Child Health Outcome Inequalities in Low and Middle Income Countries

Patrick Hoang-Vu Eozenou, Sven Neelsen, and Magnus Lindelow
Health, Nutrition, and Population Unit, The World Bank, Washington, DC, USA

ABSTRACT
Prior to the Sustainable Development Goals (SDG) era, considerable progress was made toward the Millennium Development Goals (MDGs) health indicators. Despite these achievements, many countries failed to meet the MDG target levels, between-country inequalities in health outcomes did not improve, and many countries making progress in average indicator levels did so while at the same time seeing increasing within-country inequalities. We build on the existing literature documenting levels and trends in health inequalities by expanding the number of data-points under focus, and we contribute to this literature by analyzing the extent to which inequalities in child health outcomes are related to socioeconomic inequalities, and to aggregate income growth. The objective of this paper is to examine long-run trends in average population levels and within-country inequalities for two child health outcomes—the under-five mortality rate (USMR) and stunting—in 102 countries across 6 regions. We find that only about a third of countries in our sample managed to both reduce USMR levels and inequalities, and only a quarter did so for stunting. The fact that inequality in service coverage seems to follow a more favorable trend than inequality in health outcomes suggests that policies aiming to reduce health inequities should not only foster more equitable service coverage but also focus on the social determinants of health. Moreover, there is no strong correlation between changes in health inequalities and income growth, suggesting that income generating development policies alone will typically not suffice to improve health outcomes and reduce health inequalities.

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Introduction
Universal health coverage (UHC), with its emphasis on universality, has been recognized as a unifying platform for making progress toward the Sustainable Development Goals (SDGs). UHC provides a conceptual framework that integrates improvement of average outcomes with an embedded commitment to reducing inequalities. Therefore, understanding country level performance against UHC and the SDG health-related targets implies assessing jointly how average outcomes have evolved and whether the distribution of these outcomes across different population strata have changed toward more or less inequality.

Prior to the SDG era, considerable progress was made toward the Millennium Development Goals (MDGs) health indicators. Global under-five deaths fell from over 12 million in 1990 to around 5.9 million in 2015, as global maternal deaths dropped by 44% over the same period. Despite these achievements, many countries failed to meet the MDG target levels, between-country inequalities in health outcomes did not improve, and many countries making progress in average indicator levels did so at the cost of increasing within-country inequalities.

Now is a good time to take stock of progress toward improving health outcomes and reducing health inequalities for at least two reasons: First, we are now over a third of the way toward the SDGs 2030 timeline, and second, we are facing an unprecedented global economic crisis triggered by the COVID-19 pandemic and associated containment measures that have been put in place across the world. While the extent and duration of the economic shock remain uncertain, the impact of COVID-19 on human development is already large, with hundreds of millions of people in the developing world having reversed back into poverty. Early evidence moreover suggests that the crisis is poised to increase inequality in much of the world, threatening to result in additional human capital loss among already disadvantaged populations. Understanding recent trends in average population health levels and health inequalities, as well as the extent to which these trends are associated with economic growth and with changes in socioeconomic status is critical to identifying effective policies to

CONTACT Patrick Hoang-Vu Eozenou peozenou@worldbank.org Health Nutrition, and Population (HNP) Unit, The World Bank Group, 1818 H St NW, Washington, DC 20433, USA

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mitigate the negative impacts of the current crisis on health levels and health inequality.

Among the different health outcomes relevant across the life cycle, child health outcomes are particularly important due to their large contributions to human capital accumulation and life expectancy. The latter is more sensitive to reductions in child mortality than late-life mortality improvements. Moreover, as early life years are most critical for cognitive, language, and socioemotional development, comparisons of the returns to investments in skills formation over the lifecycle have demonstrated that rates of return steeply decline in age.\textsuperscript{5-7}

Against this backdrop, the value added of this paper is to use an extensive collection of harmonized micro-datasets to examine pre-COVID-19 trends in average population levels and within-country inequalities for two child health outcomes—the under-five mortality rate (U5MR) and stunting—and to assess the extent to which changes in the average levels and inequality of these outcomes have been driven by changes in aggregate country income.

Materials and Methods

Data

Our U5MR (stunting) data come from 243 (219) Demographic and Health Surveys (DHS) and 48 (135) Multiple Indicator Cluster Surveys (MICS) collected over the 1990–2019 period, with 2007 as the median survey year. The DHS and MICS include a wealth index which is computed using principle component analysis and enables us to analyze child health inequalities by socioeconomic status. The country-year U5MR (stunting) dataset we aggregate from the household micro-data covers 91 (102) countries which together represented about 57\% (54\%) of the world population in 2019. For 67 (83) countries accounting for 49\% (47\%) of the population, we have at least two data points over time which allows us to analyze trends in U5MR (stunting) levels and inequalities. For these trend countries, we focus on long run changes and choose to compare health outcomes between the earliest and latest year for which data is available. For both outcomes, the trend datasets range from 1990 to 2019, with a median baseline year around 1999 and a median endline year around 2015. The median year span between baseline and endline is 18 years for U5MR, and 16 years for stunting. Tables 1 and 2 summarize these characteristics and provide a breakdown by World Bank region.

