in housing if they are deprived in one of the three components, or two of the three, or whether each indicator should be considered individually.

There are no global standards regarding adequate housing materials in the SDGs nor are such promulgated by UN Habitat or other institutions. The global MPI consultations favoured combining the housing indicators rather than considering each separately, and, further, identifying households as deprived if they had inadequate materials in two of the three components. However, due to the unexpectedly high censoring of the more restricted two-out-of-three housing indicator, which suggested that it was not a 'better' indicator of poverty, deprivations in any one of the housing materials was selected as the core definition. This section explains the considerations underlying this structure.

The first step was to define inadequacy with respect to the main material of the floor, roof, and exterior walls. The DHS wealth index identifies floors constructed using natural materials and roof and walls constructed using natural and rudimentary materials as inadequate (Rutstein & Johnson, 2004). Similarly, Florey and Taylor (2016) explore the effects of improved housing conditions on malaria infections in children in sub-Saharan Africa, and define natural and rudimentary roof and walls as unimproved while an unimproved floor is limited to natural materials. This is because a person who sleeps on dirt floor is more likely to suffer from long-term illnesses such as bronchitis and asthma than a person sleeping on a floor made from rudimentary materials such as wooden planks. Also, roofs and walls constructed using natural and rudimentary materials provide little protection from

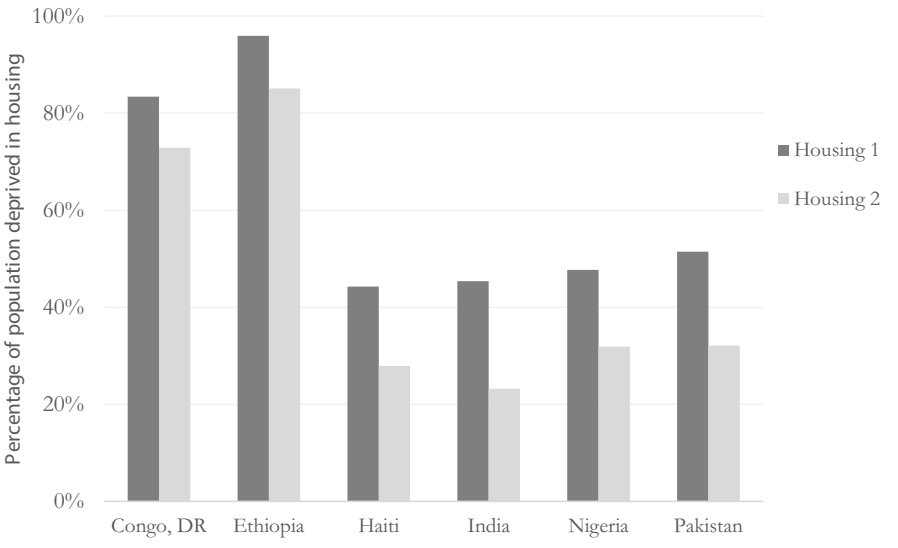

Figure 1. Percentage of population deprived in housing by different indicator cut-offs.

environmental elements, while finished materials are more durable. Following this argument, the revised global MPI considers natural and rudimentary roofs and walls, and natural flooring to be deprived.

We explored two options to aggregate information on housing materials into a single deprivation indicator. In the first option ('Housing 1′) a household is deprived in housing if any one of components (floor, roof, or walls) is inadequate. In the second ('Housing 2′), a household is deprived in housing if it uses inadequate materials for any two of the three components. As Figure 1 shows, many people are considered deprived by Housing 1, with nearly half of the population in India, Nigeria, and Pakistan in this condition. In poorer countries, the gap in the proportion of the population deprived in housing between the different cut-offs appear narrower.

Across 104 of the 105 countries included in the 2018 global MPI (China was excluded from the analysis as it lacks information on housing), 1.79 billion persons experienced a deprivation in any one of the housing components (Housing 1), whereas 1.06 billion persons experienced a deprivation in two or all three components (Housing 2). Next, as shown in Table 7, we compared censoring for two trial measures.,[9,10] When the percentage of censoring that occurs for each country is population-weighted, we found that 37% of all Housing 1 deprivations were censored, perhaps because some component was usually considered non-deprived in given climactic, social, or cultural contexts. We anticipated that Housing 2 would have far lower censoring. In fact, 27% of its observed deprivations were censored, which is also relatively high. Furthermore, in 41 countries, over 50% of people identified as deprived in Housing 2 were not identified as MPI poor, making this indicator, which intuitively would seem more precise, relatively weak in many countries.[11] We had anticipated that nearly all of those deprived in Housing 2 would be identified as poor. Among poor

Table 7. Empirical assessment of alternative housing indicators.

	Total population deprived [a]	People deprived and poor [b]	Total censoring
Housing 1: One inadequate of roof/wall/floor	1.79 billion	1.14 billion	37%
Housing 2: Two inadequate of roof/wall/floor	1.06 billion	770 million	27%

[a]This was computed by multiplying the proportion of people who experience deprivations in each of the indicators (uncensored headcount) by 2016 population data (UN DESA, 2017).

