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Reducing Child Malnutrition: How Far Does Income Growth Take Us?

by

Harold Alderman, Simon Appleton, Lawrence Haddad, Lina Song and Yisehac Yohannes

Centre for Research in Economic Development and International Trade, University of Nottingham

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Abstract
How rapidly will child malnutrition respond to GNP growth? This study explores that question using household data from twelve countries. In addition, data on the malnutrition rates since the 1970s available from a cross section of countries are employed in this investigation. Both forms of analysis yield similar results. Income increases at the household and at the national level imply similar rates of reduction in malnutrition at the same rate of increase income. Using these estimates we find that goals of halving the levels of child malnutrition in the first two decades of this century set by the 1990 UNICEF World Summit on Children or the 1996 FAO-WHO World Food summit are unlikely to be met through income growth. Thus a combination of growth and specific nutrition programs will be needed.

Outline

1. Introduction

Great strides have been made in reducing child malnutrition over the past few decades. The prevalence of stunting in children under five in the developing countries was 47.1 % in 1980. By 2000 this had dropped to 32.5% (ACC/SCN 2000). Nevertheless 182 million children in the developing world remain stunted. Moreover, progress in reducing prevalence rates has slowed somewhat in the past 2 decades; the total number of stunted children in Africa has increased. Even the *prevalence* of stunting is rising in Eastern Africa. At current trends it is clear that the goal of halving the number of undernourished people by the year 2015, set at the World Food Summit in 1996, will not be met (FAO 1999).

What is needed to accelerate reductions in malnutrition to meet this or similar targets? Even if one questions the analytical basis of such targets[1], the general question of how to hasten improvements in nutrition remains a concern. On the one hand many would argue that greater economic growth and increases in incomes of poor people are necessary and sufficient to meet these goals. If nutrition so closely tracks income poverty that it provides redundant information, then not only do rates of malnutrition not provide an independent perspective on poverty, broadly defined, it is also hard to distinguish a strategy to reduce malnutrition that is distinct from that which reduces income poverty.

On the other hand there are many who would argue that income growth is a blunt instrument for reducing child malnutrition and that more resources have to be allocated to direct nutrition programs such as community-based behavior change initiatives and micronutrient supplementation and fortification. The view that nutrition is a distinct dimension of poverty is widely held and contributes to a number of indices of human development. In principal, measures of nutritional status can augment the portrait of living standards based on the money value of goods and services consumed. For example, Steckel (1995) shows how historical patterns in adult height and weight shed light on patterns of economic growth over periods of up to two centuries.

Moreover, the fact that there is a less than perfect correlation between nutritional status and either national income levels or national income distribution is often used to distinguish those countries that are atypical or to motivate research to account for this. In places such as Sri Lanka or the Indian state of Kerala where higher levels of health status have been achieved than might have been expected given their aggregate level of income or rates of poverty, this has often happened as a result of the provision of public services (Anand and Ravallion, 1993). Similarly, but less optimistically, in countries where the data show that nutritional status has not improved as rapidly as might have been expected given their income growth, this may indicate that there is a need to make specific investments in human resources (Alderman and Garcia, 1994).

The goal of this paper, then, is to answer the following question: How far does rapid income growth take us towards the reducing the rate of child malnutrition? The majority of studies addressing this question have focused on the response of nutrient *consumption* to changes in income (Strauss and Thomas, 1995). However, despite important contributions to poverty reduction strategies that have come from analysis of food consumption patterns – for example, Reutlinger, and Selowsky's 1976 study of calorie consumption in *Malnutrition and Poverty* influenced the World Bank's support of targeted transfer programs in the 1980's and 1990's - improvements in nutritional status are only loosely related to the food consumed at the country or household level. The current study looks at anthropometric measures of child nutritional status as an outcome of household decisions in health and child care as well as food consumption and distribution. We study whether increased resources at the household level as well as at the national level explain differences in this crucial outcome.

We use both household survey data as well as aggregate data on a set of 63 developing countries to address this question. Using these two distinct sources of data we model the relationship between child malnutrition and income. We then use the model to predict the declines in malnutrition that can be expected from a sustained 5 % annual increase in per capita income from 2000 to 2020. Despite these unprecedented income growth rates, declines in malnutrition rates fall far short of the international target set above. We conclude that income growth can play an important role in malnutrition reduction, but that it is not enough. Increases in the number and effectiveness of direct nutrition interventions have a crucial role to play if nutrition goals are to be met.

2. Datasets and Models

This section describes the two data sources used to derive estimates of the response of child malnutrition to per capita income growth and outlines the types of models underlying the results reported in section 3.

2.1 The Household Surveys

We investigate how household resources affect the nutritional status of pre-school children months using household surveys from twelve countries.[2] The countries were selected from those available for the 1990s to cover a range of locations, spanning four continents. They differ appreciably in their economic position including GNP and rates of malnutrition at the national level (Table 1)[3]. Nevertheless, there is a common thread in the available data, namely that for all the countries studied there has been a integrated household survey undertaken in the 1990's using a multi-purpose, modular, living standards survey following a format utilized in over twenty countries (Grosh and Glewwe, 2000). These surveys collect data on child heights and weights as well as information on total expenditures and other socio-economic conditions of the household.

The two measures of nutritional status (N) that we study are height for age and weight for age. The former is usually considered a measure of long-run nutrition deprivation, while the latter is a more general indicator of nutritional status (Alderman, 2000, WHO, 1995).[4] Both measures are converted into standardized units called Z scores after comparison with the US data chosen as an international reference by the WHO. These are derived after subtracting the age- and gender-specific means from the reference data and after dividing by the corresponding standard deviation. In common with most of the literature, we pay particular attention to the proportion of children below two standard deviations from the median for the reference population. We refer to children with a height-for-age Z score below –2 as "stunted"; we term those with a weight-for-age Z score below –2 "underweight". In the reference population 2.3 percent have Z scores below -2, while 16.0 percent are below –1 Z score. These levels might be expected for a normal population, and provide a basis for comparison. However, as there is no sharp difference in risk of mortality or functional impairment at this or any other commonly used cutoff level (Pelletier, 1994) the regressions focus on nutritional status itself and not the probability of malnutrition defined in terms of a Z score below –2.

It is apparent from Table 1 that countries with higher levels of per capita income tend to have less under-nutrition. However, there are exceptions – South Africa has the highest level of income in our sample of twelve countries but its rates of under-nutrition are the fifth lowest and little better than those in Kenya, whose income per capita is less than an eighth of South Africa's. However, our focus with the household data is on relations between income and nutritional outcomes across households within given countries. To this end, we estimate regressions for nutritional outcomes as a function of the logarithm of household expenditures per capita (Y) and controls for parental education (or, where parentage is unknown, a proxy).[5] To account for different patterns of malnutrition by age all the regressions contained six dummy variables for age brackets, as well as six interaction terms for this dummy variable interacted with gender. In addition, to control for correlates of income which may themselves have an impact on nutrition the regressions include a dummy variable for whether the observation was from an urban area or not and indicators for the type of drinking water and toilet used.[6] Moreover, in countries where there are significant ethnic differences that relate to access to infrastructure - for example, South Africa or Peru – the regressions also include dummy variables for ethnic background.[7] Finally, the height of the mother is included in the regressions when this information is available.

