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Young Lives
An International Study of Childhood Poverty

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Stefan Dercon
Alan Sanchez

Young Lives, Department of International Development, University of Oxford, Oxford OX1 3TB, UK

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Abstract

Both cognitive and non-cognitive skills matter to understand a child's opportunities and outcomes in adulthood. However, it is unclear how non-cognitive skills are produced and what the role played by household investments is in this process. Motivated by suggestions from the medical literature and by the skills formation model proposed by Cunha and Heckman (2007, 2008), in this paper we use longitudinal data from children growing up in developing country contexts to study the role of early nutritional history in shaping these skills. To do this, we link height-for-age at the age of 7 to 8 to a set of psychosocial competencies measured at the age of 11 to 12 that are known to be correlated with earnings during adulthood: self-efficacy, self-esteem and educational aspirations. The estimation procedure is OLS with community fixed effects, controlling for a wide array of factors that can be deemed as determinants of parental investments – including an extended set of household wealth controls. We find that height-for-age predicts the three observed psychosocial measures. Auxiliary estimations suggest that the nutrition effect found is unlikely to be mediated by the effect that under-nutrition can have on cognitive skills.

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The Authors

Stefan Dercon is Professor of Development Economics at the University of Oxford;
Alan Sanchez is an economist in the Research Divison of the Central Bank of Peru.
Contact: stefan.dercon@economics.ox.ac.uk and alan.sanchez@bcrp.gob.pe

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1. Introduction

Empirical evidence supports the idea that there are returns to non-cognitive skills (or psychosocial competencies) in the labour market: they offer better job opportunities and incomes. First, aspects such as attitude, communication skills, motivation and 'personality' are high on lists of the characteristics sought by employers (Bowles et al. 2001). Second, contemporaneous, self-reported, measures of self-esteem, self-efficacy, future-orientedness and the like are found to explain a substantial portion of the variation across earnings of otherwise similar individuals (Bowles et al. 2001; Cunha et al. 2006). Third, measures of non-cognitive skills observed during the childhood period – built using components from a behavioural problem index (antisocial behaviour, anxiety, depression and hyperactivity tests) – are found to predict education and labour market outcomes (Heckman et al. 2006). Relatedly, in papers by Cunha and Heckman (Cunha and Heckman 2007, 2008), the authors find evidence to support the notion that non-cognitive skills are shaped during the early stages of the life cycle and influenced by parental investments in the same way that cognitive skills are, and that complementarities arise across skills. This model has since been tested in other countries (Coneus et. al. 2011; Helmers and Patnam 2011), with researchers finding similar, albeit not fully consistent, evidence.[1] While the notion of a production function for non-cognitive skills seems plausible, the specific type of early household investments that play a role in the acquisition of these skills is yet to be characterised within the economics field.

This paper aims to contribute to this literature by posing one specific question: what are the roles of health and nutrition in the formation of non-cognitive skills? Specifically, we focus on children growing up in developing country contexts, where under-nutrition is widespread. As is already known, early nutrition has long-term cognitive implications (Glewwe et al. 2001; Alderman et al. 2006). There is also evidence from medical studies showing that children stunted at an early age behave differently to non-stunted children, being generally less sociable, more apathetic and less willing to explore when they are very young (Grantham-McGregor et al. 1999) and having behavioural problems later on (Chang et al. 2002; Walker et al. 2007). It therefore seems natural to test whether differences in early nutrition lead to differences in the acquisition of psychosocial competences.

Nutrition can be considered an input in the production function of non-cognitive skills. While recovering the parameters of this technology would be of interest, we consider this unfeasible due to the problem of unobserved inputs. Instead, to assess the relationship between nutrition and non-cognitive skills we use ordinary least square (OLS) methods, controlling for child and household characteristics that can be deemed as determinants of non-cognitive investments – a demand function approach. To do this, we link height-for-age at the age of 7 to 8 to psychosocial outcomes at the age of 11 to 12 years, using data from around 3,300

1 Cunha and Heckman (2008) find that parental investments and lagged non-cognitive skills predict current non-cognitive skills, whereas Coneus et. al. (2011), using data from German children, find that only lagged non-cognitive skills predict current non-cognitive skills. Helmers and Patnam (2011) use data from India and find that parental investments and lagged cognitive skills (but not lagged non-cognitive skills) predict current non-cognitive skills. Studies might not be fully comparable because parental investments and skills estimates are calculated on the basis of different measurement variables; also, children are not observed during the same age periods. In addition, in Helmers and Patnam (2011) the measurement variables used to estimate lagged non-cognitive skills are not the same as those used to measure current non-cognitive skills.

children drawn from the Young Lives country surveys in Ethiopia, India, Peru and Vietnam. To measure psychosocial competencies, we focus on survey-based indicators of self-esteem, self-efficacy and (educational) aspirations. While not a complete set of psychosocial competencies, the available indicators fit well within the literature since they have been found to be correlated with earnings during adulthood (Bowles et al. 2001) and to reflect important non-cognitive dimensions of adolescent development (Stajkovic and Luthans 1998; Trzesniewski et al. 2003; Goldsmith et al. 1997; Gutman and Akerman 2008).

