



## The other Asian enigma: Explaining the rapid reduction of undernutrition in Bangladesh

Bangladesh has managed to sustain a surprisingly rapid reduction in the rate of child undernutrition for at least two decades. We investigate this unheralded success through a statistical analysis of changes in child growth outcomes across five rounds of DHS surveys from 1997 to 2011. Rapid asset accumulation and large gains in parental education are the two largest drivers of change. Other drivers are improved access to antenatal and neonatal health services, large improvements in access to toilets, and demographic change in the form of reduced fertility rates and longer birth intervals. While these initiatives were not overtly coordinated with nutritional change in mind, Bangladesh's progress is clearly the result of pro-poor multisectoral policies that have successfully addressed many – but not all – of the multiple constraints on child growth. Further reductions in child undernutrition will require sustained income growth, further expansion of education, and significant improvements in access to, and quality of, health and nutrition services.

In the nutrition literature South Asia is synonymous with unusually high rates of child undernutrition relative to its income levels, as well as sluggish reduction in undernutrition, particularly in India. This so-called 'Asian Enigma' has spawned substantial research into possible explanations, including gender and intrahousehold biases, unusually poor sanitation, genetic predispositions, low quality diets and food systems, and the inefficacy of nutritional programmes and strategies.

Yet this literature has largely ignored Bangladesh's sustained reduction in child undernutrition for at least two decades. Among countries with the highest burdens of undernutrition, Bangladesh has in fact been one of the most successful at reducing undernutrition rates in both mothers and children (along with Nepal). From 1997 to 2011, for example, stunting rates among preschoolers fell from 58.5% to 40.2%, with most of the reduction occurring in poorer rural areas (Table 1). This puzzling neglect of Bangladesh's nutritional success is seemingly explained by the absence of any highly regarded nutrition programmes. Yet both nutritionists and economists stress the paramount importance of multisectoral strategies that achieve improvements in a wide range of nutrition-sensitive

**Table 1** Changes in mean stunting prevalence rates for different samples across the five BDHS rounds

Sample >>	Stunting (HAZ < -2)		
	Total	Rural	Urban
1997	58.5%	60.0%	44.1%
2000	49.9%	51.8%	41.1%
2004	49.5%	51.0%	44.0%
2007	44.0%	45.6%	37.7%
2011	40.2%	41.4%	35.8%
<b>Change</b>	<b>18.3 points</b>	<b>18.6 points</b>	<b>8.3 points</b>
<b>Change (%)</b>	<b>-31.3%</b>	<b>-31.0%</b>	<b>-18.8%</b>

Source: Authors' estimates from the 1996/1997 and 2011 BDHS rounds, using sampling weights.

sectors, such as income generation, education, health, sanitation and family planning. Achievements in these sectors *have* been impressive in Bangladesh.

Our research assesses the contribution of these nutrition-sensitive developments to Bangladesh's unheralded success in reducing child undernutrition (as measured by linear growth). To do this we merge together five rounds of the Bangladesh Demographic Health Surveys (DHS) and apply statistical regression techniques and a simple linear decomposition to ➔

understand the sources of nutritional change over time. This rare dynamic approach to studying nutritional change allows us to assess the drivers of nutritional change over time. We show that asset accumulation (economic growth) and expansions in education (especially for girls) are the two biggest drivers of nutritional change, followed by roughly equal contributions from sanitation, health care, and demographic change (family planning). Our approach can be used prospectively, as well as retrospectively, and under feasible development targets we predict that much of Bangladesh's nutritional change in the future will need to come from sustained income growth, further expansion of education (for boys and girls), and major improvements in health service access and quality. In contrast, family planning and traditional sanitation measures will only play marginal roles, precisely because a great deal of success has already been achieved on these fronts. However, we also conjecture that there remains a very important role for both nutritional programming and food policies to improve dietary diversification, which is still very low in Bangladesh.

## Methodology

Most statistical research on nutrition identifies the determinants of nutrition at a single point in time. In this paper, however, we analyse the determinants of nutrition across five rounds of the Bangladesh DHS, namely 1996/1997, 1999, 2000, 2004, 2007 and 2011. To do so, we construct common indicators of the underlying determinants of nutrition across these five rounds, including a household asset index (scaled from 0-10), the number of years of maternal and paternal education, open defecation (households with no toilets), access to antenatal and neonatal care, birth order (a proxy for fertility rates) and preceding birth intervals. We then conduct various graphical and statistical analyses to identify the associations between these socioeconomic factors and child growth outcomes (height for age, stunting and severe stunting), and also estimate trends in these socioeconomic factors.