We undertake three specifications of the model. Model one controls for the infrastructure in the community and external to the household (E) by including cluster level fixed effects. That is, the model includes a dummy variable for each sample cluster. The impact of common attitudes and resources in the community or special local circumstances are picked up by this dummy variable. This model also includes the variables for infrastructure within the household (I) via access to piped water and sanitation. Model two controls for community fixed effects but excludes the water and sanitation infrastructure variables. Finally, model three excludes both the external infrastructure variables and the internal ones. All models include the demographic variables such as the age and sex groupings as well as variables for location. The three models can be summarized in the following way:

Model 1: N = N(Y, E, I), which estimates the short-run impacts of income growth,

Model 2: N = N(Y, E), which estimates the medium-run impacts of income growth,

Model 3: N = N(Y), which estimates the longer-run impacts of income growth.

Model one might be considered as giving the short run effect of increasing household income or consumption, holding external infrastructure and internal health infrastructure constant. Over a longer period, a household that sees its income increase may invest in sanitation or have such investments made on its behalf by the public sector. Model three, for which coefficient of income is biased to the degree that community effects that influence nutritional status are correlated with household income, may better represent the total effect of income under this long run scenario. However, even models two and three do not include changes in parental education that may also be driven by long run income growth. In principle, the education coefficient can be used to derive that impact under any assumption of changes in education. By a similar logic, the coefficient in model two is biased to the degree that household sanitation affects nutrition (holding community factors constant) and also correlated with income yet may provide an indication of the impact of a household's resource control allowing for the impact this increase may have on its investment in household sanitation.

2.2 The cross-country data for 63 countries, 1970-1995

The dependent variable we used in the cross-country analysis is the prevalence of children under five who are underweight for their age, i.e., whose weight falls more than 2 standard deviations below the median for their age. All of these data are survey based. The large majority of the underweight data, 75%, are from the World Health Organization's *Global Database on Child Growth and Malnutrition* (WHO 1997). These data have been subjected to strict quality control standards.[8] Other sources are ACC/SCN 1993) and World Bank (1997). We match each weight for age survey year with the corresponding year's value of Gross Domestic Product (GDP) expressed in purchasing power parity (PPP) -comparable 1987 U.S. dollars. The data are from the World Bank's *World Development Indicators* (World Bank 1998). [9]

The data set covers 63 developing countries, accounting for over 88% of the developing world's population. Each country has at least two observations and many have 3 or 4 observations. The total number of country-year observations is 175 spanning the period 1970 to 1995 (Smith and Haddad 2000).

3. Results: What is the Impact of Income on Malnutrition?

This section presents the regression results for the effects of income growth at the household and national levels on child malnutrition. First, we describe the results from the 12 household surveys and then we describe the results from the 63 countries used in the cross-country analysis.

3.1 The household survey results: per capita income and child malnutrition

Table 2 indicates the coefficient of the logarithm of per capita consumption (our proxy for per capita income) from three variations of the main regressions for both measures of malnutrition (The full set of results for each country are available from the authors upon request). As expected, the logarithm of per capita household consumption has a positive relationship with the nutritional status of children as measured by either weight for age or height for age in all of the countries studied. There is, however, considerable variation in the size of coefficients across countries and the coefficients also vary according to the model being estimated, being generally highest in model three. The coefficients are always statistically significant in model three (long-run impacts of income). In model one, the impact on height-for-age is insignificant in Nepal, Pakistan and Romania. The impact on weight-for-age is statistically significant in all cases except Pakistan.

Across the estimates of model one, the mean coefficient on the log of consumption per capita, is 0.223 in the height-for-age regressions and 0.188 in the weight-for-age regressions. (These averages are not weighted by either sample size or population.) In the same cases, the mean coefficients in model three are 0.276 in the height-for-age regressions and 0.245 in the weight-for-age regressions. The estimates from model two are generally close to those from model one, with the corresponding figures for the mean coefficients in the height and weight regressions being 0.220 and 0.199 respectively. Thus, estimates of income effects are more sensitive to treatment of unobserved community factors than to controls for household drinking water and sanitation. While there is no regular pattern, in the majority of the cases the coefficient in model 3 is appreciably larger than that in models 1 and 2. This implies that in these countries there are common factors in the community including health and educational programs and public goods but exclusive of household infrastructure, that improve [are detrimental to] nutritional status and also correlate positively [negatively] with income.

As mentioned, the results reported in Table 2 are based on regressions that have nutritional status as a dependent variable. While this approach utilizes more information in the data sets than one which focus on the probability of crossing a threshold, it does not allow us to directly infer the impact of income growth on malnutrition rates. However, under the assumption of a neutral distribution of income growth it is relatively straightforward to simulate expected change in the level of malnutrition between the year of the respective surveys and either 2010 or 2020 using the coefficients in Table 2. We verified that using the same coefficient for the logarithm of consumption for all income levels in any given country is generally appropriate by exploring the inclusion of the square of the logarithm as well. In only two countries (Mozambique and Kenya) were squared terms statistically significant and negative**.**

Table 3 indicates the expected proportional reduction in malnutrition following both a sustained 2.5 % per capita income growth rate and a 5% rate. Both assumptions are optimistic; growth in the selected countries in 1997-98 averaged only 1%. Since we have allowed income growth to be the same across countries, differences in the impact of this growth reflect either the magnitude of the expenditure coefficients and the density of the distribution of the nutritional status of the population slightly below the cutoff for malnutrition at a Z score of –2. Figures 1 and 2 illustrate this for the higher growth rate (5% per annum) model without country fixed effects. As indicated, despite the high assumed rate of per capita consumption growth, only in one case – weight for age in Morocco– is it possible that the malnutrition rate will be halved in the period covered. Averaging across the twelve countries, the mean reduction in malnutrition defined in terms of low weight-for-age by 2020 is 33.1% if we base our estimates on the coefficients from model three (that is to say, we assume income growth will lead to corresponding improvements in infrastructure and unobserved community factors that correlate with income). The average reduction across our countries would be 20.8% by 2010.

The projections are fairly robust to model specification. Assuming that infrastructure and community fixed factors do not improve (basing our estimates on model one) the average reduction in malnutrition from sustained high growth would be 17.5% by 2010 and 27.1% by 2020. The projections are, of course, sensitive to assumptions about the rate of income growth. If assumed income growth was halved, from 5% to 2.5%, the projected reductions in malnutrition tend also be halved. The mean reduction under model three would be 10.9% by 2010 and 17.5% by 2020. For malnutrition defined in terms of height-for-age, projected reductions due to income growth are more modest than those for malnutrition in terms of weight-for-age. For example, high growth under model three would lead to a mean 24% reduction in stunting by 2020 compared to the 33% reduction in malnutrition defined with respect to weight-for-age.

