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Estimates of Child Malnutrition in India

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This article analyses the comparability of the estimates of child malnutrition emanating from the National Family Health Surveys and the National Nutrition Monitoring Bureau. The issue has been highlighted by Deaton and Dreze (EPW, 14 February 2009). They find it puzzling that according to the NFHS, the prevalence of child malnutrition as measured by weight for age was almost unaltered between 1998-99 and 2005-06, while NNMB estimates suggest a substantial decline. This article undertakes a more detailed assessment of these two sets of estimates and finds that once the comparison is confined to comparable units, the difference is largely eliminated.

In the paper entitled, "Food and Nutrition in India: Facts and Interpretations" (EPW, 14 February 2009), Angus Deaton and Jean Dreze provide a thorough and insightful review of recent evidence on food intake and various indicators of nutrition standards in India. The authors highlight several puzzling incongruities in various statistical series and, as the title indicates, they offer interpretations and possible explanations. I find the puzzles intriguing and most of their interpretations convincing, but there is one puzzle that I am not sure they have resolved satisfactorily.

The puzzle I am concerned with relates to the observation that the prevalence of child underweight (weight for age below the international norms) in India, according to the second and the third National Family Health Surveys (NFHS), was practically unaltered - a decline by 1 percentage point only - between 1998-99 and 2005- 06. Deaton and Dreze do not pinpoint any particular irregularity in the NFHS that may have compromised the comparability of the estimates from 1998-99 to 2005-06. They find it difficult, however, to reconcile such a disappointing stagnation in child underweight with other developments in India during this period.

The first puzzle is that the per capita gross domestic product (GDP) grew by 5-6% per annum between these years. As Deaton and Dreze remind us, previous research suggests that economic growth is associated with notable reductions in child anthropometric failure worldwide. This empirical evidence is mainly based on cross-country observations of levels of income and prevalence of child malnutrition (Svedberg 2000; Smith and Haddad 2002; Haddad et al 2003).

The second reason why Deaton and Dreze doubt the accuracy of the NFHS estimates is that they have found a number of inconsistencies between these and other nutrition-related indicators. Their main focus is on the discrepancy between the NFHS and alternative anthropometric data, from the National Nutrition Monitoring Bureau (NNMB). Deaton and Dreze (2009, Table 9) present a summary of these estimates, which suggest that child underweight in India has declined notably over recent years - in sharp contrast to the NFHS estimates. In this article, I will discuss the comparability of the NNMB and the NFHS estimates and their relative reliability.

1 Scope and Reliability

The NFHS is carried out under the auspices of Macro International, a United States (US) based organisation with funding from US Aid, and the Indian International Institute for Population Sciences (IIPS) as part of a large series of Demographic and Health Surveys (DHS). Since the mid- 1980s, Macro International has produced about 270 DHSs from most developing countries, applying a standardised methodology. The surveys are usually conducted jointly with a national health and demographic agency or a university. For many countries, DHSs have been undertaken at two or more points in time - as in India - allowing analysis of changes over time.

The DHSs provide most of the statistical evidence available on child and maternal anthropometric status worldwide and they make up the bulk of the surveys found in the Global Database on Child Malnutrition and Growth compiled by the World Health Organisation (WHO). Before a survey is included in this database, it is vetted by the WHO according to several quality criteria.1 Having worked with DHS data on child anthropometrics for several years, I have not found any major systematic flaws or non-comparability in the surveys. Over the period 2003-09, at least 72 articles based on data from DHSs have been published in peer-reviewed academic journals.2 If there are serious defects in the standardised DHS sampling procedures or otherwise, these ought to have been revealed by now. My main worry is that the DHSs are all claimed to be nationally representative, but the number of children sampled in some very large and diverse countries seems too small for this claim to be convincing.

When it comes to the reach and reliability of the alternative estimates of anthropometric failures among children, from the NNMB, it first has to be recognised that these are sampled from a relatively small share of the child population in India: rural children in eight or nine states. Rural children in the nine NNMB states comprise roughly one-third of the total child population aged 0-5 years. In much of the following, the representativity of the NNMB sample will be discussed. There are also those who have serious doubts about the reliability of the NNMB estimates more generally. Deaton and Dreze (2009: 63) also express concerns: "[t]he NNMB surveys are not particularly informative, given their small sample sizes, limited geographical coverage, confusing methodology and uncertain quality". Nevertheless, let us proceed by scrutinising the comparability and reliability of the two different sets of estimates.