[b]This was computed by multiplying the proportion of people who are *MPI poor* and experience deprivations in each of the indicators (censored headcount) by 2016 population data (UN DESA, 2017).

and deprived persons, 363 million persons were MPI poor and deprived in Housing 1 – but not deprived in Housing 2. So while Housing 2 did indeed have somewhat lower overall censoring, its censoring in over 40 countries was high and generated puzzling patterns. Thus the Housing 1 indicator was used in the revised global MPI.

5. Closing observations

This paper documented the empirical analysis underlying the quest to revise the global MPI so as to better align with the SDGs while continuing to measure acute multidimensional poverty in a comparable way across over 100 countries in developing regions. Data constraints still sharply limit country coverage for individual-level global MPIs for children, women, men, and aging populations (Section 2).

Drawing on household surveys for 100 countries covering 5.7 billion people, we identified 33 potential 'new' indicators from the survey questionnaires. Only six of the 33 indicators fulfilled the criterion of covering 75 countries and 3.5 billion people. In the end, only two new indicators – ownership of a computer and animal cart – were included as additions to the assets indicator of the revised global MPI (Section 3). The quest was thus distilled to improving five of the ten existing indicators (nutrition, child mortality, years of schooling, housing, and assets) by making use of additional information from the questionnaires. The revision of the assets indicator, which included 24 potential asset specifications with different vectors of asset items, is detailed in Vollmer and Alkire (2020). This article documents how empirical assessment of alternative indicator specifications, both singly and jointly, is used to inform indicator selection (Section 4).

Globally comparable multidimensional poverty measures can and will be improved through revisions roughly once every ten years. Because the principles for their design are plural, and may conflict, the final decisions are likely to remain partially contested. The analysis shared here, which normatively interprets the empirical trials of the MPI, provides a transparent account of key empirical considerations underlying the revised global MPI. It is hoped that these will be examined and improved, and new explorations will be carried out for the next decadal revision so that the global MPI in particular, and multidimensional poverty measures more generally, will in the future, approximate their impossible dream slightly less imperfectly.

Notes

1. Barro cited a colleague in whose view 'a "normative" model should be defined as a model that fits the data badly'.
2. These desiderata, and the ways that normative reasoning for poverty measurement design interacts with them and the trade-offs between them, are discussed in Chapters 1 and 6 of Alkire et al. (2015).
3. An online consultation survey described each proposed change and sought inputs from statistics departments, ministries, international organizations, academic, and non-governmental organizations. The consultation and findings were published on https://ophi.org.uk/.
4. See Alkire et al. (2018) for the 105 country survey details. Brazil, China, Ecuador, Jamaica, Mexico, and South Africa use national surveys.
5. We identified 280 questions across 100 DHS and MICS country survey questionnaires that allowed us to construct 33 potential new indicators.
6. Four countries covered men of all age groups: China, Ecuador, Mexico, and South Africa.
7. Bhutan, Brazil, Central African Republic, Ecuador, Djibouti, Kazakhstan, Montenegro, Morocco, Syria, Serbia, Thailand, Trinidad and Tobago, Vanuatu, and Uzbekistan.
8. These seven countries are Barbados, Bosnia and Herzegovina, Jamaica, Macedonia, Mexico, Saint Lucia, and Suriname
9. This compares Trials 9 and 11, which varied only in the definition of housing measures. Neither is exactly the same as the final revised global MPI.
10. A person is multidimensionally poor if they are deprived in 1/3 of the weighted indicators. Censoring sets aside deprivations of non-poor persons in order to focus on individuals who are multidimensionally poor.
11. The 41 countries were Armenia, Bosnia and Herzegovina, Barbados, Kazakhstan, Saint Lucia, Ukraine, Moldova, Libya, Trinidad and Tobago, Montenegro, Jamaica, Tunisia, Macedonia, Jordan, Turkmenistan,

Albania, Kyrgyzstan, Egypt, Mexico, Algeria, Thailand, Uzbekistan, Syria, Azerbaijan, Ecuador, Philippines, Tajikistan, Maldives, Paraguay, Colombia, Palestine, Vietnam, Nicaragua, Mongolia, El Salvador, Peru, Dominican Republic, Belize, South Africa, Morocco, and Guyana. For Housing 1, 49 countries had censoring rates above 50%.

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Notes on contributors

Sabina Alkire direct the Oxford poverty and Human Development Initiative (OPHI), a research centre within the Oxford Department of International Development, University of Oxford. Her research interests include multi-dimensional poverty measurement and analysis, welfare economics, capability approach, and human development. She holds a DPhil in Economics from the University of Oxford.

Usha Kanagaratnam is a Senior Research Officer at the Oxford Poverty and Human Development Initiative (OPHI). She has a D.Phil. in Sociology from the University of Oxford. She currently leads the global Multidimensional Poverty Index (MPI) project at OPHI. Her research interest include international comparative research on poverty, and analysis of gender and poverty.

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