These average projected reductions hide considerable variation across countries. Consider, for example, the 34.3 mean projected reduction in the prevalence of low weight for age by 2020 in the high growth scenario. The range of projections in this case runs from 18.8% (Pakistan) to 54.1% (Morocco). The impact of prolonged income growth on rates of malnutrition are lowest in some of the countries with the highest starting levels of malnutrition, such as Mozambique, Nepal, and Pakistan, even though the consumption term is statistically significant in the household regressions. However, the sample does not cover enough countries to generalize on this pattern.

Before looking at the impact of GDP growth on cross-country regressions, we first discuss the coefficients of the auxiliary variables included the household regressions to reduce missing variable bias, such as parental education and the infrastructure terms, focusing our attention on model one. Parental characteristics are often important determinants of anthropometric status (see Table 4). This is particularly true for the mother's height, which had a positive and significant relationship to the child's nutrition in all of the countries where the information was available[10]. The variables for years of parental education are positive and significant determinants of anthropometric status in just over a quarter of all cases. The lack of significance may be surprising given the conventional wisdom, although it mirrors the findings of Sahn, Stiffel and Younger (1999) for Demographic and Health Surveys for nine African countries[11]. Note that the estimates of the coefficients are almost always positive and, taken together, make it unlikely that their true value is zero. On average, an extra year of parental education raises Z-scores by around 0.01 of a standard deviation of nutritional status (more in the case of the maternal education and height-for-age). Thus, giving mothers and fathers an extra six years of schooling each would, on average, raise weight-for-age by 13% of a standard deviation. As a point of reference, this can be compared to the 19% average change predicted from doubling income.

In all cases, the age bracket variables for the child were jointly significant and in most cases individually so. The anthropometric data show no evidence of bias against girls even in countries where it is commonly suspected, such as Pakistan and Nepal (See also Harriss, 1995). Z-scores are almost always higher on average for girls than for boys, although the differences are often statistically insignificant.

Piped drinking water often did not have a significant and positive impact on the height for age of children. In Kenya, and Peru there was a significant positive impact of piped water on weight for age, but in Morocco, Nepal and Romania, there were significant negative coefficients. Similarly, flush toilets had significant positive effects on anthropometric status in only a minority of cases: Pakistan (for both weight and height); Jamaica, Mozambique, and South Africa (for height only) and Vietnam (for weight only). The variability of the results may reflect the fact that the various surveys do not classify the variables in the same manner. In some cases the question on piped water distinguishes public from private provision, while in others it distinguishes protected from non-protected sources of water. Since that quantity of water used by a household – reflecting the convenience of collecting it – may affect nutrition through a different pathway than the purity of the supply (Burger and Esrey, 1995) it is difficult to compare this variable across different data sets. Because the infrastructure coefficient have a modest impact the omitted variable bias in model two relative to model one is small.

Finally, while the fixed effect model does not include a dummy variable for urbanization since that variable will not vary over the cluster, such a variable was included in model three. In five countries (Kenya, Mozambique, Peru, Vietnam, and –for height for age only - Morocco) the urban dummy was positive and significant. In Jamaica (for height-for-age only) and in South Africa (for weight-for-age only), the urban dummy was negative and significant. We also explored whether income effects differed in weight-for-age regressions performed separately for rural and urban areas, but found no consistent pattern. In eight cases, income effects were stronger for rural areas (See Appendix Table 1).

3.2 The cross-country results: GDP per capita and child malnutrition

Table 5 presents the mean prevalence of malnutrition in our cross-country sample, both for the all countries and for the sub-sample for which we have observations in each decade. We report both unweighted cross country means and means weighted by country population. Comparisons of trends over time in malnutrition rates are complicated by the fact that we do not have observations for India in the 1980s or China in the 1970s. However, the data do illustrate the cross sectional variation of malnutrition with national income. Figure 3 plots the predicted negative relationship between smoothed malnutrition rates and GDP per capita based on the smoothed regression routine for each decade [12]. Moreover, the relationship between GDP and nutrition has been fairly constant; the line on the graph for 1970 runs parallel to that for the next two decades. At any given level of GDP in the 1980s or 1990's, a country could expect a lower rate of malnutrition than in the 1970s. That is, even in countries with stagnant economies, the expected rate of malnutrition in 1980 was lower than in 1970. Plausible candidates that may account for this change between the 1970s and 1980s include a number of improvements in technology that are not strongly related to the income or investment in the countries in the sample such as the promotion of oral rehydration salts and mass immunization. The average price of food was also higher in the 1970's. While it is also true that the average education of women (as well as men) improved in the period, this is less likely an explanation since – as discussed below – the 1970s imply higher malnutrition even in regressions that control for education. Moreover, the improvement in education continued and, indeed, accelerated in many countries into the 1990s.

In Table 6, we report models of malnutrition rates as a function of the log of per capita GDP, female secondary school enrolment and decade dummy variables. Column (1) of Table 6 presents Ordinary Least Squares results. Column (2) of Table 6 presents the country fixed effects estimates. The change over time is indicated by the negative and significant dummy variables for the 1980s and 1990s relative to the 1970s in Table 6, column (2). The inclusion of fixed effects leads to a smaller estimate of the impact of income growth. The coefficient on GDP per capita drops to 63% of its column (1) value in column (2). This suggests that there are many time invariant unobservables that are positively associated with both high (low) income and low (high) malnutrition, biasing up the OLS estimates[14].

The estimated coefficient on the log of per capita GDP in column (2) of Table 6 implies that 5% growth per annum in GDP per capita between 1995 and 2020 would reduce malnutrition by 10 percentage points. These results refute a hypothesis that per capita GDP growth fails to improve the nutritional status of the most vulnerable. This improvement in nutrition that is related to GDP growth may be a direct effect of economic growth on income of the poor or indirect effects of this growth on the infrastructure of the country or a combination of both. The results in Table 6 are based on malnutrition *rates*, not anthropometric status across an entire population and, thus, are not directly comparable with the results based on the analysis of household survey data in Table 2. However, the predicted 10 percentage point reduction in malnutrition is two fifths of the mean rate of malnutrition in the cross-country data for the 1990s (Table 5). This proportionate reduction is somewhat higher than the results from the analysis of household survey data in Table 3, where the corresponding fall was a third.

Even when both sets of results are converted to the common measure of rates of malnutrition, there is no automatic correspondence between the household regressions and the GNP results. For one thing, income growth estimated using the national accounts that provide the GNP data in the cross country regressions do not strongly track those using reported household expenditures in surveys (Deaton, 2000). Also the rate f income growth for those households a risk of malnutrition may differ from the national average depending on whether inequality is increasing or declining. Moreover, the cross country results might be biased downwards due to mismeasurement in purchasing parity. Conversely, one might expect the cross-country results to give higher income elasticities than those based on household survey data since the latter condition on time varying, as well as time invariant, country-level factors. For example, if all households in a survey are subject to the same national health system, then household level estimates of income effects will not include the indirect effects of rising national income that influence the performance of the system. Thus, it is reassuring that our main results on the expected impact of income growth are fairly robust to the alternative source of our income data. .

