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Nowcasting impact of COVID-19 on multidimensional child poverty

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Abstract. From the onset, it was clear that the impact of the global economic and social crisis caused by the COVID-19 pandemic was unlikely to affect all children equally. Thus, it was necessary to ascertain the impact of COVID-19 on child poverty as the events unfolded.
Many of the indirect effects of the pandemic – disruptions to health services, delayed vaccination programmes, widespread school closures, and increases in food insecurity – have significant impacts on the realisation of children's rights and, consequently, were expected to increase material deprivations across different dimensions. The question was by how much?
In this article we explain the modelling and methodological approach to project or nowcast the answer to that question. The method is dynamic as it was revised as additional information emerged during 2020 and 2021.

Keywords: Nowcasting, poverty, child poverty, children, COVID-19

1. Introduction

While children are often not the face of the global COVID-19 pandemic, they might be its biggest victims. The pandemic has led to unprecedented economic consequences, resulting in the worst recession in a century with impacts on economic growth, unemployment, and income inequality. Also, there were unparalleled social impacts, including school closures or reduced access to public services, threatening to reverse much of the development progress made over the last decades.

Thus, early in the pandemic, it became necessary to estimate the impact of COVID-19 on child poverty.

Children experience poverty differently from adults. The main reason is that their needs are different – from nutrition through schooling to health care. Moreover, they depend on adults for support, care, and satisfaction of their needs. Children are not supposed to earn a living on their own and resources are often not shared equally within the household. Thus, it is essential to measure the actual material shortcomings children are experiencing, through a multidimensional child poverty measurement [1]. Many of the indirect effects of the pandemic – disruptions to health services, delayed vaccination programmes, widespread school closures, and increases in food insecurity – have significant impacts on the realisation of children's rights and are likely to increase material deprivations across different dimensions. In this article we present the methodology used to investigate the various effects of the pandemic on different dimensions, discuss some of the challenges faced when undertaking such a nowcasting effort, and a few results.

In addition to measuring children's material deprivations, it is also important to know if children live in households that can make ends meet. This is particularly relevant in the context of COVID-19, as many caregivers lost their employment opportunities and in-

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come. As a result, those monetary consequences impact children negatively and can lead to a violation of their right to a minimum standard of living. As the methodology and the results of the projections of children living in monetary poor households have been presented elsewhere [2], they are not included here.

After a summary description of the concept of child poverty (in the following section) the principles of measuring multidimensional child poverty are presented in the third section along with the baseline numbers prior to COVID-19. Then, the nowcasting methodology is explained in section 4, which also includes the main findings of this exercise and some of its limitations. Section 5 concludes the article.

2. Child poverty

Children experience poverty differently from adults. As they are also not supposed to earn a living on their own, it is essential to measure the actual material shortcomings children are suffering.

Conceptually, child poverty is the lack of public and private material resources to realize their rights constitutive of poverty. Rights constitutive of poverty are those rights that require directly and fundamentally material resources for their continued realization [3,4].

The concept of constitutive rights is important to establish which dimensions should be included in the measurement of child poverty. A test to include a dimension (right) is to ask if the realization of the right depends on the utilization of material resources (publicly provided or privately purchased). Thus, housing, sanitation, and education, which require material resources are included but privacy or religious freedom or happiness are not.

Nevertheless, although based on the above child poverty would not include a monetary dimension, it is important to know if children live in households that can make ends meet. Ideally, child poverty (as measured by material shortcomings) as well as children living in monetary poor households should be considered together and cross-tabulated. However, very few household surveys have the required data to estimate both forms of poverty.[1] Therefore, they are usually estimated separately and our nowcasting models are also carried out separately. In what follows, the baseline and the projections for child poverty are presented.[2]

[1] In addition, the collection of those surveys was significantly impacted during the pandemic [5].

[2] As mentioned above, the nowcasting for children in monetary poor households has already been presented in a separate article [2].

3. Measuring the internationally comparable child poverty baseline

The baseline for the impact of COVID-19, i.e. the pre-20202 estimates of child poverty is based on available internationally comparable estimates of child poverty. These estimates are measured at the level of the individual child – it is not a disaggregation of a household measure. The dimensions of the metric are rights constitutive of poverty and they are considered equally important, thus all dimensions are equally weighted [6–8].