### Child Health Outcomes

#### Mortality among Children under 5

There are different methods to compute U5MR rates from survey data. For our analysis of trends in U5MR inequality, we use the 'synthetic cohort life table' approach (SCLTA), for which the U5MR is expressed in deaths per 1,000 live births. SCLTA combines observed mortality rates for small, typically monthly, age segments into mortality rates for broader age segments from which the U5MR is subsequently obtained. The combining into broader age segments accounts for partial cohort exposure which, for

| Table 1. Dataset characteristics (Under 5 mortality rate) |
|----------------------------------------------------------|
| # countries | % population | # countries | % population | Baseline (min. year) | Baseline (med. year) | Endline (med. year) | Endline (max. year) | Span (median) |
| All | 91 | 57 | 67 | 49 | 1990 | 1997 | 2015 | 2019 | 18 |
| EAP | 10 | 24 | 6 | 21 | 1993 | 1999 | 2017 | 2018 | 15 |
| ECA | 12 | 24 | 6 | 13 | 1993 | 1999 | 2014 | 2018 | 9 |
| LAC | 14 | 58 | 10 | 24 | 1990 | 1995 | 2014 | 2016 | 19 |
| MNA | 14 | 58 | 3 | 32 | 1990 | 1992 | 2014 | 2017 | 19 |
| SAR | 6 | 99 | 5 | 97 | 1990 | 1993 | 2016 | 2019 | 22 |
| SSA | 41 | 98 | 37 | 93 | 1990 | 1997 | 2016 | 2019 | 18 |

EAP = East-Africa, ECA = Europe and Central Asia, LAC = Latin America and the Caribbean, MNA = Middle East and North Africa, SAR = South Asia, SSA = Sub-Saharan Africa

| Table 2. Dataset characteristics (stunting) |
|------------------------------------------------|
| # countries | % population | # countries | % population | Baseline (min. year) | Baseline (med. year) | Endline (med. year) | Endline (max. year) | Span (median) |
| All | 102 | 54 | 83 | 47 | 1990 | 1999 | 2015 | 2019 | 16 |
| EAP | 10 | 11 | 7 | 11 | 2000 | 2000 | 2015 | 2018 | 14 |
| ECA | 17 | 22 | 15 | 21 | 1993 | 2005 | 2014 | 2018 | 10 |
| LAC | 17 | 78 | 12 | 24 | 1990 | 1996 | 2014 | 2018 | 16 |
| MNA | 9 | 94 | 6 | 44 | 1990 | 1998 | 2014 | 2018 | 14 |
| SAR | 6 | 97 | 5 | 97 | 1990 | 1996 | 2016 | 2019 | 22 |
| SSA | 43 | 99 | 38 | 89 | 1990 | 1998 | 2016 | 2019 | 18 |

EAP = East-Africa, ECA = Europe and Central Asia, LAC = Latin America and the Caribbean, MNA = Middle East and North Africa, SAR = South Asia, SSA = Sub-Saharan Africa.
By contrast, for our micro-data-based decomposition analysis, we compute the U5MR using the ‘true cohort life table approach’ (TCLTA), where the mortality rate is the probability of death in a sample limited to births with full ‘mortality exposure’, in this case being born more than five and less than ten years before the survey. Hence, unlike for SCLTA, births with partial mortality exposure—those occurring 0–59 months prior to the survey—are omitted from this mortality computation. The TCLTA approach is needed because unlike the SCLTA method, it generates probabilities of death not for aggregated age groups but for individual observation which can be related to other individual level decomposition variables.

**Concentration Index**

There are several ways to measure health inequalities, which reflect different value judgments on what aspects of health inequality are important to capture, as well as different underlying axiomatic properties. Following Wagstaff, Paci and Van Doorslaer and Van Doorslaer et al., we use the concentration index (CI) since it satisfies the following conditions: (i) it measures inequalities in health outcomes across a continuous living standard measure like the DHS and MICS wealth index; (ii) unlike comparisons across distributional parameters like wealth quintiles, it summarizes the entire distribution of health outcomes across a population; (iii) it is sensitive to changes in the distribution of the population across socioeconomic groups; and (iv) it is decomposable by population subgroups, such as urban and rural residents.