The cross country data also confirm that the income growth rates used in our simulations are optimistic. Using all observations available, the mean growth in GDP per capita between the earliest and latest years averages just one percent per annum, the same as the average growth rate in 1997/98 for the twelve countries selected previously for the analysis of household surveys. In the countries for which we have observations for all three decades, the growth of income per capita averaged only 0.65% per annum.

The cross country regression results explain a third to a half of the variation in malnutrition rates. Many countries have managed to reduce malnutrition beyond what might be expected based on their income – as is readily apparent from comparing Figure 4 with the smoothed curves in Figure 3. While it would be wrong to interpret this variation as implying income is unimportant, it is useful to look further at the improvements in nutrition that come from moving ‘off the curve’ as opposed to along it. From Table 7 we can see that eight of the eighteen countries in our sample for which we have observation from the 1970s as well as the 1990's reduced the rate of malnutrition by more than 2 percent of the base levels per year – a rate that would reduce malnutrition by at least half in a quarter of a century. Three suffered increases in malnutrition rates – in part because of declining incomes.

We decompose the observed improvements in malnutrition into that accounted for by the country fixed effects estimates in Table 6 - that is, by changes in predicted rates of malnutrition based on GDP and education – and the amount of change that comes from improved policies and programs that move a country below the curve. In four of the eight fastest improving countries virtually all of the improvement can be explained by income growth. Conversely, two Central American countries among the countries with the fastest improvements in malnutrition did so with virtually no income growth. In the most rapidly improving Asian countries in this particular sample the improvement can be attributed equally to income growth and to movement below the curve. Similarly, although no African country in this sample has a rate of improvement in malnutrition sufficient to halve malnutrition in 25 years, the country with the most rapid improvement (Uganda) did so with more or less equal contribution from income growth and other improvements.

4. Conclusions

The results presented here at both the cross-country and the household levels show that sustained income growth can achieve a sizable reduction in malnutrition in the next two decades. Even holding community and household infrastructure constant, malnutrition rates (in terms of low weight-for-age) are projected to decline by around 20% by 2010 and over 30% by 2020 if countries that can achieve very strong per capita income growth (5% per annum). If growth is more modest, say halved from 5% to 2.5%, the projected reductions tend also to be halved. Cross country regressions imply somewhat greater reductions, consistent with income growth improving country-level factors such as national health systems. They add an additional dimension since they show that historical patterns of income distribution are consistent with income growth leading to marked improvements in nutrition.

While clearly this is encouraging, there are some disturbing elements of these results as well. For one thing, the two low-income African countries in the sample of twelve countries do not show as large an impact on height for age of increased household per capita income as do the other countries studied nor does the rate of low weight for age in Pakistan respond rapidly. Moreover, our projections are based on per capita income growth rates that are probably optimistic. Few countries have sustained 5% economic growth for several decades and amongst our sample of twelve countries, only a minority achieved 2.5% growth or more in 1997-98. Even with the very optimistic assumption of 5% income growth, only one country is projected to be able halve their rate of malnutrition in terms of low weights for age by 2020 and none will do so in terms of heights.

Yet, some countries in our data set have reduced malnutrition at rates that far exceed what would be expected based on income growth alone. For example, the proportional reduction in malnutrition in Peru between 1994 and 1997 was nearly 20% (see Table 1). That is, the actual reduction in child malnutrition was far greater than could be predicted from income growth on the basis of the household survey regressions, although the income coefficients were virtually the same using either year's survey. Similarly, in the discussion of the cross-country regressions we indicated that some countries have been able to improve nutrition at a rate far faster than implied by income growth. In other words, direct nutrition interventions can be highly effective.

Thus, we conclude that despite the importance of income growth as a factor in reducing malnutrition, it is, by itself, almost surely unlikely to meet the needs of the coming generation of children. In this, we echo the conclusions of Berg (1981) as well as Reutlinger and Selowsky (1976) who noted that hunger would persist in the face of rapid income growth in the absence of additional direct measures to combat malnutrition. That is, the results point to the crucial importance of pursuing a balanced strategy to accelerate reductions in malnutrition though by themselves they do not identify which programs are more effective in which environment (see Gillespie, Mason and Martorell, 1996 for examples).

However, we also stress that income growth is also part of this balanced strategy. Sustained per capita income growth will go a long way towards the goal of halving child malnutrition rates by 2020. Indeed, despite the potential of direct nutrition interventions ranging from community-based behavior change activities (such as infant growth promotion) to national campaigns for immunization, micronutrient supplementation and food fortification the impact of such interventions is likely to be hampered in the absence of the income growth.

References

ACC/SCN. 2000. The Fourth Report on the World Nutrition Situation. ACC Subcommittee on Nutrition (Geneva) and the International Food Policy Research Institute (Washington D.C.).

Alderman, Harold. 2000. "Anthropometrics" in Grosh and Glewwe (eds.). Designing Household Survey Questionnaires for Developing Countries: Lessons from Ten Years of LSMS Experience. Oxford: Oxford University Press.

Alderman, Harold and Marito Garcia. 1994. "Food Security and Health Security: Explaining the Levels of Nutritional Status in Pakistan." Economic Development and Cultural Change. 42 (3) 485-508.

Anand, Sudhir and Martin Ravallion. 1993. "Human Development in Poor Countries: On the Role of Private Income and Public Services." Journal of Economic Perspectives. 7 (Winter): 133-150.

Appleton, Simon and Lina Song. 1999. "Income and Human Development at the Household Level: Evidence from Six Countries". Background Paper for World Development Report. 2000/1.

Behrman,-Jere-R.; Deolalikar,-Anil-B.; Wolfe,-Barbara-L. 1988. .Nutrients: Impacts and Determinants. World-Bank-Economic-Review 2(3), September: 299-320.

Berg, Alan. 1981. Malnourished People. A Policy View. Washington DC: World Bank.

Burger, Susan and Steven Esrey. 1995. Water and Sanitation: Health and Nutrition Benefits to Children. in Pinstrup-Andersen, Per, David Pelletier, and Harold Alderman (eds.) Enhancing Child Growth and Nutrition in Developing Countries: Priorities for Action. Ithaca. Cornell University Press.

Deaton, Angus. 2000. Counting the World Poor: Problems and Possible Solutions. Princeton, University. Processed.

FAO. 1999. The State of Food Insecurity in the World. FAO, Rome.

Grosh, Margaret and Paul Glewwe (eds.).2000. Designing Household Survey Questionnaires for Developing Countries: Lessons from Ten Years of LSMS Experience. Oxford: Oxford University Press.

Gillespie, Stuart., John Mason, and Reynaldo Martorell 1996. *How Nutrition Improves*. Geneva :UN ACC/SCN.

Harriss, Barbara. 1995. The Intrafamily Distribution of Hunger in South Asia in Jean Dreze, Amartaya Sen, and Artar Hussain (eds) The Political Economy of Hunger. Selected Essays Oxford: Clarendon Press.

Maxwell, Simon. 1999. International Targets For Poverty Reduction And Food Security: A Mildly Skeptical But Resolutely Pragmatic View With Greater Calls For Subsidiarity. IDS Bulletin. 30(2):92-105.

