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Accounting for nutritional changes in six success stories: A regression-decomposition approach

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ABSTRACT

Over the past two decades, many developing countries have made impressive progress in reducing undernutrition. We explore potential explanations of this success by applying consistent statistical methods to multiple rounds of Demographic Health Surveys for Bangladesh, Nepal, Ethiopia, Odisha, Senegal, and Zambia. We find that changes in household wealth, mother's education and access to antenatal care are the largest drivers of nutritional improvement, except for Zambia where large increases in bednet usage is the single largest factor. Other factors play a smaller role in explaining nutritional improvements with improvements in sanitation only appearing to be important in South Asia. Overall, the results point to the need for multidimensional nutritional strategies involving a broad range of nutrition-sensitive sectors.

1. Introduction

Between the mid-1990s and the 2010s, the five countries and the state of Odisha, India that are the focus of this special issue saw significant reductions in chronic undernutrition. These encouraging trends beg the main research question motivating this paper: what explains rapid and sustained progress in undernutrition across otherwise diverse settings? Addressing such a question is challenging. Experimental designs are generally not applicable to national level data, and are, in any case, not well suited to identifying the impacts of changes across multiple sectors. Qualitative approaches, as applied elsewhere in this issue, are essential for understanding the policy processes underlying national level change in nutrition, but stop short of identifying and quantifying which policies and programs have made a substantive difference to nutritional change. On the other hand, many quantitative observational analyses of nutrition have identified plausible determinants of nutritional differences across children, but stopped short of conducting more dynamic analyses of which factors may be driving nutritional change over time.

In this study we apply an alternative approach that is quantitative, dynamic and comparative. We build on the approach found in Headey et al. (2015), Headey and Hoddinott (2014) and Headey et al. (2016) (see Zanello et al. (2016) for the application of a quantile decomposition approach to Cambodia). The essence of this approach is: (1) to combine multiple rounds of comparative surveys, such as Demographic Health Surveys (DHS), to capture long term nutritional change; (2) to construct consistently measured explanatory variables over time; (3) to measure trends in these explanatory variables over time; (4) to estimate multivariate regression analyses to derive estimates of the marginal effects of these variables on nutrition outcomes; and (5) to apply decomposition techniques to estimate plausible changes in nutrition due to the changes in means observed in Step (3) and the marginal effects estimated in Step (4).

In this paper we go one step further by applying this approach to several countries spanning two continents and very diverse nutritional contexts: Bangladesh (1996/97-2014), Nepal (1996–2011), Odisha State, India (1992/93-2005/06, with an extension to 2011), Ethiopia (2000–2011), Senegal (1993–2011) and Zambia (2002–2014). We focus on linear growth, since this is widely regarding as the single most relevant indicator of overall nutrition with poor height-for-age z-scores (HAZ) causally linked to a whole host of adverse later life outcomes (Hoddinott et al., 2013). This exploratory approach is not without its limitations (we return to these caveats in our discussion section); mindful of these we emphasize that in the absence of experimental alternatives, it offers a transparent means of identifying a series of plausible explanations of nutritional change that more experimental studies can assess further.

The remainder of this paper is structured as follows. Section 2 outlines the data and methods used in the paper. Sections 3 and 4 present our results while Section 5 concludes.

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2. Data and estimation

We use DHS data from the five countries that are the focus of this special issue: Bangladesh, Nepal, Ethiopia, Senegal and Zambia as well as the state of Odisha in India. Details of these data sets and the surveys underlying them are found in ICF-International (2015). These multi-cluster surveys of ever-married women of reproductive age are generally well suited to our purposes, being high quality, nationally representative surveys that cover a broad range of the hypothesized drivers of nutritional change. We use the following DHS data sets:

- The 1996/1997, 1999/2000, 2004, 2007, 2011 and 2014 rounds of the Bangladesh DHS;
- the 1996, 2001, 2006 and 2011 rounds of the Nepal DHS;
- the 2000, 2005 and 2011 rounds of the Ethiopian DHS;
- the data on Odisha found in the 1992/1993 and 2005/2006 rounds of the India DHS;
- the 1992/1993, 2005 and 2010/2011 rounds of the Senegal DHS; and
- the 2001/2002, 2007 and 2013/2014 rounds of the Zambia DHS.

Our outcome variables are height for age (HAZ) z-scores for preschool children aged 0–59 months (Bangladesh, Ethiopia, Senegal, Zambia), 0–35 months (Nepal) and 0–47 months (Odisha) as measured against WHO growth standards that are described in de Onis et al. (2007). Table 1 presents HAZ means for the first and last round of data available to us (using sampling weights). Mean HAZ scores improved substantially from the 1990s to 2010s increasing by 0.90 in Bangladesh, 0.62 in Ethiopia, 0.57 in Nepal, 0.37 in Zambia, 0.33 in Odisha, and 0.29 in Senegal.