The CI can be graphically derived from the concentration curve. The curve displays the cumulative shares of a given health outcome accounted for by cumulative shares of a population ordered from its poorest to its richest members. If the health outcome is perfectly equally distributed across the population, the concentration curve is a 45-degree line, known as the line of equality. If, by contrast, the health outcome takes on higher (lower) values among poorer people, the concentration curve will lie above (below) the line of equality. The farther the curve is above the line of equality, the more concentrated the health outcome is among the poor.

The CI is defined as twice the area between the concentration curve and the line of equality. If there is no socioeconomic inequality, the CI is equal to zero. By convention, the CI takes on a negative value when the curve lies above the line of equality, indicating disproportionately high concentration of the health outcome among the poor. Conversely, the CI assumes a positive value when the concentration curve lies below the line of equality, indicating concentration among the rich. If the health outcome is ‘bad,’ such as illness, mortality, or stunting, a negative CI value indicates that ill health is more concentrated among the poor.

It is important to note that the CI implies a value judgment, where the health of the poor is given more importance than that of the rich. This ‘inequality aversion’ is operationalized in the computation of the CI by assigning the highest weight to the poorest population member and having the weights decline stepwise for individuals with higher ranks in the wealth distribution until they reach a value close to zero for the richest person.

Except for a few data points from the most recent DHS and MICS surveys, the CIs of the stunting rates and the SCLTA U5MRs in our analysis, as well as the rates themselves are downloadable from the Health Equity and Financial Protection Indicators (HEFPI) database.
Achievement Index
Health policymakers often face trade-offs when considering policy reform. One such dilemma relates to the potential tension between the goals of maximizing improvements in average health outcomes and reducing health inequalities. Policymakers may be willing to trade one off against the other—a little more inequality might be considered acceptable if average health improves substantially.

In this context, overall ‘achievement’ in health reflects both the average level and inequality of health across a population. It can be operationalized as a weighted average of the health levels across members of a population, where higher weights are assigned to poorer than to richer members. The achievement index (AI) proposed by Wagstaff captures this idea by harnessing the aforementioned ‘inequality aversion’ feature of the CI. It is defined as the product of the average population outcome (µ) and the complement of the CI:

\[ AI = \mu \times (1 - CI) \]

Taking stunting as an example, we can see that a disproportionate concentration of stunting among the poor \( (CI < 0) \) will add a ‘penalty’ to the population stunting rate \( \mu \), so that the \( AI \) exceeds it (i.e. \( AI < \mu \)).

Results
How are Inequalities Related to Average Outcome Levels?

Figure 1 shows the degree of within-country socioeconomic inequality, as well as its association with average outcome levels for a dataset that pools all our country-year observations. 95% confidence intervals are shown as vertical lines for the CIs and as horizontal lines for the population averages. For the large majority of datapoints, CIs are below zero, indicating that both U5MR and stunting are concentrated among the poorest households: The median CI for both outcomes is negative and of similar magnitude, at −0.12 for U5MR, and −0.13 for stunting. Comparing median CIs of datapoints before and after 2010 (which is close to the median year in our sample) reveals that while inequalities in U5MR have remained constant, inequalities in stunting have slightly increased, from −0.11 to −0.15.

In terms of the association of inequality with outcome levels, the upward slope of the linear regression line in Figure 1 indicates that inequalities are largest, on average, for datapoints (country-year pairs) with lower levels of stunting and U5MR, suggesting that, on average, there is a trade-off between better average child health and lower child health inequalities. Figure 1, however, also shows a large degree of dispersion of CIs at given outcomes levels, which is most pronounced when U5MR and stunting are low. This heterogeneity indicates that the trade-off we observe on average is not a fatality. Instead, it suggests that achieving both low levels and low inequality of U5MR and stunting is feasible.

How Have Countries Progressed over Time in Improving Child Health Outcomes and Reducing Socioeconomic Inequalities?

While we observe an on-average trade-off between better overall levels and lower inequalities in child health in our pooled country-year sample, we now analyze trends to assess the extent to which countries have been able to make progress in either domain. For each country with two or more datapoints, annex Tables 1 and 2 show how U5MR and stunting levels, CIs, and AIs have evolved between the first and latest available datapoints. Tables 3 and 4 aggregate the country trends to the level of World Bank regions and income groups, as well as time-periods using population-weighted averages.

For most countries in our trend analysis, child health levels have improved over time. This is the case for 62 of 67 countries for U5MR, and for 77 of 83 countries for stunting. Child health inequalities, by contrast, have declined for far fewer countries, namely for 26 of 67 for U5MR, and for 25 of 83 for stunting. The number of countries which managed to both reduce inequalities

![Figure 1. Within-country inequalities and outcome levels](image-url)
and improve child health outcomes is even slightly lower, at 24 for U5MR, and 21 for stunting.