2 Comparability between NFHS and NNMB Estimates

In their paper, Deaton and Dreze present two tables with summary statistics on child anthropometric failure from the NNMB and NFHS. In Table 9, the NNMB estimates from the late 1970s up to the mid-2000s are reproduced. The estimates from the three NFHS, conducted in 1992-93, 1998-99 and 2005-06 are presented in Table 11. Both sets of estimates are based on the weight and height norms from the US National Centre for Health Statistics (NCHS). The NNMB estimates cited by Deaton and Dreze show a decline in child underweight by 7.3 percentage points between 1996-97 and 2004-05. At face value this is certainly in sharp contrast to the NFHS estimated decline by 1.1 percentage points between 1998-99 and 2005-06.3 However, there are several differences in the coverage and estimation methodology between the two sets of estimates, which may explain at least part of the incongruities.

States and Areas Covered

The two most recent NNMB surveys in 2001 and 2005-06, cover rural areas in the same nine states that are included in most of their earlier surveys.4 In the 1996-97 survey, however, one of these states, Madhya Pradesh (MP) was excluded. Deaton and Dreze (2009: 49-50) notice this mismatch, but say that the omission of this state "makes little difference to the aggregates". A quick check basically confirms this. Actually, re-estimating the prevalence of child underweight in the eight overlapping states (excluding MP) in the recent NNMB surveys suggests a decline between 1996-97 and 2005-06 by 8.4 percentage points rather than the 7.3 percentage points shown in Deaton and Dreze's Table 9. This recalculation hence reinforces the discrepancy between the NNMB and NFHS estimates (Table 1). The difference in the decline when MP is included or excluded reflects that, according to the NNMB surveys, MP had a higher prevalence of child underweight than any of the other eight states in 2005-06.

The two NFHs in 1998-99 and 2005-06 have a national coverage of all states and cover both rural and urban areas.5 The comparison by Deaton and Dreze of the change in child underweight at the all-India level from the NFHs, with estimates from rural areas in eight or nine states from the NNMB, may hence suffer from selection bias. In order to check this possibility, we re-estimated the decline in child underweight, as reported by the NFHs, for rural children in the eight states covered by the NNMB in 1996-97 as well as in its later surveys.

According to the NFHs, the prevalence of child underweight in the rural areas of the eight NNMB states declined by 4.3 percentage points between 1998-99 and 2005-06. When the comparison is restricted to the same states and rural areas, about half of the discrepancy between the NFHS and NNMB estimates is hence eliminated (Table 1). There are three further differences to consider. First, the time period elapsing between the two NFHS surveys is two years less than between the two NNMB surveys. Second, the age groups covered are not the same. Third, the sampling and aggregation methods applied are not comparable.

Different Survey Years

With the exception of the latest surveys from 2005-06, the NFHS and NNMB surveys are not conducted in the same years. However, there are NNMB surveys in 1996- 97 and 2001 covering the same eight states. By taking the averages from the two surveys, one hopes to get numbers that are more comparable with the estimates for rural areas in those eight states in the NFHS 1998-99 survey. The average prevalence of child underweight in 1996- 97 and 2001 in the two NNMB surveys is 60.4% and the decline up to 2005-06 in the same pooled eight states is 6.6 percentage points (Table 1). This estimate is higher than the 4.3 percentage point decline according to the NFHS estimates, but the gap between the NNMB and NFHS surveys narrows further when differences in sampling years are taken into account.

