



## Poverty and childhood undernutrition in developing countries: A multi-national cohort study

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### ABSTRACT

The importance of reducing childhood undernutrition has been enshrined in the United Nations' Millennium Development Goals. This study explores the relationship between alternative indicators of poverty and childhood undernutrition in developing countries within the context of a multi-national cohort study (Young Lives). Approximately 2000 children in each of four countries – Ethiopia, India (Andhra Pradesh), Peru and Vietnam – had their heights measured and were weighed when they were aged between 6 and 17 months (survey one) and again between 4.5 and 5.5 years (survey two). The anthropometric outcomes of stunted, underweight and wasted were calculated using World Health Organization 2006 reference standards. Maximum-likelihood probit estimation was employed to model the relationship within each country and survey between alternative measures of living standards (principally a wealth index developed using principal components analysis) and each anthropometric outcome. An extensive set of covariates was incorporated into the models to remove as much individual heterogeneity as possible. The fully adjusted models revealed a negative and statistically significant coefficient on wealth for all outcomes in all countries, with the exception of the outcome of wasted in India (Andhra Pradesh) and Vietnam (survey one) and the outcome of underweight in Vietnam (surveys one and two). In survey one, the partial effects of wealth on the probabilities of stunting, being underweight and wasting was to reduce them by between 1.4 and 5.1 percentage points, 1.0 and 6.4 percentage points, and 0.3 and 4.5 percentage points, respectively, with each unit (10%) increase in wealth. The partial effects of wealth on the probabilities of anthropometric outcomes were larger in the survey two models. In both surveys, children residing in the lowest wealth quintile households had significantly increased probabilities of being stunted in all four study countries and of being underweight in Ethiopia, India (Andhra Pradesh) and Peru in comparison to children residing in the highest wealth quintile households. Random effects probit models confirmed the statistical significance of increased wealth in reducing the probability of being stunted and underweight across all four study countries. We conclude that, although multi-faceted, childhood undernutrition in developing countries is strongly rooted in poverty.

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### Introduction

Childhood malnutrition has been defined as a pathological state resulting from inadequate nutrition, including undernutrition due to insufficient intake of energy and other nutrients, overnutrition due to excessive consumption of energy and other nutrients, and deficiency diseases due to insufficient intake of one or more specific nutrients such as vitamins or minerals (Ge & Chang, 2001). Childhood undernutrition remains highly prevalent in developing countries with 178 million children less than 5 years of age estimated to be stunted, 112

million estimated to be underweight and 55 million estimated to be wasted in 2005 (Black et al., 2008). Undernutrition is considered to be the underlying cause of more than one third of childhood deaths globally (Black, Morris, & Bryce, 2003). It is also considered to compromise physical and intellectual development during childhood, educational attainment, and health and labour market outcomes during adulthood (Alderman, Hoddinott, & Kinsey, 2003; Manary & Sandige, 2008; United Nations System Standing Committee on Nutrition, 2004; Victora et al., 2008). The importance of reducing childhood undernutrition has been enshrined in the United Nations' Millennium Development Goals (MDGs), a set of global time-bound and quantified targets for improving the social and economic conditions of the world's poorest (UN Millennium Project, 2005). MDG1, for example, set a target to reduce by half the

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prevalence of underweight children under-five years of age by 2015. MDG4 set a target to reduce by two-thirds the mortality rate among children under-five years of age by the same date, implicitly recognising the role of undernutrition as an underlying cause of many of these deaths. Progress towards achieving these goals has been variable. Notable progress towards reducing underweight prevalence, among children under-five years of age, has been made in Eastern Asia, whilst the majority of countries making the least progress in this area are in sub-Saharan Africa (UN Millennium Project, 2008; UN Millennium Project, 2009). Similarly, many countries, particularly in sub-Saharan Africa and Southern Asia, have made little or no progress towards reducing childhood deaths, among children under-five years of age (Countdown Coverage Writing Group, 2008; UN Millennium Project, 2009). Moreover, the recent worldwide economic and food crises have endangered, and even threatened the reversal of, the limited progress that has been made in these areas (UN Millennium Project, 2009).