Among the 62 countries experiencing reductions in U5MR levels over time, the improvement was not sufficient for 15 of them to offset the increase in inequalities, resulting in a lower AI for child survival at endline. Likewise, for stunting, while 77 countries saw a reduction in levels, the AI increased in only 67 countries. Altogether, 45 of the 67 countries in our U5MR sample, or about two-thirds, improved their achievement AI, as did 67 of the 83 countries, or about 80%, in our stunting sample.

**How are Inequalities Related to Aggregate Income Levels?**

We now assess the extent to which cross-country variations in child health inequality can be accounted for by differences in aggregate income. Figure 2 plots the CI of the household wealth index (a version of the Gini-coefficient, here shown in blue scatter) and the CI of the respective health outcome (red scatter) against aggregate income, measured as real GDP per capita. The correlation between aggregate income and wealth inequalities is strongly negative ($r = -0.64; p = .00$), as is the correlation of aggregate income with inequalities in U5MR ($r = -0.32; p = .00$) and in stunting ($r = -0.52; p = .00$). This implies that while inequalities in wealth tend to decrease with aggregate income (the wealth CIs reduce in the positive range as GDP increases), inequalities in child health outcomes tend to increase with aggregate income (the health CIs decrease in the negative range, indicating a larger concentration of mortality or stunting among the poorest for higher GDP).

### Table 3. Achievement trends (under 5 mortality rate)

| Region | Total # of countries | # countries improving achievement index | # countries improving child survival | # countries improving equity | # countries improving both survival and equity | # countries improving survival only | # countries improving equity only | # countries decreasing survival and equity |
|--------|----------------------|----------------------------------------|-----------------------------------|---------------------------|-----------------------------------------------|-----------------------------------|-------------------------------|----------------------------------------|
| EAP    | 6                    | 2                                      | 6                                 | 2                         | 4                                             | 0                                 | 0                             | 0                                      |
| ECA    | 6                    | 2                                      | 6                                 | 2                         | 4                                             | 0                                 | 0                             | 0                                      |
| LAC    | 10                   | 6                                      | 9                                 | 4                         | 4                                             | 5                                 | 0                             | 1                                      |
| MNA    | 3                    | 2                                      | 3                                 | 2                         | 2                                             | 1                                 | 0                             | 0                                      |
| SAR    | 5                    | 4                                      | 5                                 | 1                         | 1                                             | 4                                 | 0                             | 0                                      |
| SSA    | 37                   | 29                                     | 34                                | 16                        | 14                                            | 20                                | 2                             | 1                                      |
| Low income | 20                   | 17                                     | 20                                | 8                         | 8                                             | 12                                | 0                             | 0                                      |
| Upper middle | 15                | 9                                      | 12                                | 7                         | 6                                             | 6                                 | 1                             | 2                                      |
| <2005 | 17                   | 11                                     | 16                                | 5                         | 5                                             | 11                                | 0                             | 1                                      |
| [2005–2010] | 34               | 27                                     | 32                                | 15                        | 14                                            | 18                                | 1                             | 1                                      |
| ≥2010 | 16                   | 7                                      | 14                                | 6                         | 5                                             | 9                                 | 1                             | 1                                      |
| Total  | 67                   | 45                                     | 62                                | 26                        | 24                                            | 38                                | 2                             | 3                                      |

EAP = East-Asia Pacific, ECA = Europe and Central Asia, LAC = Latin America and the Caribbean, MNA = Middle East and North Africa, SAR = South Asia, SSA = Sub-Saharan Africa. <2005 = countries for which the median year between the first and last available survey is earlier than 2005. [2005–2010] = countries for which the median year between the first and last available survey is between 2005 and 2009. ≥2005 = countries for which the median year between the first and last available survey is later than 2009.

### Table 4. Achievement trends (stunting)

| Region | Total # of countries | # countries improving achievement index | # countries improving stunting | # countries improving equity | # countries improving both level and equity | # countries improving level only | # countries improving equity only | # countries decreasing level and equity |
|--------|----------------------|----------------------------------------|-------------------------------|---------------------------|-----------------------------------------------|-----------------------------------|-------------------------------|----------------------------------------|
| EAP    | 7                    | 7                                      | 7                              | 2                         | 2                                             | 5                                 | 0                             | 0                                      |
| ECA    | 15                   | 11                                     | 14                             | 5                         | 5                                             | 9                                 | 0                             | 1                                      |
| LAC    | 12                   | 8                                      | 12                             | 4                         | 4                                             | 8                                 | 0                             | 0                                      |
| MNA    | 6                    | 5                                      | 6                              | 4                         | 4                                             | 2                                 | 0                             | 0                                      |
| SAR    | 5                    | 5                                      | 5                              | 1                         | 1                                             | 4                                 | 0                             | 0                                      |
| SSA    | 38                   | 31                                     | 33                             | 9                         | 5                                             | 28                                | 4                             | 1                                      |
| Low income | 22                   | 19                                     | 18                             | 8                         | 4                                             | 14                                | 4                             | 0                                      |
| Upper middle | 25                | 19                                     | 24                             | 9                         | 9                                             | 15                                | 0                             | 1                                      |
| <2005 | 21                   | 16                                     | 18                             | 5                         | 3                                             | 15                                | 2                             | 1                                      |
| [2005–2010] | 43               | 37                                     | 42                             | 10                        | 9                                             | 33                                | 1                             | 0                                      |
| ≥2010 | 19                   | 14                                     | 17                             | 10                        | 9                                             | 8                                 | 1                             | 1                                      |
| Total  | 83                   | 67                                     | 77                             | 25                        | 21                                            | 56                                | 4                             | 2                                      |