There are two main data limitations. Most household surveys that can be used to estimate child poverty do not have the full ideal set of indicators. Also, even if the indicator is included in the survey, it is not asked of all children (e.g. nutrition is not usually measured for adolescents).

In the absence of knowledge, no imputations are made. The avoidance of imputation clearly leads to underestimation of child poverty. Nevertheless, it is better to err on the side of caution and not overestimate child poverty.

For indicators that are only measured at the household level (e.g. overcrowding), all the children are treated the same way (i.e. if there is overcrowding in the household, all children therein are considered deprived in their right to housing). Nonetheless, in some cases it is possible to disentangle these indicators. For example, in cases when the household is far from a safe water source, it is possible to know what household member actually fetches water. Similarly, access to communication and information devices (i.e. mobile phones) or access to reproductive health can sometimes be separated between boys and girls. Nevertheless, due to data limitations, unfortunately, these elements were not included in the internationally comparable estimates.

The methodology for calculating child poverty is very simple and within the canon for multidimensional poverty estimation. It is based on two steps. First, identifying which children are deprived in each dimension – identification – and second, compiling the individual child's information into a summary measure – aggregation (across equally weighted dimensions).

Reliable data for six dimensions are available for 72 countries, representing 65% of the total child population in low- and middle-income countries in 2019. The dimensions and indicators used in the internationally comparable estimates of child poverty are described in the Annex. The sources of the data are Demographic and Health Surveys (DHS) and Multi-Indicator and Cluster Surveys (MICS) between 2012 and 2019.

Using severe thresholds of deprivation in each of these dimensions, we find that 40–50% of children across these 72 countries are deprived in at least one dimension (weighted by the child population). Moreover, on average each child experiences 0.7 of a deprivation.[3]

Using moderate[4] thresholds of deprivation in each of these dimensions, we find that 70–80% of children across these 72 countries are deprived in at least one dimension (weighted by the child population). Also, on average, children suffer 1.4 deprivations.

4. Projected impact of COVID on child poverty

Understanding the evolution of child poverty requires analysing the various dimensions (rights) that constitute child poverty. For nowcasting, the analysis requires simulations of changes in individual dimensions, acknowledging that not all negative impacts have been felt yet and might only materialise over the coming years. Moreover, in the first year of COVID-19, it is important to distinguish dimensions that are affected more immediately and those which only react slowly.

For instance, for children who have access to safe drinking water at home, their situation does not change due to the pandemic. Even in the case of a recession, it would take several months for individual families' economic dislocation to force them to move to lodgings without access to safe drinking water. It would take even longer for the accumulation of these cases to be noticeable in national averages.

Thus, the two dimensions affected most rapidly are education, caused by the immediate effect of school closures, and health, due to the disruption of essential health services. Also, deprivation in these dimensions might change differently in the first year of a pandemic than in the subsequent years, and we therefore suggest a method which allows for different paces and impacts over time (see below). After the initial shock, we would also expect impacts on nutrition, however those accumulate more slowly and might not be noticeable in the first two years [9].

[3]In other words, while some children suffer no deprivation, other children suffer one or two or more deprivations. Averaging across all these children we obtain a measure of how poor children are.

[4]Within the continuum of deprivation, from extreme, through severe and moderate, thresholds can be established to determine the degree of deprivation for each indicator. The thresholds used in the internationally comparable estimates of child poverty are described in the Annex. They are based on international standards and agreements as well as Sustainable Development Goals indicators.

4.1. Education

In our baseline, children were considered deprived in education if they were not currently attending school (if between 7–14 years of age) or not currently attending secondary school (if between 15–17 years of age). Within these groups children who have never been to school (if between 7–14 years of age) or who have not completed primary school (if between 15–17 years of age) were considered severely deprived. The baseline data suggest that about one in five children were deprived in the education dimension across low- and middle-income countries. Of these children, about half were severely deprived in education.