In the first part of the empirical analysis we use a baseline specification that controls for child's age, gender, ethnicity and disability status; caregiver's age, gender, ethnicity and education; and household size, access to basic services, and holding of durable goods (among other aspects). In addition, the estimation includes community fixed effects to account for the role of time-invariant community characteristics. This initial set-up, while basic, controls for some of the key correlates of early under-nutrition, a feature intrinsically correlated to poverty. We use this specification to provide a first glance at the relationship of interest for each of the non-cognitive indicators.

In the next part of the analysis we proceed to check the robustness of the results. A main concern is that of unobservable household heterogeneity; while the initial specification controls for dimensions of household wealth traditionally observed in national household surveys, it does not directly account for the role of the household budget in driving parental investments in the child. Nor do the results control for the household psychosocial environment. This matters since poor parents as well as parents with low non-cognitive skills could be more likely to invest less in the human capital of their children. To deal with these aspects, we present results for an extended specification where we add as controls contemporaneous household consumption expenditure (in per capita terms), lagged household-level occurrence of shocks – as a measure of household vulnerability, another dimension of poverty – and measurements of maternal psychosocial competencies analogous to the outcomes (i.e., maternal aspirations for the child, self-efficacy and self-esteem) – to proxy for the household psychosocial environment. In addition, these estimations control for the (contemporaneous) body mass index (BMI) of the child – as a measure of current nutritional status.

We also consider the possibility that our results could be reflecting the impact of relative height on non-cognitive skills rather than the long-term implications of investing in early nutrition. That is, stunted children could have poorer non-cognitive skills simply because they are more likely to be bullied by their taller peers. Were this to be the case, a similar relationship between height-for-age and skills could be found even in populations of healthy children.[2] While this possibility can not be ruled out with the information at hand, we try to deal with this concern by re-estimating our model for sub-samples that only include communities where stunted children are not a minority, and, thus, are less likely to be treated differently because of their relative height.

Finally, we discuss to what extent the linkage between height-for-age and non-cognitive skills could be mediated by schooling performance. As suggested by the nutrition literature, height-for-age predicts both age of school enrolment (Glewwe and Jacoby 1995) and cognitive achievement (Alderman et al. 2006; Glewwe et al. 2001). In turn, a satisfactory school performance could improve a child's psychosocial competencies. We bring this aspect into the discussion by presenting results from auxiliary regressions that include lagged levels of

2 We thank Ingo Outes-Leon for pointing out this possibility.

reading skills, writing skills and age of school enrolment. Under some assumptions, this allows partialling-out of the effect that nutrition could have on non-cognitive skills through a cognitive achievement channel.

Main results are as follows. First, the correlation between height-for-age and the available measurements of non-cognitive skills is very robust. In the pooled sample, a marginal increase in height-for-age at the age of 7 to 8 years predicts higher levels of school aspirations, self-efficacy and self-esteem at the age of 11 to 12 years in the baseline and in the extended specification. Keeping other factors constant, an increase of one standard deviation in height-for-age increases school aspirations, self-efficacy and self-esteem by about 7.8 per cent, 5.8 per cent and 3.4 per cent of a standard deviation, respectively (extended specification). We do not reject the hypothesis that the nutrition effects estimated are the same across the four study countries, reinforcing our prior hypothesis that there is an underlying mechanism linking early nutritional investments and non-cognitive skills. While these results can not be interpreted in a causal sense, they are suggestive of a relationship between early under-nutrition and later psychosocial status.

Second, consistent with Dercon and Krishnan (2009), we find that household consumption per capita and maternal non-cognitive skills turn out to be the main correlates of a child's non-cognitive skills. Third, in terms of the possible channels through which lower height-for-age could negatively affect psychosocial competencies, results from auxiliary estimations suggest that at most only a small part of the nutrition effect can be expected to be mediated by a cognitive channel.