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How Do Inequalities in Health Outcomes Relate to Socioeconomic Inequalities within Countries?

Following Wagstaff, Van Doorslaer, and Watanabe,23 we decompose inequalities in health outcomes into a part accounted for by inequalities in socioeconomic status (SES)—here measured by the household wealth index score, household head education and child sex and age—and a part accounted for by other factors. For observations before and after 2010, Tables 5 and 6 show average levels and inequalities of child health outcomes across World Bank regions and income groups, and, in the last two columns, the result of our decomposition—the share of health inequalities accounted for by SES. We again see that while child health levels have, on average, improved over time, inequalities have not, and that differences in SES account for at least 80% of health inequalities.

We now take a closer look at how socioeconomic inequalities in child health vary with aggregate income. Figure 3 plots the difference between inequalities in child health and inequalities in SES, as well as child health levels, against real GDP per capita. When the difference between the two inequalities is negative, inequalities in SES are larger

Table 5. Average outcomes and inequalities (under 5 mortality rate)

|        | Mean child mortality (%) | Average inequality (CI) | Share of infant mortality CI accounted for by SES (%) |
|--------|--------------------------|--------------------------|-----------------------------------------------------|
|        | N                        | Before 2010              | After 2010              | Before 2010 | After 2010 |
| EAP    | 26                       | 7.0                      | 4.6                    | -0.19       | -0.20       | 79.1 | 92.9 |
| ECA    | 23                       | 5.1                      | 3.0                    | -0.10       | -0.14       | 98.1 | 92.3 |
| LAC    | 47                       | 7.2                      | 3.4                    | -0.17       | -0.18       | 85.9 | 93.4 |
| MNA    | 20                       | 5.5                      | 2.8                    | -0.15       | -0.06       | 83.4 | 94.8 |
| SAR    | 23                       | 11.1                     | 6.1                    | -0.12       | -0.11       | 80.8 | 85.3 |
| SSA    | 152                      | 16.1                     | 9.9                    | -0.10       | -0.10       | 83.2 | 88.5 |
| Low income | 79                | 19.2                     | 10.4                   | -0.08       | -0.09       | 86.5 | 84.4 |
| Lower middle | 143           | 11.0                     | 7.1                    | -0.13       | -0.13       | 82.1 | 92.1 |
| Upper middle | 69            | 5.5                      | 3.1                    | -0.15       | -0.16       | 89.1 | 96.7 |
| All    | 291                      | 11.6                     | 7.2                    | -0.12       | -0.12       | 95.7 | 80.0 |

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Table 6. Average outcomes and inequalities (stunting)

|        | Mean stunting (%) | Average inequality (CI) | Share of stunting CI accounted for by SES (%) |
|--------|-------------------|--------------------------|------------------------------------------------|
|        | N                 | Before 2010              | After 2010              | Before 2010 | After 2010 |
| EAP    | 26                | 38.4                     | 26.1                   | -0.11       | -0.17       | 96.6 | 92.9 |
| ECA    | 44                | 19.3                     | 10.9                   | -0.15       | -0.12       | 94.0 | 90.5 |
| LAC    | 54                | 25.1                     | 15.5                   | -0.27       | -0.30       | 92.9 | 93.8 |
| MNA    | 24                | 21.5                     | 15.5                   | -0.14       | -0.09       | 94.2 | 89.6 |
| SAR    | 23                | 49.7                     | 35.6                   | -0.10       | -0.14       | 85.0 | 91.0 |
| SSA    | 182               | 40.0                     | 32.1                   | -0.10       | -0.14       | 91.3 | 93.2 |
| Low income | 100             | 42.4                     | 35.3                   | -0.09       | -0.11       | 93.6 | 89.6 |
| Lower middle | 159         | 37.1                     | 27.3                   | -0.13       | -0.16       | 92.2 | 93.2 |
| Upper middle | 93              | 20.6                     | 13.2                   | -0.20       | -0.22       | 93.4 | 94.6 |
| All    | 353               | 34.1                     | 25.9                   | -0.14       | -0.16       | 92.9 | 92.9 |

EAP = East-Asia Pacific, ECA = Europe and Central Asia, LAC = Latin America and the Caribbean, MNA = Middle East and North Africa, SAR = South Asia, SSA = Sub-Saharan Africa.
than health inequalities. The opposite holds when the difference is positive. Figure 3 shows that for low-income countries, U5MR and stunting levels are high, and socioeconomic inequalities are typically larger than health inequalities. As aggregate income increases, health outcome levels improve, health inequalities typically increase as well, and SES inequalities tend to decrease, to the point where health inequalities are actually larger than inequalities in SES.