At the hight of COVID-19, 1.3 billion pupils worldwide were out of school [10,11]. However, as most governments set up distance education to continue children's learning (distributed for instance by radio, TV or online), school closures do not automatically translate into education deprivation.[5]

Clearly, for children to be able to participate in distance learning, they need to have access to these technologies. Using information (from the same surveys used to estimate the baseline) on the availability of TV, radios and online devices in the household, we suggest counting children as severely deprived of education in the aftermath of COVID-19 if either they have been severely deprived before, or (in countries where at least 10% of children were out of school due to school closures in 2020 and 2021)[6] had no access to the technology[7] used in their country to access distance learning opportunities. The modelling is done country-by-country, meaning that, if in a country, the government used radio for distance learning, we only checked availability of radio in the household. If instead, TV was used, we checked for the presence of TV in the household. If both were used, we checked for the presence

[5]This does not imply that we assume the quality of in-class and online learning are equivalent, nor do we intend to minimize other issues (affecting happiness, socialization, etc) which are affected by school closures. We are only attempting to measure children that were cut off from learning or whose learning was diminished due to the material restriction imposed by living in cramped quarters.

[6]This assumption is used to "filter" and separate countries. In other words, if school closures were minimal (i.e. no more than 10% of students were missing classes due to school closures), the simulation model is not applied to them and, consequently, no increase in education deprivation is projected in those countries.

[7]Countries used different approaches (and often more than one approach) in these circumstances. The country-specific information regarding the type of means (radio, TV, etc.) required by children was obtained from [12].

of at least one of either radio or TV. This approach is generalizable for the cases where governments also (or instead) used online means to impart distance learning.

We furthermore assume that children living in an overcrowded household would struggle to access consistently the technology needed for distance education. We consider children in those cases as moderately deprived. Most surveys only assess the presence of at least one unit (i.e. "is there a TV in the house?") but not how many units are present. Also, we have no information about sharing its use. Nevertheless, the assumption is that if there are more children per room in the household, it is likely that there will be less time to use the means (whether one or more are present) to access distance learning for each of them seems plausible.[8]

Our projections suggest that the proportion of children deprived in education increased sharply in 2020 (by a factor of roughly three and half times for both moderate and severe deprivation), before declining again in 2021 (about double their pre-COVID levels).[9] A significant proportion of the increase in education deprivation using the moderate threshold is because more than 60% of children are at least moderately deprived in housing, i.e. living in overcrowded settings.[10]

4.2. Health

Turning the attention to health deprivations there are age-specific thresholds for different services. Also, even prior to the pandemic, there were issues of data availability influencing the choice of indicators. For children 12–35 months of age immunisation against measles and DPT is considered, while for children between 36–59 months of age children's deprivation is assessed based on the medical treatment children with acute respiratory infections have received. For children 15–17 years of age, unmet contraception needs constitute deprivation in health. Using these indicators, roughly one in eight children across low- and middle-income countries were considered deprived in health.

There is a wide range of evidence showing that health services have been disrupted due to the impact of the COVID-19 pandemic. However, the actual levels of disruption vary significantly between countries[11] and different types of health services. Our projections rely on information from periodic UNICEF country office reporting against an evolving questionnaire to assess the socio-economic impact of the pandemic as well as disruption of social services [14]. When data for a particular country were missing, we estimated changes based on those observed in neighbouring countries (and of similar per capita income). We then assume that for instance a decline of 10% in child immunisation services would consequently lead to an equivalent increase of deprivation in immunisation for children of the relevant age group.[12]

However, ascertaining the national change in health services is not sufficient when estimating the impact of COVID-19 on child poverty. Instead, that information needs to be complemented with a modelling exercise determining in the microdata which children will face the additional burden. Without that step of the simulation, we would not be able to assess if the drops in essential health services would lead to an increase in the depth/breadth of poverty (if it affected children who are already deprived in another dimension), the headcount of poverty (if it affected mostly children who were not previously deprived and became newly poor), or a combination of both. For each of the three health deprivations considered in the analysis (immunisation, treatment of children with lower respiratory infections, and access to contraception) we therefore need to rank children in the likelihood of getting deprived.

Let us take the case of vaccination to explain how this was carried out. Obviously, once immunized, the pandemic does not take away the vaccination. In order to assess how pandemic might impact immunization, we need to focus on the children who are newborn or were still too young to be vaccinated before the onset

[8] From the perspective of intra-household allocations, there may be a "pecking order" for utilization (e.g. older siblings may be given priority). Unfortunately, we do not have such data. However, for a few countries we do have information about cell phone ownership among adolescents and it does show a bias against girls, creating a wedge between boys' and girls' levels of child poverty [13]. However, this information is available for too few countries to be able to incorporate these considerations in the global simulations.