Different Age Cohort Coverage

The NFHS estimates of child underweight discussed above are for 0-3 year olds while the NNMB estimates are for 1-5 year olds. In almost all developing country child populations, estimates of the prevalence of anthropometric failure among 1-5 year olds are higher than for 0-3 year olds (Shrimpton et al 2001). The simple reason is that the prevalence of underweight and stunting is the least among the youngest (the infants), who are not included in the 1-5 year cohort. A comparison of the agespecific NFHS and NNMB estimates of child underweight in 2005-06 shows the same pattern (Table 2). The largest difference is in the NNMB estimates with NCHS norms between 0-3 year olds and 3-5 year olds. The smallest differences are between 1-3 year olds and 3-5 year olds, i e, two cohorts leaving out infants (0-1 year).6

These are level estimates, however, and say nothing about changes over time for different age cohorts. Unfortunately, the data at hand on changes over time are not readily comparable. The only matching NFHS estimates (based on the NCHS norms) are for 0-3 year olds, the only cohort covered in the 1998-99 survey. In the 2005-06 NFHS, estimates are available for 0-3 year olds as well as for the 0-5 year group. In the NNMB reports for 1996-97 and 2001, no age-specific estimates of child underweight are published. The 2005-06 NNMB survey covers 0-5 year olds and separate estimates are also provided for 1-3 and 3-5 year olds. These estimates can be compared with the estimates for these two age groups in a NNMB report for 1994, covering the same nine NNMB states (and also one state usually not included, Uttar Pradesh). These estimates, based on the NCHS norms, show that the decline in child underweight between 1994 and 2005-06 was slightly larger among the 3-5 year cohort (-10.2 percentage points) than for the 1-3 year cohort (-7.2 percentage points).

If the relative decline between 1994 and 2005-06 carries over to the change between 1998-99 and 2005-06, we are down to a drop by 4.6 percentage points for 1-3 year olds between these years in the NNMB surveys, practically identical to the decline as estimated for 0-3 year olds from the NFHs, at -4.3 percentage points (Table 1). This is a rather bold assumption though, and the -4.6 percentage point age-adjusted NNMB estimate should be interpreted with much caution, but at least it reveals a correction in the

expected direction. That is, when the comparison between NFHS and NNMB of estimated changes in child underweight is confined to as comparable units as the data permit, the difference dwindles considerably.

Sampling and Aggregation Methods

The sampling methodology and the sample sizes in the NFHS and the NNMB surveys are quite different. The samples in the NFHs are obtained through two-stage stratified random sampling in clusters, aimed at capturing nationally representative populations. This method has become standard in most sample collection exercises in many fields and for many purposes. In the NNMB surveys, 120 villages are chosen in each of the nine (or eight) states - irrespective of the relative size of the state - and in each village, 20 households are selected. Some of the NNMB surveys are repeat surveys meaning that 90 of the 120 villages are the same as in the previous survey and 30 are new ones. Also, the number of children sampled in the rural areas of the nine states by the NNMB is on average about half of that covered in the NFHS surveys.

The NNMB sampling method means that the samples derived in the nine (or eight) states are roughly equally large: children from 120 villages and 20 households in each state. The small difference in the number of children included in the state samples is thus mainly determined by the number of children under five that reside in the selected 2,400 households in each state. Hence one expects that there should be a positive correlation between the NNMB state sample sizes and the proportion of young children in the state populations. A check reveals no correlation at all. Moreover, when the NNMB pools its state estimates it uses the sample sizes as weights, not the relative sizes of the base child population in the nine states. This implies that if small states have on average lower (higher) prevalence of child malnutrition, the pooled average will understate (overstate) the "true" aggregate.

In the NFHS, the relative size of the samples from the different states is broadly proportional to the underlying child population, but not strictly so. However, when the estimates of child anthropometric failure in the individual states are aggregated to get an all-India estimate, the NFHs do not rely on their state sample sizes as weights, but rather the sizes of the base child population. This implies that the all- India weighted average is strictly proportional to the base population, i e, national representativity is ensured, which is not the case in the NNMB surveys.7

To check how sensitive the NNMB estimates of child underweight are for the use of the almost identical weights, the nine-state pooled NNMB estimate was reestimated using two alternative sets of weights: (1) the NFHS state samples of rural children, and (2) the size of underlying rural child population, as estimated in the 2001 Census. Two observations are notable. First, the nine-state pooled NNMB estimate of the level of child underweight in 2005-06 is a few percentage points lower than when either the NFHS-3 or the census population weights are used to aggregate the estimates for the nine states (not shown). Second, when it comes to changes over time, these are practically the same with all three weighting methods (Table 4). The NNMB practice of estimating child anthropo-

metric failure, based on an (almost) equal number of children in the nine states, has obviously not distorted the average change, at least not for child underweight between these two particular years.8