While SES inequalities and health outcome inequalities seem to follow a close but inverted relationship with aggregate income in our pooled sample, we now assess whether changes in SES inequalities over time are directly related with changes in health inequalities. Figure 4 shows scatter plots of the annualized percentage changes in the CIs of health outcomes and the CIs of SES for our trend analysis samples. Overall, the majority of countries experienced concomitant reductions in health and SES inequalities over time, in the sense that SES became less concentrated toward richer households, and ill health less concentrated among poorer households. A substantial number of countries (23 countries for U5MR, and 22 countries for stunting), however, experienced an increase in health inequalities despite reductions in SES inequalities. The correlation between changes in health inequalities and changes in SES inequalities is hence weak for both U5MR ($r = -0.25, p = .05$) and stunting ($r = 0.21, p = .06$), and it differs in sign for the two outcomes. Overall, changes in SES inequalities account for only 6% of the variation in U5MR inequalities, and 5% of the variation in stunting inequalities.

**How Much Does Income Growth Affect the Level and Inequalities in Health Outcomes?**

We now examine whether long-run aggregate income growth is correlated with changes in health inequalities. We have demonstrated above that in our sample, changes in income or SES inequalities are not associated with changes in health inequalities (Figure 4). Consistent with this result, we also report a weak relationship between aggregate income growth and changes in health outcomes for our trend analysis sample (Figure 5). For U5MR, the correlation is, in fact, not statistically significant ($r = -0.16, p = .19$), and income growth accounts for only 1% of the variation in changes in U5MR. For stunting, the correlation is negative ($r = -0.23$ and $p = .04$) but weak, with

![Figure 3](image3.png)

**Figure 3.** Relative socioeconomic status inequalities, stunting and aggregate income

![Figure 4](image4.png)

**Figure 4.** Changes in socioeconomic status and changes in health inequalities
income changes accounting for only 5% of the variation in changes in stunting levels across countries.

We extend this analysis by assessing whether changes in aggregate income are correlated with changes in health inequality. In Figure 6, we plot the annualized percentage change in the health CIs against the annualized percentage in real GDP per capita. The scatter of points is quite dispersed for both U5MR and stunting, and the correlations are positive but weak ($r = 0.25$, $p = 0.05$ for U5MR; $r = 0.21$, $p = 0.07$ for stunting). GDP growth accounts for only 6% of the variation in changes in U5MR inequalities, and 4% of the variation in changes in stunting inequalities.

**Discussion**

In this paper, we first contribute to the large and growing literature on health inequality trends within countries by expanding the number of countries and the time period covered. This literature, summarized in annex Table 3, suggests that while within-country inequalities in essential health service coverage have mostly reduced over time, trends in health outcome inequalities have been more mixed. As Gwatkin,24 summarizes, “The findings of all these studies […] produce an unusually distinct picture of a glass that is clearly more than half full, but still well over a quarter empty.” Focusing on child health outcomes, our account is even less favorable than a glass half full, with only about a third of countries in our sample managing to both reduce U5MR levels and inequalities, and only a quarter managing to do so for stunting. On a more positive note, if we explicitly account for possible trade-offs between improvement in health outcomes and improvement in the distribution of these outcomes through the achievement index, we note that the improvement in average outcomes has more often than not compensated the increase in inequalities. The majority of countries have increased their achievement indices for U5MR (45 out of 67) and for stunting (67 out of 83). The fact that inequality in service coverage seems to follow a more favorable trend than inequality in health outcomes suggests that policies aiming to reduce health inequities should not only foster more equitable service coverage but also focus on the social determinants of health which often extend beyond the reach of the health sector. A limitation of our analysis and the other literature on trends in health inequalities is that due to data constraints, baseline and endline survey years differ across countries, leading to differing time trend lengths and periods.
A second contribution of this paper is to analyze the extent to which inequalities in health outcomes are associated with socioeconomic inequalities, and whether aggregate income growth can help reduce inequalities in health outcomes. Previous studies have shown that variations in income or socioeconomic status levels are strongly associated with differences in health outcomes, both at the aggregate country level and within countries. The strong empirical association between income and health has led some authors to also argue that income growth would constitute a strong driver of improvement in health outcomes. The view that economic growth can be regarded as a necessary, and sometimes sufficient, condition for improving population health has, however, been nuanced by the work of Filmer and Pritchett, Deaton, or Vollmer et al., who find the empirical relation between changes in income and changes in health outcomes to be much less robust. Our results are in line with these findings, showing that while there seems to be a clear relation between socioeconomic inequalities and health inequalities on one hand, and aggregate income levels on the other, there is no strong correlation between changes in health inequalities and income growth. This result suggests that income generating development policies alone will typically not suffice to improve health outcomes and reduce health inequalities if they are not complemented by explicit and targeted policies designed to improve equity in health service coverage and the social determinants of health. Encouragingly, a large body of research now identifies such equity-focused, cost-effective interventions to improve child health among the poorest population segments.