Our choice of drivers of change reflects the factors broadly outlined in the UNICEF (1990) and Lancet (Black et al., 2013) nutrition frameworks and in the existing economic and nutrition literatures on the underlying determinants of undernutrition. We discuss each in turn.

Table 1
Changes in the mean HAZ scores between earliest and latest DHS survey: Bangladesh, Nepal, Odisha (India), Ethiopia, Senegal, Zambia.
Source: Authors' calculations from Demographic and Health Surveys, using sampling weights.

Year	HAZ
	Bangladesh
1997	−2.28
2014	−1.38
Change	0.90
% Change	−39.6%
	Nepal
1996	−2.20
2011	−1.62
Change	0.57
% Change	−26.07%
	Odisha, India
1993	−1.98
2006	−1.65
Change	0.33
% Change	−16.59%
	Ethiopia
2000	−2.16
2011	−1.54
Change	0.62
% Change	−28.60%
	Senegal
1993	−1.44
2011	−1.14
Change	0.29
% Change	−20.35%
	Zambia
2002	−1.86
2014	−1.48
Change	0.37
% Change	−20.14%

Household socioeconomic status has long been identified as an important determinant of nutrition, whether measured as income or in terms of household assets (Haddad et al., 2003). Since the DHS does not collect income data, we used the asset/wealth index approach pioneered by Filmer and Pritchett (2001). This approach has been used in a large number of studies, though not without some criticism. Harttgen et al. (2013) note that the DHS data does not allow us to account for durables' age and depreciation when calculating asset indices. Other criticisms focus on the problems of using dichotomous variables in such an index, the lack of comparability between urban and rural areas; Filmer and Scott (2012) review these and other criticisms. Though cognizant of the limitations of this index, we include an asset index for each country – consistently measured across rounds in order to assess the role that changes in socio-economic status have played in these observed changes in nutritional status. The DHS asset module typically includes ownership of household durables (TV, radio, refrigerator, bicycle, motorcycle, and car) and housing characteristics (floor, wall and roof materials, number of bedrooms, and access to electricity) with the precise list of assets varying across countries. In our analysis, we use the set of assets that are recorded in all rounds for each country and state. We construct an asset index with the weights attached to different assets derived from a principal component analysis (PCA) for all the pooled rounds of data available for a given country(state). Hence, within each country(state) common weights are used across rounds to ensure consistent measurement of asset scores over time. The index is then scaled so that it varies between 0 and 10, with 10 being the maximum score observed across all rounds in a country and zero being the minimum. The values of these indices rise everywhere, but at rates ranging from 43% and 53% in Senegal and Zambia by more than 270% in Bangladesh and Nepal (Table 2).

Parental education has long been associated with child nutrition outcomes (Alderman and Headey, 2014; Behrman and Wolfe, 1984, 1987; Desai and Alva, 1998; Webb and Block, 2004). There are many hypothesized linkages, but parental education affects households' capacity to generate income and smooth shocks, knowledge of correct child care practices and, in the case of maternal schooling, bargaining power within the household. We include both mother's and father's education as measured by years of schooling. In all six case studies both maternal and paternal schooling rise over time with maternal schooling rising faster but from a lower initial value. There are large differences in schooling across case studies, with years of schooling higher in Zambia than elsewhere (where primary and lower secondary schooling are both free and compulsory). We note, however, that there is a difference between grades of schooling attained and years in school; the latter includes the impact of grade repetition and thus is an imperfect measure of educational attainment. Likewise years of schooling does not necessarily reflect schooling quality (Alderman and Headey, 2014).

Both work in nutritional sciences and economics stresses the importance of accounting for maternal height (see Behrman and Deolalikar (1988) for an early statement). Maternal height reflects genetics as well as the circumstances surrounding early life nutritional status of the mother. Since these are correlated with the circumstances surrounding investments in mother's schooling, failing to include maternal height will lead to upwardly biased estimates of the influence of maternal schooling on children's heights. However, maternal height changes little over the time period covered by these surveys (unsurprisingly).

The health environment surrounding the child also appears as an argument in reduced form demand functions for children's nutritional status. In this regard, work by Spears and co-authors has re-invigorated attention to sanitation (Hathi et al., 2014; Spears, 2013). In our regressions, we capture this as the proportion of households with no toilet at the village(cluster) level, with the exception of Zambia. This follows from the extant literature which shows that external bacteria