This paper is organised as follows. Section 2 provides a conceptual motivation of our study, sketches a simple human capital model to explain our ideas and describes the empirical methodology. Section 3 describes the data and provides a discussion on the validity and stability of the psychosocial indicators used in the estimations. Sections 4 and 5 present the main findings and robustness checks. Section 6 concludes.

2. Conceptual and empirical framework

2.1 Conceptual framework

There are two strands of the literature on human capital accumulation that are relevant to this study. The first one is the literature on early child development, which stresses the importance of nutritional investments during the *in utero* period as well as during the first three years of life as causally linked to later cognitive achievement, educational attainment, productivity and wages (Alderman et al. 2006; Almond 2006; Glewwe et al. 2001; Grantham-McGregor et al. 1991; Grantham-McGregor et al. 1997; Pollitt et al. 1993; Maluccio et al. 2009). The case made by these studies is based on evidence from low-income countries, where mild and severe malnutrition is still widespread. A second strand of the literature is the one initiated by Cunha and Heckman (2007, 2008), later extended in Cunha et al. (2010). The authors develop a conceptual framework to understand the accumulation of human capabilities and the novelty of their approach is the explicit incorporation of non-cognitive skills in a model of human capital accumulation. They assume that both cognitive and non-cognitive skills are produced on the basis of household investments, the influence of environment and innate endowments. They establish the notion that cognitive and non-cognitive skills are self-reinforcing and that complementarities across skills can arise over time. To test this model, they use longitudinal data from children growing up in the USA, finding evidence of both self-productivity and complementarity across both types of skills.

In this study, we aim at linking these two strands of the literature. In particular, we argue that the skills formation model proposed by Cunha and Heckman (2007) misses one key feature highlighted in the early childhood development literature: the role of early nutrition. By explicitly incorporating a physical health stock in the skills formation model, it is possible to illuminate different pathways through which early nutrition could be driving the accumulation of non-cognitive skills, a linkage already suggested in the medical literature (Grantham-McGregor et al. 1999; Chang et al. 2002).

To set up ideas about the hypothesised relationship between physical health and non-cognitive skills, we sketch a human capital technology where these two variables are explicitly linked. Denote the stock of psychosocial competencies (hereafter, non-cognitive skills) in a given period t as S_t^P. Suppose S_t^P is acquired through the following technological process,

$$S_t^P = f^P(H_{t-1}, S_{t-1}^C, S_{t-1}^P, I_t^P) \quad (1)$$

where H_{t-1}, S_{t-1}^C and S_{t-1}^P stand for health, cognitive and non-cognitive skills accumulated up to t-1 (respectively), I_t^P denotes contemporaneous parental investments in psychosocial skills and $t = 1,2,\ldots,T$. An analogous equation can be defined for the production of cognitive skills in period t,

$$S_t^C = f^C(H_{t-1}, S_{t-1}^C, S_{t-1}^P, I_t^C) \quad (2)$$

whereas health can be assumed to be determined purely in terms of lagged health and health parental investments,

$$H_t = f^H(H_{t-1}, I_t^H) \quad (3)$$

This framework follows closely the skills formation model proposed by Cunha and Heckman (2007, 2008), but is extended to account for the role of lagged health and nutrition. In particular, the sketched technology features a situation in which past health and nutrition act as an input for current cognitive and non-cognitive skills. Given that this model allows for skills complementarities, this implies that the effect of past health, H_{t-k}, on S_t^P is direct as well as indirect, through the effect that health has on S_{t-1}^C and S_{t-1}^P between periods $t-k$ and $t-1$. Another essential feature of this technology is that the accumulation of non-cognitive skills is shaped by parental investments, $I_t = (I_t^H, I_t^P, I_t^C)$. The optimal allocation of I_t over $t = 1,2,\ldots,T$ can be modelled as part of a maximisation problem whereby parents decide how to allocate resources between consumption and investments in the child over time, subject to preferences, budget constraints and initial conditions. Initial conditions can include child and household exogenous characteristics that affect the rate of return of these investments. Note that some of these initial conditions (child's innate cognitive and non-cognitive abilities, household environment) are likely to be unobserved, an aspect that is further discussed below. Assuming the utility function and equations 1, 2 and 3 satisfy the regularity conditions, a maximisation process would yield optimal allocations for consumption and investments as a function of preferences, prices and initial conditions.