Conclusions

The evidence presented in this paper shows that while average child health outcomes have improved over time almost universally, only a minority of countries have achieved simultaneous reductions in child health inequality. Our results also show that such inequalities do not automatically diminish with income growth. Both findings highlight the need to prioritize the more vulnerable populations in policy design. This need is even more imperative now, as (1) progress toward reducing child health inequalities before 2020 has been underwhelming, (2) health and socioeconomic inequalities are likely to increase through the COVID-19 pandemic, and (3) fiscal space to fund pro-poor human capital investments will likely narrow in the medium term due to growing public debt. As we are now almost halfway through the SDGs timeline, several countries have demonstrated that it is indeed possible to improve health outcomes and to reduce health inequalities simultaneously.

Note

1. The reverse is, however, not necessarily true: When the CI equals zero, socioeconomic inequality in health can still exist, as the CI might mask compensatory effects between pro-poor and pro-rich inequalities.

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Data Availability Statement

The data underlying the analyses presented in this paper are available from the authors upon request.

Disclosure of Potential Conflicts of Interest

No potential conflict of interest was reported by the authors.

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References

1. UN IGME. 2015. Levels & trends in child mortality report 2013. New York, United States: United Nations Inter-agency Group for Child Mortality Estimation.
2. World Health Organization. 2015. Trends in maternal mortality: 1990–2015: estimates from WHO, UNICEF, UNFPA. Geneva, Switzerland: World Bank Group and the United Nations Population Division: World Health Organization.
3. World Bank. 2020. Poverty and Shared Prosperity 2020: reversals of Fortune. Washington, DC: The World Bank.
4. Deaton A. The great escape: health, wealth, and the origins of inequality. Princeton, New Jersey: Princeton University Press; 2013.
5. Cunha F, Heckman JJ, Lochner L, Masterov DV. Interpreting the evidence on life cycle skill formation. Handbook Econ Edu. 2006;1:697–812.
6. Cunha F, Heckman J. The technology of skill formation. Am Econ Rev. 2007;97(2):31–47. doi:10.1257/aer.97.2.31.
7. Hoddinott J, Alderman H, Behrman JR, Haddad L, Horton S. The economic rationale for investing in stunting reduction. Matern Child Nutr. 2013;9:69–82. doi:10.1111/mcn.12080.
8. Rutstein SO, Rojas G. Guide to DHS statistics. Calverton (MD): ORC Macro; 2006. 38.
9. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, Ezzati M, Grantham-McGregor S, Katz J, Martorell R, et al. Maternal and child undernutrition and overweight in low-income and
middle-income countries. Lancet. 2013;382(9890):427–51. doi:10.1016/S0140-6736(13)60937-X.
10. World Health Organization. 2006. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Geneva, Switzerland: World Health Organization.
11. Kraay A. The world bank human capital index: a guide. World Bank Res Obs. 2019;34(1):1–33. doi:10.1093/wbro/lk001.
12. Amouzou A, Kozuki N, Gwatkin DR. Where is the gap?: the contribution of disparities within developing countries to global inequalities in under-five mortality. BMC Public Health. 2014;14(1):1–5. doi:10.1186/1471-2458-14-216.
13. Wagstaff A, Eozenou P, Neelsen S, Smits M. The 2019 Update of the Health Equity and Financial Protection Indicators Database: An Overview. Policy Research Working Paper;No. 8879. World Bank. Washington (DC): © World Bank;2019. https://openknowledge.worldbank.org/handle/10986/31869 License: CC BY 3.0 IGO
14. Harper S, Lynch J. Health inequalities: measurement and decomposition. In: Oakes JM, Kaufman JS, editors. Methods in social epidemiology. 2nd ed. San Francisco (CA): Jossey-Bass;2017:91–131.
15. Wagstaff A, Paci P, Van Doorslaer E. On the measurement of inequalities in health. Soc Sci Med. 1991;33 (5):545–57. doi:10.1016/0277-9536(91)90212-U.