Together, the impacts of each factor on child growth and its change over time will determine the estimated impact of each factor on changes in child nutrition between 1996/97 to 2011. As an example, consider maternal education. We know that because of the secondary school stipend and other interventions, maternal education has increased very rapidly over time in Bangladesh. If we also find that maternal education has a large statistical effect on child growth outcomes (i.e. a large coefficient), then the change in maternal education multiplied by the maternal education coefficient will give us an estimate of the contribution of maternal education to the nutritional change of young children.

## Biggest improvements to child growth take place in the womb

Starting with our graphical analysis, Figure 1 demonstrates how undernutrition (the height for age Z score, or HAZ) has changed over time for different age groups of children. This is particularly important given the well known importance of nutrition in the first 1000 days of life. In Bangladesh it appears that a large share of the growth faltering starts in the womb, since HAZ scores are negative among newborns (e.g. 0-3 months of age). However, in 1997 the HAZ score at birth was just under -1 standard deviations, whereas it was around -0.5 standard deviations in 2011, suggesting major improvements in birth size and hence birth weight.

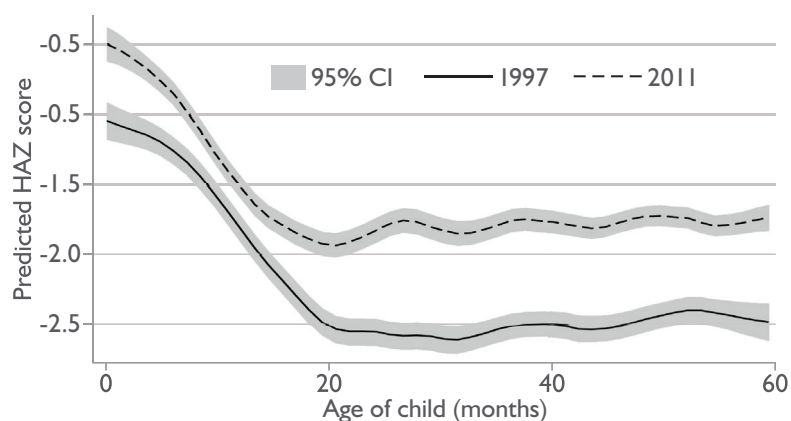
After several months, growth faltering further accelerates until around 20 months of age, a process that is probably related to both poor care practices (e.g. feeding practices) and significant exposure to disease. After 20 months or so growth faltering stabilises. Interestingly, however, Figure 1 suggests that most of the improvement in nutrition outcomes has occurred because of increased birth size, not because of reduced postnatal growth faltering (in other words, the intercept in Figure 1 has shifted upwards, but the slope of the curve has changed very little).

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## Factors that explain child growth outcomes in Bangladesh

In Figure 2 we present estimates of the predicting change in stunting resulting from moving a variable from its minimum value to its maximum value. So for example, the asset score is scaled from 0 to 10, so moving from an asset score of 0 to an asset score of 10 would result in a 14 percentage point reduction in stunting. Unsurprisingly, this association between household assets and child growth outcomes is one of the strongest. Also unsurprisingly,

Figure 1 HAZ scores by child age, 1997 and 2011



Source: Authors' estimates from various rounds of the Bangladesh DHS.

maternal height is strongly associated with child height; this intergenerational effect captures both genetic traits and the biological relevance of maternal nutrition for child birth size. Next we find that both maternal and paternal education have strong effects on child growth; indeed, statistically we find that there is no significant difference between the effects of mothers' and fathers' education on child growth outcomes. Birth order and birth interval have sizeable effects too. For example, a firstborn child is about 7 percentage points less likely to be stunted than a child born sixth in a family. This suggests an important role for family planning in nutritional programmes. In terms of health variables we find that prenatal doctor visits and births in a medical facility are important, though in other results we find that severe stunting is more affected by access to more basic health services, such as antenatal care from other health professionals and basic vaccinations.