Pelletier, David. 1994. "The Potentiating Effects of Malnutrition in Child Mortality: Epidemiologic Evidence and Policy Implications." Nutrition Reviews. 52 (12) 409-415.

Reutlinger, Shlomo and Marcelo Selowsky. 1976. Malnutrition and Poverty: Magnitude and Policy Options. Baltimore: Johns Hopkins University Press.

Sahn, David, David Stiffel, and Stephen Younger, 1999. "Inter-temporal changes in welfare: preliminary results from nine African countries", mimeo, Cornell University.

Smith Lisa and Lawrence Haddad. 2000. Explaining Child Malnutrition in Developing Countries: A cross-country Analysis. Research Report 111. International Food Policy Research Institute. Washington D.C.

Steckel. Richard. 1995. "Stature and the Standard of Living." Journal of Economic Literature 33 (Dec): 1903-40.

Strauss, John and Duncan Thomas. 1995. "Human Resources: Empirical Modeling of Household and Family Decisions" in Jere Behrman and T.N. Srinivasan (eds) Handbook of Development Economics Vol. 3A Amsterdam: North Holland Publishing Company. 1885-2023.

WHO (World Health Organization). 1995. *Physical Status: The Use and Interpretation of Anthropometry*. Technical Report Series 854 Geneva: World Health Organization.

Table 1: Summary of Household Survey Datasets Used

Country	Number of preschool children used in regressions	Year of sample survey	Maternal heights coverage (yes/no)	GNP per capita[1] (Dollars) 1998	Rates of Malnutrition (%)						GNP per capita growth rate (%)[1] (1997-98)
					Height-for-age			Weight-for-age			
					Male	Female	All	Male	Female	All	
Egypt	1235	1997	Yes	1290	17.2	19.1	18.1	10.3	11.1	10.7	3.3
Jamaica	755	1995	No	1680	8.7	5.8	7.3	4.9	5.2	5.0	-1.9
Kenya	7661	1994	No	330	33.6	32.6	33.1	20.9	18.4	19.7	-0.9
Kyrgyz	1679	1997	Yes	350	30.3	26.6	28.5	13.4	13.1	13.3	2.8
Morocco	2249	1990-1	Yes	1250	29.2	27.7	28.5	14.7	15.4	15.0	-1.0
Mozambique	3309	1997	No	210	39.7	34.7	37.2	23.8	21.7	22.8	9.2
Nepal	1561	1996	No	210	50.7	46.0	48.4	50.4	45.6	48.1	-0.1
Pakistan	3076	1991	Yes	480	44.8	41.3	43.0	48.4	43.2	45.7	2.5
Peru 1994	2092	1994	No	2460	29.6	32.7	31.1	9.6	8.2	8.9	N/A
Peru 1997	2154	1997	No	2460	23.8	24.7	24.3	7.5	5.5	6.5	N/A
Romania	3625	1994	No	1390	26.4	16.4	21.7	7.9	4.8	6.4	-5.3
South Africa	4151	1993	No	2880	28.0	24.4	26.2	18.2	17.7	18.0	-1.2
Vietnam	2637	1993	Yes	330	49.0	49.7	49.3	39.8	41.5	40.7	2.8

[1] Taken from WDR 1999/2000

Table 2: Coefficients of logarithm of per capita expenditures						
Country	Height for Age			Weight for Age		
	Model 1 N=N(Y,E,I) With fixed effects and infrastructure	Model 2 N=N(Y,E) With fixed effects, no infrastructure	Model 3 N=N(Y) Without fixed effects, no infrastructure	Model 1 N=N(Y,E,I) With fixed effects and infrastructure	Model 2 N=N(Y,E) With fixed effects, no infrastructure	Model 3 N=N(Y) Without fixed effects, no infrastructure
Egypt	0.227 (2.49)	0.246 (2.78)	0.162 (2.14)	0.178 (2.17)	0.204 (2.55)	0.160 (2.32)
Jamaica	0.358 (3.44)	0.437 (4.47)	0.360 (3.62)	0.280 (3.43)	0.323 (4.27)	0.314 (4.07)
Kenya	0.147 (5.10)	0.151 (5.24)	0.166 (6.65)	0.138 (7.01)	0.144 (7.33)	0.138 (8.35)
Kyrgyz	0.348 (3.93)	0.346 (3.94)	0.449 (5.74)	0.126 (1.82)	0.133 (1.94)	0.175 (2.87)
Morocco	0.440 (5.38)	0.239 (2.17)	0.296 (3.17)	0.221 (3.67)	0.215 (2.46)	0.366 (5.16)
Mozambique	0.172 (2.65)	0.174 (2.72)	0.199 (4.71)	0.136 (2.81)	0.139 (2.91)	0.273 (8.70)
Nepal	0.116 (1.38)	0.115 (1.37)	0.184 (2.70)	0.184 (3.04)	0.179 (2.97)	0.307 (6.18)
Pakistan	0.039 (0.59)	0.049 (0.74)	0.210 (3.48)	0.072 (1.39)	0.089 (1.67)	0.225 (4.72)
Peru 1997	0.301 (4.37)	0.313 (4.57)	0.367 (6.21)	0.247 (4.37)	0.264 (4.69)	0.294 (5.91)
Romania	0.091 (1.45)	0.084 (1.06)	0.097 (1.85)	0.333 (5.35)	0.350 (5.81)	0.175 (4.34)
South Africa	0.240 (4.02)	0.273 (5.52)	0.355 (8.28)	0.236 (4.68)	0.223 (4.74)	0.239 (6.05)
Vietnam	0.200 (2.80)	0.214 (3.04)	0.466 (8.75)	0.105 (2.06)	0.127 (2.54)	0.268 (6.95)