A number of proximal determinants of childhood undernutrition amenable to effective intervention, such as inappropriate feeding practices and behaviours and inadequate micronutrient intake, have been identified in the scientific literature (Bhutta et al., 2008). Other determinants of childhood undernutrition in developing countries include low maternal schooling (Ruel, Levin, Armar-Klemesu, Maxwell, & Morriss, 1999), living in a single-parent household (Bronte-Tinkew & DeJong, 2004), economic shocks to the household (Hoddinott & Kinsey, 2001), inadequate use of antenatal care (Gribble, Murray, & Menotti, 2009), low birthweight (Gribble et al., 2009), short periods of birth spacing (Gribble et al., 2009), rural areas of residence (Smith, Ruel, & Ndiaye, 2005), and poor access to services (Christiaensen & Alderman, 2004). Many of these factors are rooted in poverty, suggesting that a holistic and integrated approach to tackling childhood undernutrition over a life-course perspective is required. A previous study by Haddad et al., which modelled the relationship between both household and gross domestic product estimates of per capita income and childhood undernutrition in developing countries up to the 1990s, suggested that sustained income growth could lead to a sizeable reduction in undernutrition rates (Haddad, Alderman, Appleton, Song, & Yohannes, 2003). In this study, we use individual and household data from a more recent international study of childhood poverty to explore the relationship between alternative indicators of poverty and childhood undernutrition in developing countries. In so doing, we identify the potential contribution of poverty-alleviating strategies that lie at the heart of the MDG initiative to tackling childhood undernutrition.

## Methods

### *Study population*

This study uses data from the Young Lives international research project of childhood poverty. Young Lives is tracing the lives of approximately 12,000 children in Ethiopia, India (Andhra Pradesh), Peru and Vietnam over the timeframe set by the United Nations to assess progress towards the MDGs. The study countries were selected to reflect a wide range of cultural, political, geographical and social contexts. Detailed descriptive information on the study countries can be found on the Young Lives website ([www.younglives.org.uk](http://www.younglives.org.uk)). In each of the four study countries, approximately 2000 children aged between 6 and 17 months and approximately 1000 children aged between 7.5 and 8.5 years were recruited in 2002. In each country, a sentinel site sampling approach was employed whereby 20 sentinel sites were selected semi-purposively by local experts to represent a range of regions, policy contexts and living conditions, with oversampling of sites

covering poor areas (Wilson & Huttly, 2004). Within each site, 150 children (100 for the younger cohort and 50 for the older cohort) were selected by an equivalent of random sampling; the exact sampling procedure varied between sites because of topographical and administrative differences within and between countries, but was carefully documented to ensure a sample indistinguishable from one drawn at random from qualifying households, with reasonable control of bias (Wilson & Huttly, 2004). Children in both cohorts were followed up in 2006 with an attrition rate of less than 5% in all four countries (Outes-Leon & Dercon, 2008). The lives of children in both the younger and older cohorts are being examined in a multi-disciplinary way. Further details about the Young Lives study, its sampling and recruitment procedures, methodology and response rates are reported elsewhere (Outes-Leon & Dercon, 2008; Wilson & Huttly, 2004). For the purposes of the investigation reported in this paper, all analyses are restricted to children in the younger cohort in order to focus on the period of early childhood when interventions for tackling childhood undernutrition are likely to be most effective (Bhutta et al., 2008). Ethical clearance for data collection was obtained from the participating research institutions in the United Kingdom and each study country. Prior to data collection, informed consent was obtained from all study participants.

### *Anthropometric outcomes*

As part of the Young Lives study, children in the younger cohort had their heights measured and were weighed when they were aged between 6 and 17 months (survey one) and again when they were aged between 4.5 and 5.5 years (survey two). Child height (H) was measured to the nearest 0.1 cm using height boards made for the purpose. Child weight (W) was measured using calibrated child scales and recorded to the nearest 0.1 kg. These measures coupled with the age of the child, measured in days based on the birth and interview dates, enabled us to estimate height-for-age (H/A), weight-for-age (W/A) and weight-for-height (W/H). The anthropometric outcomes of stunted, underweight and wasted were subsequently calculated using the Epi-Info statistical package (Dibley, Goldsby, Staehling, & Trowbridge, 1987), and based on the World Health Organization, 2006 reference standards for assessing the growth and development of children (de Onis et al., 2007; World Health Organization, 2006). Children were classified as stunted if they had a height-for-age Z score  $< -2$ , underweight if they had a weight-for-age Z score  $< -2$  and wasted if they had a weight-for-height Z score  $< -2$ . All three of these anthropometric outcomes were calculated for survey one, whilst only the outcomes of stunted and underweight were calculated for survey two due to the absence of current World Health Organization reference standards for weight-for-height beyond 60 months of age (de Onis et al., 2007; World Health Organization, 2006).

### *Measures of living standards*

Alternative measures of living standards were incorporated into the Young Lives study. These were developed on the basis of evidence from a literature review of measures of childhood poverty in developing countries and descriptive analyses of relevant data sets, including the Demographic and Health Survey, the Living Standards Measurement Survey and the UNICEF Multiple Indicator Cluster Survey (Attawell, 2004; White, Leavy, & Masters, 2002). Information gathered from these preliminary reviews and analyses was used to inform the development of a broader conceptual framework for analysing the causes and consequences of childhood poverty (Attawell, 2004), building on previous work in this area by other social scientists (Brooks-Gunn & Duncan, 1997; García Coll &

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