[9] For severe deprivation, the baseline was around 12% and the nowcasting exercise yields values of almost 40% in 2020 and close to 25% in 2021. The respective values for moderate deprivation are: 20%, 72%, and 40%.

[10] Theoretically the education recovery could be either due to families buying the means to access distance learning or due to a relaxation of school closures. However, given the data limitations, the nowcasting model is only able to capture the latter effect.

[11] Regrettably, this type of data (which could have been combined with the existing subnational admin level 1, estimates of child poverty prior to COVID-19) was not available in a consistent fashion across countries to be able to incorporate it into the modelling exercise.

[12] The data reported by UNICEF country office were in ranges. For example, a disruption between 10 to 30 percent. For the projections, we used both the upper and lower bounds of these estimates, which resulted in more or less optimistic bands for our nowcasting.

of COVID. These are the children at risk of not being vaccinated due to the health services closure described above.

This requires establishing a ranking of children, from the least likely to the most likely to be vaccinated. Two ways to establish the ranking were pursued.[13] One was the calculation of probabilities using a logistic regression. The other one was a clustering of children using Classification Tree Analysis.[14] The two approaches provided consistent results in the sense that both rankings were similar (the Spearman Rank Correlation was above 0.8 in most countries).

Once children are ranked according to the probability that they would be vaccinated, the projected change in immunization rates is applied to the ranking in two steps.[15] The baseline is determined by the pre-COVID immunization and non-immunization rates. Secondly, an additional group of children is added to the latter. This second group is made up of children who would likely have been vaccinated if pre-COVID rates had prevailed, but whose likelihood of being vaccinated is close to those with the lowest chances of being vaccinated.

For instance, let us assume that 50% of children were not vaccinated prior to COVID and immunization services declined by 10%. Then, due to COVID, the percentage of unvaccinated children would become 55%. These additional children (i.e. 5% of the age-appropriate children) are those between the 50th and 55th percentile in the ranking of the likelihood of being vaccinated. They can be considered the "newly" deprived in health (i.e. who would have been vaccinated were it not for the disruption in health services due to COVID).

A similar logic is applied for deprivation in Acute Respiratory Illness treatment and for access to Reproductive Health services. However, this means that the pool from which additional children can be found to fall into poverty is small as the former only applies to children 3–5 years old and the latter to children 15–17 years old. These groups represent a small fraction of all children.

Nevertheless, in many countries the disruptions have been significant. Thus, it is possible to find the new percentage and number of children who are expected to suffer shortcomings in the health dimension.

As during 2021 many health services throughout the world started to revert to some degree of normalcy (at least avoiding operating at full capacity) the model captures the likelihood of a reduction in health deprivation. This was done taking the 2020 projection as a baseline and repeating the process with the new data on health services disruption.

Applying this analysis across the 72 countries for which child poverty had been estimated prior to COVID-19, we project the proportion of children severely deprived in health to roughly triple during 2020, before declining again to about 15% in 2021.

4.3. Nutrition

The case of nutrition is slightly more complicated and hampered by availability of data. As explained above, for children under the age of five only stunting is used as an indicator for the pre-COVID child poverty estimates. Stunting could be considered as reacting slowly in the immediate term. Consequently, it was not taken into account for the 2020 projections. However, after the initial shock, there could be noticeable effects in the second year. According to the FAO, IFAD, UNICEF, WFP, WHO, stunting could increase up to a whole percentage point compared to the 2019 level.[16]

Then, the question, as in the health dimension, is to identify who are the children most likely to become stunted. The basic data to estimate child poverty already includes information about standardized height for age for children five years old or younger. We can use the standardized height for-age values to rank children. These standardized values are distributed along a normal distribution. We can shift this distribution until the percentage of children whose height-for-age is below two standard deviations from the international norm matches the projected level of moderate stunting.

[13] In both cases, residence (urban/rural), sex, housing characteristics (severe and moderate overcrowding) and nutrition status (severe and moderate stunting) are used as independent variables.