Table 3: Projected reduction in Malnutrition

Country	Rate of growth (%)	Height-for-age						Weight-for-age					
		Year 2010			Year 2020			Year 2010			Year 2020		
		Without fixed effects	With fixed effects	With fixed effects & infrastructure	Without fixed effects	With fixed effects	With fixed effects & infrastructure	Without fixed effects	With fixed effects	With fixed effects & infrastructure	Without Fixed effects	With fixed effects	With fixed effects & infrastructure
Model		N=N(Y)	N=N(Y,E)	N=N(Y,E,I)	N=N(Y)	N=N(Y,E)	N=N(Y,E,I)	N=N(Y)	N=N(Y,E)	N=N(Y,E,I)	N=N(Y)	N=N(Y,E)	N=N(Y,E,I)
Egypt													
	2.5	6.7	8.9	8.9	9.8	14.3	13.4	10.6	12.9	10.6	15.9	18.2	16.7
	5.0	10.7	16.5	14.3	19.6	29.0	29.0	16.7	20.5	18.2	24.2	28.8	25.8
Jamaica													
	2.5	12.7	18.2	12.7	23.6	27.3	23.6	15.8	15.8	15.8	23.7	23.7	23.7
	5.0	27.3	32.7	27.3	38.2	49.1	38.2	28.9	28.9	26.3	44.7	47.4	44.7
Kenya													
	2.5	5.2	4.6	4.6	8.6	7.5	7.5	7.4	7.4	7.4	11.4	12.3	11.4
	5.0	10.2	9.4	9.4	17.0	15.4	14.6	14.4	15.7	14.4	23.8	24.8	23.8
Kyrgyz													
	2.5	6.5	5.2	5.2	13.6	10.6	10.6	9.0	7.6	7.6	12.6	9.0	9.0
	5.0	15.9	12.1	12.1	28.4	21.9	22.8	13.9	10.3	10.3	21.1	17.0	15.7
Morocco													
	2.5	8.4	6.7	13.1	13.6	10.5	20.2	17.2	12.4	12.4	29.9	16.6	17.2
	5.0	18.9	13.6	27.3	27.8	22.0	39.7	37.9	22.8	23.7	54.1	31.1	37.3
Mozambique													
	2.5	4.8	3.3	3.3	7.6	6.9	6.1	10.8	5.0	5.0	19.1	9.0	9.0
	5.0	8.1	7.6	7.6	14.8	13.5	12.8	21.0	12.4	10.8	35.2	19.1	19.1
Nepal													
	2.5	3.1	2.2	2.5	4.4	3.1	3.1	10.5	6.9	6.9	17.0	10.5	10.5
	5.0	5.3	3.3	3.3	9.7	6.1	6.1	18.5	12.1	12.1	31.0	18.5	19.1
Pakistan													
	2.5	5.3	1.0	0.5	7.6	1.8	1.0	7.8	2.8	2.8	10.3	3.2	3.2
	5.0	11.2	2.4	1.8	18.2	3.5	2.9	12.8	6.0	3.4	18.8	8.5	7.9
Peru 1997													
	2.5	8.8	7.5	7.3	16.4	13.4	12.8	10.0	9.3	8.6	20.7	17.1	15.0
	5.0	18.2	15.7	15.1	32.7	27.2	26.0	22.9	20.7	20.7	38.6	36.4	31.4
Romania													
	2.5	3.4	3.4	3.4	7.2	7.1	7.1	8.2	19.8	19.8	15.5	39.2	36.6
	5.0	7.5	7.2	7.5	12.4	11.1	11.8	19.8	44.0	42.2	39.2	58.2	56.9
South Africa													
	2.5	12.2	8.5	8.0	17.3	13.6	12.7	10.4	8.6	10.4	15.3	13.7	13.7
	5.0	22.3	17.3	15.3	31.4	25.4	22.8	18.5	16.6	18.5	29.6	27.7	28.5
Vietnam													
	2.5	12.3	6.3	6.3	20.5	9.0	8.6	12.8	7.1	5.2	19.1	9.7	8.6
	5.0	24.6	11.2	10.6	37.3	18.6	16.8	24.5	12.0	9.7	36.3	17.9	14.9

Absolute value of T-statistics given in parenthesis

Table 4: Coefficients on Parental Characteristics
Model 1: N=N(Y, E, I)

Country	Height for Age			Weight for Age		
	Father's education	Mother's education	Mother's Height	Father's education	Mother's education	Mother's height
Egypt	-0.003 (0.35)	-0.009 (0.89)	0.050 (6.56)	-0.014 (1.83)	0.004 (0.45)	0.025 (3.71)
Jamaica	-0.028 (1.03)	0.027 (1.55)	NA	0.008 (0.39)	0.006 (0.48)	NA
Kenya	-0.005 (0.83)	0.014 (2.51)	NA	-0.001 (0.34)	0.014 (3.66)	NA
Kyrgyz	0.008 (0.33)	0.007 (0.32)	NA	0.060 (3.05)	0.007 (0.42)	NA
Morocco	0.074 (0.94)	0.0 56 (0.17)	0.050 (7.34)	0.000 (0.01)	-0.011 (0.05)	0.029 (5.82)
Mozambique	0.011 (0.80)	0.027 (1.46)	NA	0.008 (0.81)	0.023 (1.69)	NA
Nepal	0.027 (2.76)	0.005 (0.32)	NA	0.023 (3.41)	0.017 (1.52)	NA
Pakistan	0.020 (2.25)	0.058 (4.24)	0.014 (4.48)	0.020 (2.91)	0.030 (2.88)	0.006 (2.47)
Peru 1997	0.003 (0.43)	0.057 (5.00)-	NA	-0.012 (1.51)	0.029 (3.05)	NA
Romania	-0.010 (0.62)	-0.047 (2.95)	NA	0.036 (2.72)	-0.033 (2.67)	NA
South Africa	0.006 (0.44)	0.009 (0.76)	NA	0.016 (1.34)	0.018 (1.83)	NA
Vietnam	0.010 (0.98)	0.014 (1.31)	0.040 (7.40)	-0.003 (0.43)	0.017 (2.11)	0.025 (6.43)

Table 5: Mean Prevalence of Low Weight for Age (<-2) in Cross Country data

a) All countries

Decade	Mean prevalence		Observations
	Unweighted	Population weighted	
1970	29.18	50.8	30
1980	24.23	29.0	74
1990	23.80	28.5	71
All	24.90		175

b) Countries with observations in all decades

Decade	Mean prevalence		Observations
	Unweighted	Population weighted	
1970	27.07	33.9	18
1980	20.69	26	27
1990	19.65	24.5	22
All	22.06		67

Table 6: OLS and Country Fixed Effects Regressions, dependent variable, Prevalence of Low Weight for Age (<-2)

Explanatory variable	OLS	Country Fixed-Effects
	(1)	(2)
Log of Per capita GDP	-12.673	-8.025
	(8.00)**	(3.17)**
Female Secondary School Enrollment	-0.011	-0.092
	(0.19)	(1.18)
decade=1980s	-4.411	-4.830
	(1.77)	(3.37)**
decade=1990s	-6.385	-5.294
	(2.52)*	(3.18)**
Constant	124.220	92.021
	(11.24)**	(5.06)**
Observations	175	175
Number of country dummies		61
R-squared	0.45	
Absolute value of t-statistics in parentheses		
* significant at 5% level; ** significant at 1% level		