16. Van Doorslaer E, Wagstaff A, Blechrodt H, Calonge S, Gerdtham U-G, Gerfin M, Geurts J, Gross L, Håkkinen U, Leu RE, et al. Income-related inequalities in health: some international comparisons. J Health Econ. 1997;16 (1):93–112. doi:10.1016/S0167-6296(96)00532-2.
17. Kakwani NC. Applications of Lorenz curves in economic analysis. Econometrica. 1977;45(3):719–27. doi:10.2307/1911684.
18. Kakwani N, Wagstaff A, Van Doorslaer E. Socioeconomic inequalities in health: measurement, computation, and statistical inference. J Econom. 1997;77(1):87–103. doi:10.1016/S0304-4076(96)01807-6.
19. Wagstaff A. Inequality aversion, health inequalities, and health achievement. J Health Econ. Washington, DC, United States. 2002;21(4):627–641. ISSN 0167-6296. doi:10.1016/S0167-6296(02)00006-1.
20. Wagstaff A, Eozenou P, Neelsen S, Smits M. The 2018 health equity and financial protection indicators database: overview and insights. The World Bank; 2018.
21. Wagstaff A, Eozenou P, Neelsen S, Smits M-F. Introducing the World Bank’s 2018 Health Equity And Financial Protection Indicators Database. Lancet Global Health. 2019;7(1):e22–e3. doi:10.1016/S2214-109X(18)30437-6.
22. Wagstaff A, Eozenou P, Neelsen S, Smits M. The 2019 Update of the Health Equity and Financial Protection Indicators Database: An Overview. Policy Research Working Paper;No. 8879. World Bank. Washington (DC): © World Bank; 2019. https://openknowledge.worldbank.org/handle/10986/31869 License: CC BY 3.0 IGO
23. Wagstaff A, Van Doorslaer E, Watanabe N. On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. The World Bank; 2001.
24. Gwatkin DR. Trends in health inequalities in developing countries. Lancet Global Health. 2017;5(4):e571–e2. doi:10.1016/S2214-109X(17)30080-3.
25. Preston SH. The changing relation between mortality and level of economic development. Popul Stud. 1975;29 (2):231–48. doi:10.1080/00324728.1975.10410201.
26. Cutler D, Deaton A, Lleras-Muney A. The determinants of mortality. J Econ Perspect. 2006;20(3):97–120. doi:10.1257/jep.20.3.97.
27. Svedberg P. Declining child malnutrition: a reassessment. Int J Epidemiol. 2006;35(5):1336–46. doi:10.1093/ije/dyi157.
28. Wagstaff A. Socioeconomic inequalities in child mortality: comparisons across nine developing countries. Bull World Health Organ. 2000;78:19–29.
29. Wagstaff A, Watanabe N. What difference does the choice of SES make in health inequality measurement? Health Econ. 2003;12(10):885–90. doi:10.1002/hec.805.
30. Moser KA, Leon DA, Gwatkin DR. How does progress towards the child mortality millennium development goal affect inequalities between the poorest and least poor? Analysis of demographic and health survey data. BMJ. 2005;331(7526):1180–82. doi:10.1136/bmj.38659.580125.79.
31. Pritchett L, Summers LH. Wealthier is healthier (English). Policy, Research working papers; no. WPS 1150. World development report. Washington (DC): World Bank Group. 1993. http://documents.worldbank.org/curated/en/684651468741004317/Wealthier-is-healthier.
32. Haddad L, Alderman H, Appleton S, Song L, Yohannes Y. Reducing child malnutrition: how far does income growth take us? World Bank Econ Rev. 2003;17(1):107–31. doi:10.1093/wber/lhg012.
33. Filmer D, Pritchett L. The effect of household wealth on educational attainment: evidence from 35 countries. Popul Dev Rev. 1999;25(1):85–120. doi:10.1111/j.1728-4457.1999.00085.x.
34. Vollmer S, Hartgen K, Subramanyam MA, Finlay J, Klasen S, Subramanian SV. Association between economic growth and early childhood undernutrition: evidence from 121 demographic and health surveys from 36 low-income and middle-income countries. Lancet Global Health. 2014;2(4):e225–e34. doi:10.1016/S2214-109X(14)70025-7.
35. Carrera C, Azrack A, Begkoyian G, Pfaffmann J, Ribaira E, O’Connell T, Doughty P, Aung KM, Prieto L, Rasathanth K, et al. The comparative cost-effectiveness of an equity-focused approach to child survival, health, and nutrition: a modelling approach. Lancet. 2012;380(9850):1341–51. doi:10.1016/S0140-6736(12)61378-6.
36. Chopra M, Sharkey A, Dalmiya N, Anthony D, Binink N. Strategies to improve health coverage and narrow the equity gap in child survival, health, and nutrition. Lancet. 2012;380(9850):1331–40. doi:10.1016/S0140-6736(12)61423-8.