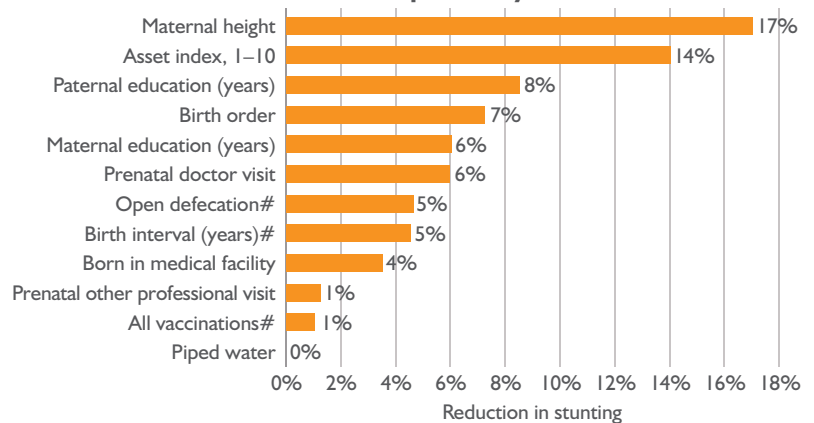
### Large gains for nutrition when rates of open defecation fall below 30%

Finally, we find that access to toilets – or the eradication of open defecation – has a reasonably large effect on stunting, though it is a non-linear effect (Figure 3). Community open defecation rates have fairly modest effects on child growth until the rate of open defecation falls below 30 percent, after which there are sizeable improvements in child HAZ scores as exposure to external bacteria and disease presumably declines sharply below this threshold. We also find a much stronger association between open defecation and child growth in urban areas, since open defecation is more harmful in higher density populations where a given disease carrier (e.g. flies) can reach more people. These results provide substantial support for reducing open defecation at the community level, such as in the Community Led Total Sanitation (CLTS) approach that was pioneered in Bangladesh.

### Asset accumulation and education fuel largest contribution to nutrition outcomes

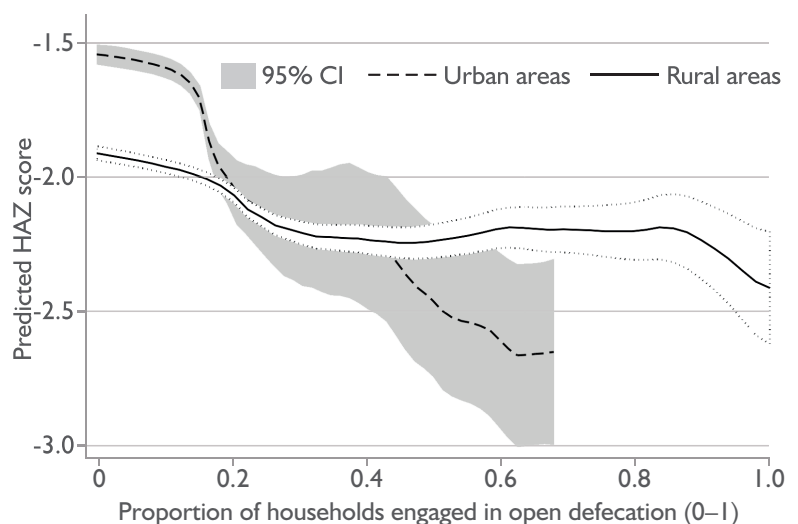
As noted above, the contribution of these factors to explaining nutritional change over time depends on how much the X variables have changed over time. As expected, we observe large changes in most of the explanatory variables over time, particularly asset, maternal education and some of the health, sanitation and family planning outcomes. Figure 4 reports the expected contribution of these changes to the total explained change in child growth outcomes (HAZ scores). Among individual factors, asset accumulation makes the single largest contribution, explaining 25% of the total explained change. However, maternal and paternal education together account for 26% of the change, with the

**Figure 2 Comparing the strength of associations – the predicted reduction in stunting from moving from minimum to maximum scores for each explanatory variable**