Table 7: Decomposing Changes in The Prevalence of Low Weight For Age over Time

Country	Year 1	Actual % low Weight of age, Year 1	Predicted % low weight for age, Year 1	Year 2	Actual % low Weight of age, Year 2	Predicted % low weight for age, Year 2	Year 3-Year 1	Difference in Actual % low Weight for age	Difference in Predicted % low Weight for age	Change in % Actual low weight for age per year	Predicted change in low weight for age as a percent of Actual	Annual change in % low weight for age as a percentage of low weight for age rate in year 1
Guatemala	1977	43.5	36.8	1995	26.6	34.5	18	-16.9	-2.3	-0.94	13.61	-2.16
Pakistan	1977	52.8	47.8	1995	38.2	41.2	18	-14.6	-6.6	-0.81	45.21	-1.54
Philippines	1973	49.9	41.1	1993	29.6	32.6	20	-20.3	-8.5	-1.02	41.87	-2.03
Costa Rica	1978	16	6.4	1994	2.2	5.4	16	-13.8	-1	-0.86	7.25	-5.39
Sri Lanka	1977	54.3	49.8	1993	37.7	39.1	16	-16.6	-10.7	-1.04	64.46	-1.91
Brazil	1975	18.4	14.3	1996	5.7	7.4	21	-12.7	-6.9	-0.60	54.33	-3.29
Uganda	1977	33.2	29.2	1995	25.5	25.9	18	-7.7	-3.3	-0.43	42.86	-1.29
Guyana	1971	24.9	22.8	1993	18.3	18.64	22	-6.6	-4.16	-0.30	63.03	-1.20
Zaire	1975	28.8	28.2	1994	35	29.1	19	6.2	0.9	0.33	14.52	1.13
Colombia	1977	16.8	16.5	1995	8.4	5.7	18	-8.4	-10.8	-0.47	128.57	-2.78
Tunisia	1974	20.2	19.9	1994	9	5.7	20	-11.2	-14.2	-0.56	126.79	-2.77
Jamaica	1978	9.3	9.2	1993	10.2	9.3	15	0.9	0.1	0.06	11.11	0.65
Zambia	1972	24.1	24.4	1996	23.5	23.2	24	-0.6	-1.2	-0.03	200.00	-0.10
Peru	1975	16.1	16.7	1996	7.8	9.1	21	-8.3	-7.6	-0.40	91.57	-2.45
Indonesia	1978	43.6	45.8	1995	34	34.8	17	-9.6	-11	-0.56	114.58	-1.30
Chile	1978	2.1	5.4	1995	0.9	-2.63	17	-1.2	-8.03	-0.07	669.17	-3.36
Egypt	1978	15.9	19.5	1995	12.4	8.1	17	-3.5	-11.4	-0.21	325.71	-1.29
Lesotho	1976	17.3	21	1994	21.4	13.5	18	4.1	-7.5	0.23	-182.93	1.32

Note: Predicted values of percent low weight for age are based on the country fixed effects regressions in Table 6.

Appendix Table 1 :
Comparison Of The Income Coefficient on Weight-for-age
For Urban And Rural By Country:
Model 1: N=N(Y, E, I)

Country	Urban	Rural	Urban/Rural Ratio
Egypt	0.326	0.024	13.58
Jamaica	0.262	0.334	0.78
Kenya	0.218	0.130	1.68
Kyrgyz	0.149	0.194	0.77
Morocco	0.302	0.366	0.83
Mozambique	0.237	0.255	0.93
Nepal	0.099	0.181	0.55
Pakistan	0.066	0.071	0.93
Peru	0.250	0.325	0.77
Romania	0.267	0.348	0.77
South Africa	0.383	0.230	1.66
Vietnam	0.200	0.072	2.78

Appendix Table 2: OLS regressions by Decade: dependent variable, Prevalence of Low Weight for Age (<-2)

Explanatory variable	By decade: all observations			By decade: only countries with observations in all decade		
	1970s (1)	1980s (2)	1990s (3)	1970s (4)	1980s (5)	1990s (6)
Log of Per capita GDP	-11.582	-14.310	-11.597	-10.731	-13.366	-11.880
	(2.65)*	(5.70)**	(5.13)**	(1.84)	(2.95)**	(3.26)**
Female Secondary School Enrollment	-0.010	-0.004	-0.019	-0.042	0.031	-0.033
	(0.06)	(0.05)	(0.25)	(0.22)	(0.24)	(0.31)
Constant	116.053	131.892	110.187	109.986	122.323	112.113
	(3.83)**	(7.71)**	(7.46)**	(2.64)*	(3.78)**	(4.52)**
Observations	30	74	71	18	27	22
R-squared	0.30	0.46	0.50	0.26	0.32	0.53
Absolute value of t-statistics in parentheses						
* significant at 5% level; ** significant at 1% level						

Figure 1: Percent reduction in prevalence of stunting (low standardized height for age) due to 5% per capita income growth rates to 2020

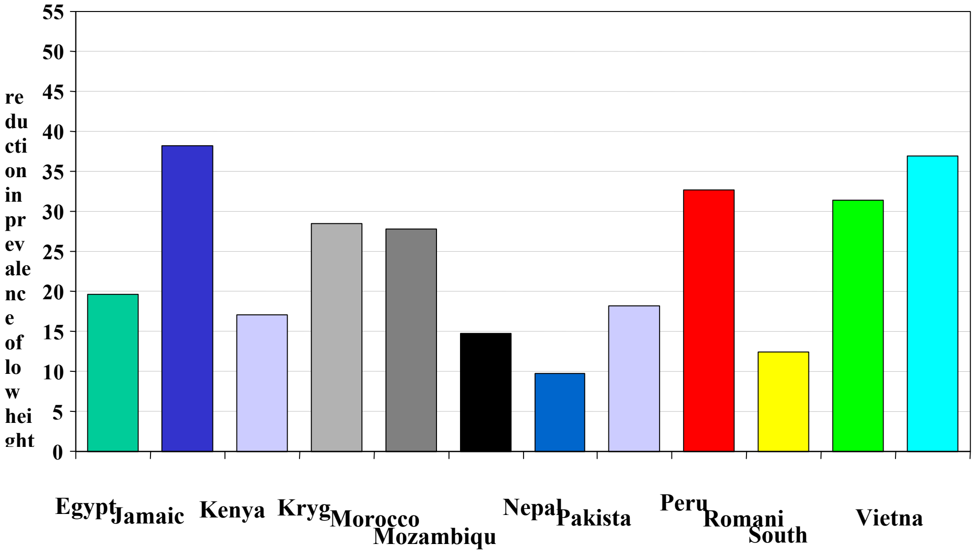


Figure 2: Percent reduction in prevalence of underweight (low standardized weight for age) due to 5% per capita income growth rates to 2020

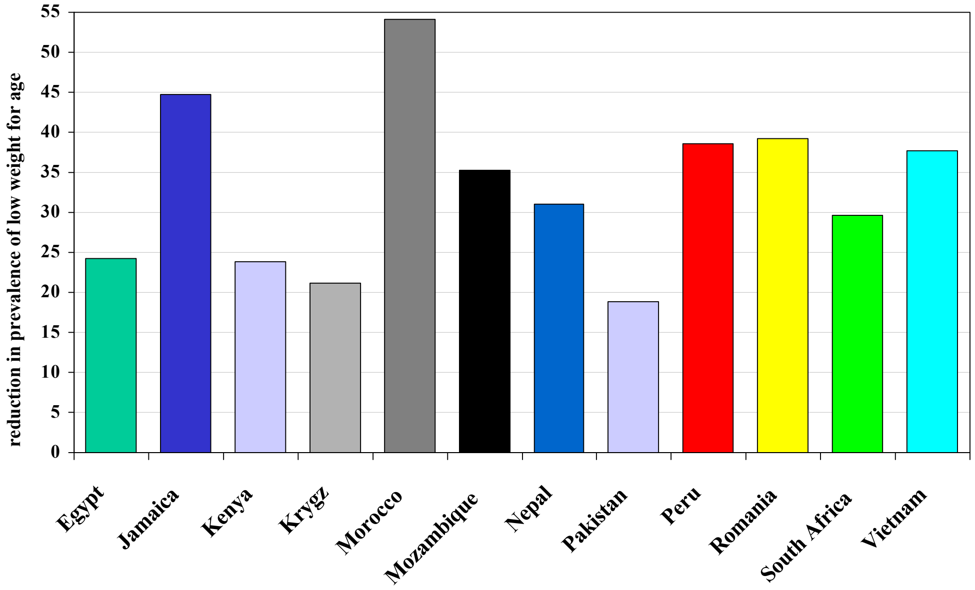


Figure 3: The fitted relationship between child underweight rates and GNP per capita (PPP) by decade, developing countries