3 Summary and Conclusions

Deaton and Dreze are commendably careful in pointing out that the stagnant-underweight- high-growth puzzle can also be because the economic growth rate has been exaggerated. They do not present any concrete evidence on flaws in the GDP growth data, but a possibility is that inflation has been underestimated and hence real growth overestimated. One may add that growth has been rather sluggish in the large northern/central states with the highest burden of child malnutrition and that income distribution in India has become more uneven in most dimensions. These developments tend to mitigate the beneficial impact of economic growth at the all-India level on child nutritional status. Deaton and Dreze further point out that there may also be measurement problems associated with the other (than NNMB) "conflicting" indicators of food consumption and nutrition. As they conclude, "the nutrition situation in India is full of 'puzzles'. We hope that the puzzles, if not resolved, are at least clearer" (Deaton and Dreze 2009: 63).

I cannot claim to have resolved the puzzle regarding the practically unaltered prevalence of child underweight in India between 1998-99 and 2005-06 according to the two recent NFHs. What my scrutiny of the comparability between these estimates and the alternative ones from the NNMB demonstrates is that when it comes to changes over time, the two sets of estimates do not differ much. That is, once the comparison is restricted to comparable units - the same states, areas, age cohorts and years of observation - the difference is largely eliminated. This cannot, however, be taken as a vindication that both sets of estimates are equally reliable (or unreliable). There are disturbingly large differences between the NFHS and NNMB estimates of child underweight (and stunting and wasting) in rural areas in many of the individual nine NNMB states in 2005-06. These discrepancies are yet to be thoroughly analysed and explained.

Notes

1 See De Onis and Blossner (2003) for a description of the WHO quality controls.

2 Micro International provides a list of academic articles in refereed scientific journals that are based on data from the DHS. As of 11 November 2009, the list comprises 72 articles out of which about half is focused on the Indian DHS/NFHS estimates.

3 For 0-3 year olds, the IIPS (2007, Table 10.3) also provides estimates of changes in underweight, stunting and wasting at the all-India level between the 1998-99 and the 2005-06 NFHS, based on the WHO 2006 norms. These estimates suggest a decline of underweight among 0-3 year olds by 2.3 percentage points, which is larger than when the NCHS norms are applied, but still rather modest in comparison with the nine-state pooled estimates produced by the NNMB for rural areas. There are no NNMB estimates based on the WHO norms for a year prior to 2005-06.

4 In Deaton and Dreze (2009, Table 9), the latest NNMB survey is dated to 2004-05, but the estimates in their table are from the NNMB (2006), which dates the survey to 2005-06.

5 In the 1992-93 NFHS, no estimates of stunting and wasting were obtained in five of the Indian states, while underweight was estimated in all states. For additional analysis of the comparability of child anthropometric surveys in India, see Svedberg (2006).

6 The difference in the NNMB estimates for 2005- 06 in Table 2, when derived with the alternative norms, the NCHS and WHO, is much larger than in most other surveys. In the WHO Global Database, more than a 100 surveys are presented that provide estimates for countries derived with both norms and these show much smaller differences. There is hence reason to doubt the NNMB estimates based on the WHO norms.

7 Some of the Indian states, especially in the northeast, have a very small child population, a few hundred thousand, while some other states are home to 5 to 10 million children under the age of five. It would be infeasible to use sample sizes that are strictly proportional to the base population and at the same time ensure representativity in the smallest states. The method to use the base population as weights for estimating all-India prevalence of child anthropometric failure is the proper way to get around this dilemma. (See NNMB vs NFHS sample weights.xls file.)

8 The equivalent NNMB estimates for child stunting suggest an increase of about 3 percentage points between the two years, while NFHS estimates show a substantial decline; yet another puzzle to be resolved in future work.

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