[14] For classification tree analysis, see for instance [15].

[15] Conceptually and technically, the correct way of doing this is by applying the ranking to the new cohort. Given that the number of children of one age and the previous one are roughly similar (in high under-5 mortality countries there may be more of a change between children under one year of age and children 12 to 23 months but these differences become smaller for older children), the description here avoids the cohort-shifting complication. In practice, the differences are small. Researchers, scholars, and other colleagues can safely avoid this step without affecting the direction and order of magnitude of the projections.

[16] The relatively small number should not numb us to the fact that stunting affects millions of children as well as the extreme situation (and grave consequences) of stunting.

4.4. Overall child poverty

Finally, bringing estimates for the various dimensions together, it is important to take into account that some of those children who are newly deprived in health or education (or nutrition in the 2021 projections), might in fact already be counted as poor due to a deprivation in another sector (e.g., sanitation or housing). Furthermore, some of the newly deprived children in health might also be those who would be newly deprived in education. In conclusion, the increase in overall prevalence of child poverty will be smaller than the increase of those deprived in an individual sector.

We estimate that COVID-19 increased the proportion of children being severely deprived in at least one dimension from by about ten percentage points in 2020, before decreasingly slightly by five percentage points in 2021. The average number of deprivations a child is suffering is projected to have increased by a quarter of its value in 2020, before decreasing to an intermediate level between these two levels in 2021.[17] We also find that the effects were more pronounced in least developed countries, experiencing increasing poverty rates quite sharply in 2020 and a slightly lower recovery than the other countries in 2021. In addition, the gap in the headcount between children whose mothers had no or incomplete formal education compared to those with completed secondary education was projected to increase in 2020.

5. Conclusion

As other multifaceted crises, the COVID19 pandemic has affected countries and individuals differently. The theme of this article is that it is possible to project or nowcast those impacts based on previous evidence, model-based projections, and sources of data which were trickling in during the pandemic. Thus, the impact of COVID19 on child poverty was assessed (with updates as more information became available).

Despite our model providing estimates of the projected impact of COVID19 on child poverty, the need for quality data, including rapid surveys to understand the situation before and after shocks, as well as the development of standardized protocols to conduct surveys (including phone or other not face-to-face mechanisms) during crises such as COVID19 is critical to ensure good understanding of how children experience covariate shocks in the short and long run.

[17] We also projected/simulated the situation of the poorest of the poor, i.e. the share of children suffering several (four or more) deprivations. However, in many countries, fortunately, this is estimated as a small proportion of children in the sample. Thus, care is needed when assessing changes due to the large confidence intervals.

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Annex: Dimensions, indicators, and thresholds for moderate and severe material shortcoming

Dimension	Unit of Analysis	Severe Deprivation Definition	Moderate Deprivation Definition (includes severe deprivation)
Shelter	Children under 17 years of age	Children living in a dwelling with five or more persons per sleeping room.	Children living in a dwelling with three or more persons per sleeping room.
Sanitation	Children under 17 years of age	Children with no access to a toilet facility of any kind (i.e. open defecation, or pit latrines without slabs, hanging latrines, or bucket latrines, etc).	Children using improved facilities but shared with other households.
Water	Children under 17 years of age	Children with no access to water facilities of any kind (i.e. using surface water or unimproved facilities such as. non-piped supplies).	Children using improved water sources but more than 15 minutes away (30 minutes roundtrip).
Nutrition	Children under 5 years of age	Stunting (3 standard deviations below the international reference population).	Stunting (2 standard deviations below the international reference population).
Education	Children between 5–14 years of age	Children who have never been to school.	Children who are not currently attending school.
	Children between 15–17 years of age	Children who have not completed primary school.	Children who are not currently attending secondary school (or did not complete secondary school).
Health	Children 12–35 months old	Children who did not receive immunization against measles nor any dose of DPT.	Children who received less than 4 vaccines (out of measles and three rounds of DPT).
	Children 36–59 months old	Children with severe cough and fever who received no treatment of any kind.	Children with severe cough and fever who did not receive professional medical treatment.
	Children 15–17 years old	Unmet contraception needs.	Unmet contraception needs (using only traditional methods).