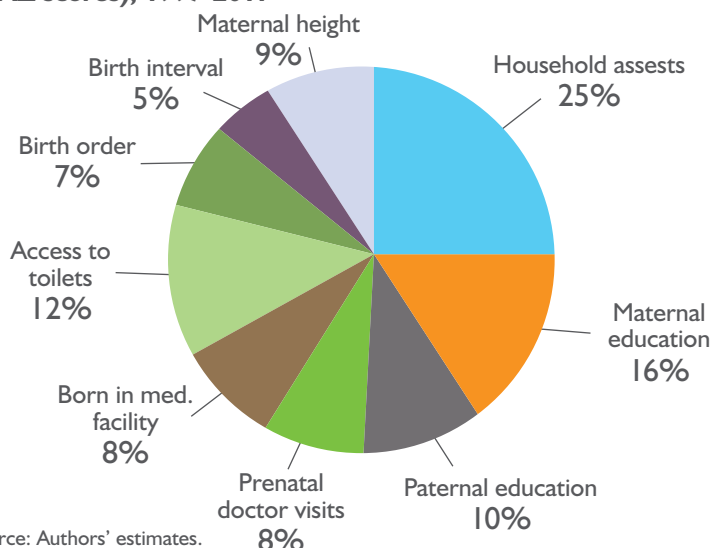
Notes: Each predicted reduction in stunting is the product of the estimated coefficient for each indicator and its statistical range. The one exception is maternal height, for which we use a two standard deviation range of 10 cm. The coefficient estimates are based on pooled regression models with village-clustered standard errors and a number of time-invariant controls, including regional fixed effects, month-specific child age dummy variables, and dummy variables for various categories of maternal age. See the full discussion paper for details.

**Figure 3 Open defecation has more harmful effects in urban areas than in rural areas**



Source: Authors' estimates from various rounds of the DHS.

**Figure 4 Sources of predicted change in child growth outcomes (HAZ scores), 1997-2011**



Source: Authors' estimates.

bulk of this coming from maternal education gains (16%) because of the more rapid expansion of girls' secondary education due to the stipend programme. Next, improved prenatal and neonatal care account for around 16% of the predicted change, while improved access to toilet facilities accounts for 12%, as do the two indicators of demographic change (birth order and interval). Improvements in maternal height account for the residual 9% of change. Hence improvements in women's human capital (their education and nutrition/height) together account for around 25% of the predicted improvement in child growth outcomes over 1997-2011.

These decomposition results look somewhat different for urban areas (sanitation accounts for almost 20% of the explained improvement), and somewhat different for severe stunting (with vaccination coverage and access to other health professionals becoming important in place of medical facility births and prenatal doctors visits), but in general the results are quite robust to different samples and estimators. One persistent enigma, however,

“Among individual factors, asset accumulation makes the single largest contribution, explaining 25% of the total explained change.”

is that the model as a whole only accounts for 56% of the actual change in child growth outcomes over time, with the model's explanatory power much weaker in rural areas than in urban areas. One explanation may be that the country's rapid improvements in rice productivity accounts for the larger

improvement in rural areas. Consistent with this conjecture are the rapid improvements in maternal nutrition (body mass). When maternal body mass is added to the model the explanatory power of the model improves from 56% to around 70%. A forthcoming IFPRI discussion paper by the same authors provides a more nuanced finding: there is robust evidence of a strong impact of rice productivity growth on child weight gain, but not linear growth. A second explanation may be that the country's various nutritional programmes have been more effective than is commonly thought. Indeed, the DHS report some substantial improvements in infant and young feeding practices – particularly the more timely introduction of complementary foods – that would be consistent with this hypothesis.

## Further reading

Headey, D., Hoddinott, J., Ali, D., Tesfaye, R., Dereje, M., 2014. The Other Asian Enigma: Explaining the Rapid Reduction of Undernutrition in Bangladesh. IFPRI Poverty, Health, and Nutrition Division. IFPRI Discussion Paper 01358.

Srinivasan, C.S., Zanello, G., Shankar, B., 2013. Rural-urban disparities in child nutrition in Bangladesh and Nepal. BMC Public Health 13, 1471-2458.

Kabir, I., Khanam, M., Agho, K.E., Mihrshahi, S., Dibley, M.J., Roy, S.K., 2012. Determinants of inappropriate complementary feeding practices in infant and young children in Bangladesh: secondary data analysis of Demographic Health Survey 2007. Maternal & Child Nutrition 8, 11-27.

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## Policy implications

**Our research has important policy implications for the government, and other stakeholders working to reduce undernutrition in Bangladesh. Going forward, our quantitative approach sheds light on the sectors which, with sustained and increased investment, could deliver further nutritional gains in Bangladesh. Our study suggests that continued improvements in child growth can come from:**

- 1 further investment in education;
- 2 major progress in access to improved health services (which is still very limited);
- 3 continued broad-based economic growth;
- 4 dietary diversification, which, in particular, remains very low in Bangladesh, and should be a primary intermediate objective for improving maternal and child nutrition outcomes; and
- 5 expanded and enhanced nutrition programmes to improve infant and young child care and feeding practices, which still remain well below the optimum.



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