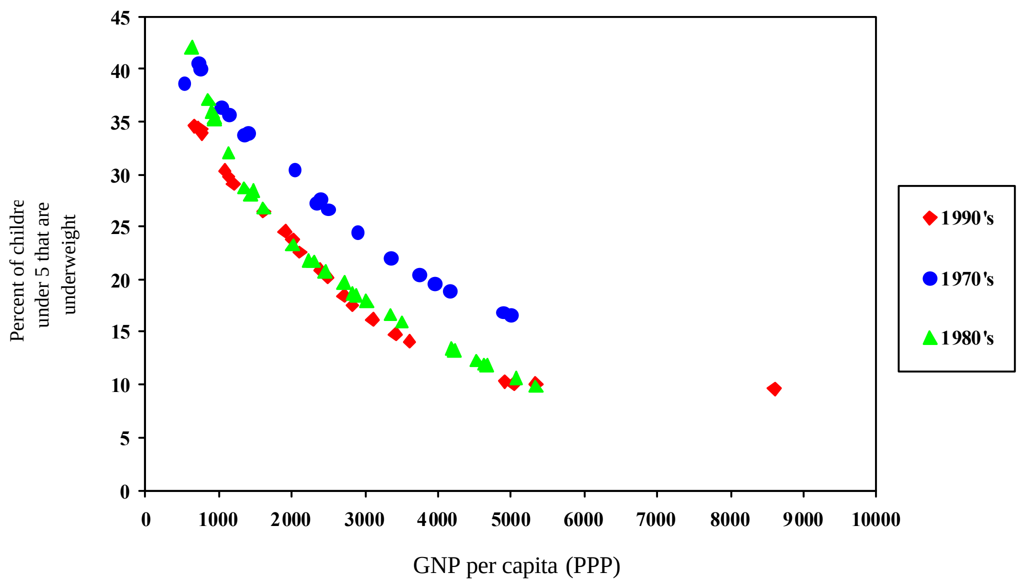
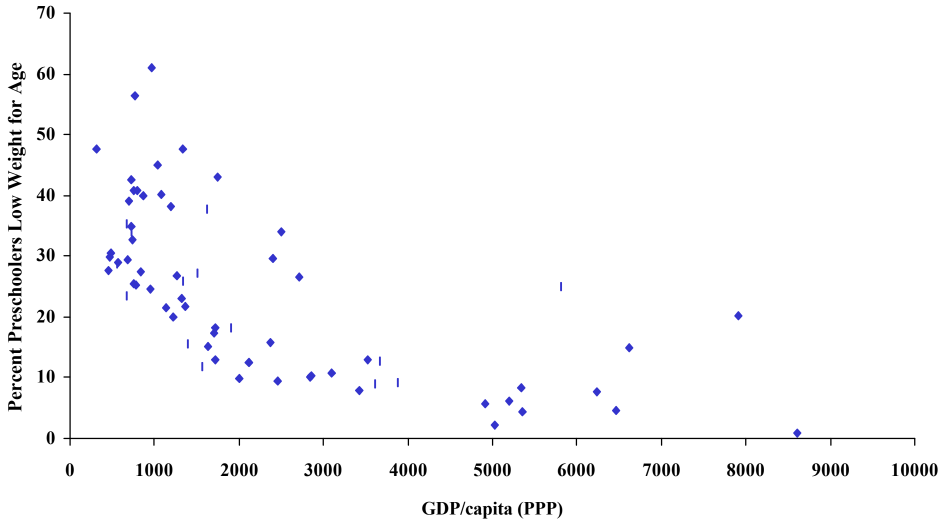


Figure 4: Low weight for age by GDP/capita (PPP): 1990s



Endnotes

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[1] We note Maxwell's (1999) reminder that "international targets can over-simplify and over generalize complex problems….and distort public expenditure priorities" p.93

[2] The age range was usually 0-60 months. In Kenya, the age range was 6-60 months and in Nepal it was under three years.

[3] For reasons of data availability, we were unable to cover the half of the world's population that lives in China and India.

[4] An additional measure, weight for height provides information on acute malnutrition. While this measure is useful for clinical nutrition and for programs such as growth promotion, it is relatively difficult to interpret the relationship of this measure to economic conditions.

[5] If the child's father could not be identified, the education of the most educated adult male in the household was used. In Jamaica and Kenya, neither of a child's parents was identified, so the education of the household head and their spouse were used instead. Typically, education was measured in years although this was not available for Kenya, in which case, dummy variables for educational level were used instead.

[6] Typically, the distinction was whether the household had piped water and whether it had a toilet or not.

[7] However, WHO (1995) advocates having a single international reference for child growth. That is, there are few, if any, ethnic differences in growth patterns of young children; children from privileged or middle-class families in developing countries generally have height and weight distributions that do not differ from international references.

[8] The inclusion criteria are: (1) a clearly defined population-based sampling frame, permitting inferences to be drawn about an entire population; (2) a probabilistic sampling procedure involving at least 400 children; (3) use of appropriate equipment and standard measurement techniques; and (4) presentation of data in the form of z-scores in relation to the NCHS/WHO reference population (WHO 1997).

[9] These data are only reported for 1980-present. To arrive at comparable purchasing power parity (PPP) GDP per-capita figures for the 1970s data points, it was necessary to impute growth rates from the data series on GDP in constant local currency units and apply them to countries' 1987 PPP GDPs.

[10] Quite plausible there is an upwards bias on the coefficient of income for those countries for which parental height is not included (Alderman, 2000). However, note that the regressions for Morocco, the country with the largest percentage improvement with income growth, does contain parental heights and, thus, is not subject to this form of missing variable bias.

[11] In one specification, parental education variables were only significant determinants of height-for-age in 11 out of 32 cases studied by Sahn, Stiffel and Younger, (1999, see Table 14A). This is a somewhat higher ratio than we obtain, but Sahn et al. do not control for household consumption. They also distinguish between primary and post-primary education, with the latter more frequently being significant.

[12] The ksm command in Stata (V6) was used to generate the smoothed variables. A bandwidth of 0.8 was used.

13In preliminary estimates, we augmented the regressions in Table 6 with an additional explanatory variable; the Gini coefficient from the Deininger and Squire data set on income inequality. (Internet address: http://www.worldbank.org/html/prdmg/grthweb/dddeisqu.htm.) However, the Gini coefficient was not statistically significant in the country fixed effects estimates. We subsequently, dropped the variable because limiting ourselves to countries and years for which the estimated Gini coefficients are classified as "acceptable" reduced the number of observations from 175 to 96.