2.2 Empirical framework

Our empirical analysis focuses on one dimension of physical health: nutritional status. We aim at testing the relationship between non-cognitive skills in a given period t and the nutritional history of a child up to period $t-1$. For us, t represents the late childhood period and $t-1$ the mid-childhood period, so that several years separate t from $t-1$. While we use the previously sketched model as a conceptual framework, we lack information to estimate the skills production function. For instance, we do not observe S_{t-1}^{P}. More generally, we consider the estimation of human capital production functions to be problematic because many inputs at the child, household, school and community level not considered in our sketched model, but that can realistically alter S_t^P, are unobserved by the econometrician, implying that technology parameters are difficult to recover. Thus, for the empirical estimation we choose to take a different route. We estimate the relationship between lagged nutrition and non-cognitive skills by OLS, including community fixed effects and controlling for a number of characteristics that can be deemed as determinants of parental investments. Specifically, for child i born in cluster[3] j we estimate the following linear equation,

$$S_{ij,t}^{P} = \beta H_{ij,t-1} + X_{ij,t}\Gamma + \alpha_j + \mu_{ij,t}^{1} \tag{4}$$

where $S_{ij,t}^{P}$ is a non-cognitive outcome observed in period t; $H_{ij,t-1}$ is lagged nutrition; α_j represents cluster characteristics that are constant over time; $X_{ij,t}$ is a vector of child and household predetermined characteristics; and $\mu_{ij,t}^{1}$ is the error term. Note that this estimation is similar in essence to a demand function for non-cognitive skills where inputs other than nutrition are replaced by their determinants. This `hybrid' equation is commonly used in the early childhood development literature.

Omitted variable bias is likely to be a problem in this specification since there are determinants of parental investments that are unobserved by the econometrician. To illustrate in more detail,[4] consider the following disaggregation of the error term from equation 4: $\mu_{ij,t}^{1} = c_i^1 + h_i^1 + \varepsilon_{ij,t}^{1}$, where c_i^1 and h_i^1 stand for child and household unobserved, time-invariant, characteristics that determine non-cognitive investments and $\varepsilon_{ij,t}$ is iid noise. Specifically, c_i^1 is meant to represent a child's inherent psychosocial skills, whereas h_i^1 captures the psychosocial environment of the household. Next, consider the following definition for lagged nutrition,

$$H_{ij,t-1} = Z_{ij,t-1}\Theta + \alpha_j + \mu_{ij,t-1}^{2} \tag{5}$$

where $Z_{ij,t-1}$ are observed determinants of lagged nutrition (that might or might not be included in $X_{ij,t}$) and $\mu_{ij,t-1}^{2} = c_i^2 + h_i^2 + \varepsilon_{ij,t-1}^{2}$, where c_i^2 and h_i^2 are meant to reflect aspects such as a child's inherent healthiness and household health environment, respectively. Within this model, endogeneity is likely to arise due to correlation between the unobserved elements that determine nutrition and non-cognitive investments. First, households with a better health environment could have a better psychosocial environment, which implies that $E(h_i^1, h_i^2) \neq 0$. Second, parents who invest more in inherently healthier children might also invest more in children with better social skills, which implies that $E(c_i^1, c_i^2) \neq 0$. Third, note that $E(c_i^1, c_i^2) \neq 0$ might also happen for genetic reasons.

3 Community and cluster are used as synonymous throughout the paper.

4 The following discussion is similar in structure to that presented by Alderman et al. (2006) to discuss the role of unobservables in the estimation of the nutrition–cognition nexus.

In this investigation, we can only imperfectly deal with these sources of endogeneity. In particular, we lack the means to deal with endogeneity due to child-level unobservables. On the other hand, we make use of the wealth of information available in the Young Lives surveys (see next section) in two ways. First, to ensure that $X_{ij,t}$ contains as much information as possible in terms of predetermined child and household characteristics. Second, in order to alleviate concerns of endogeneity due to household-level unobservables we resort to proxy variables of the household psychosocial enviroment. The variables considered for this purpose are enumerated later, once the data is presented.

3. Data characteristics

3.1 The sample

Data come from Young Lives, a study tracking the lives of eight cohorts of children in four countries: Ethiopia, India (Andhra Pradesh), Peru and Vietnam. There are two age cohorts in each country. In this paper we concentrate on the Older Cohort, which consists of approximately 1,000 children from each country (700 in Peru) born in 1994–5. To select the children, a multi-stage sampling procedure was used. Firstly, 20 clusters were selected within each country; at random in Peru and based on a number of predetermined criteria in the other three countries.[5] Secondly, within each cluster, a village/town (or a group of villages/towns) and a group of eligible households within each village/town was chosen at random, respectively.[6] For simplicity, onwards we use the terms cluster and community indistinguishably.

While the samples (with the exception of Peru) were not selected to be nationally representative, their wide geographical and ethnic coverage make them informative of the living conditions faced by the population in each of the selected countries. Approximately 50 households were selected in each village/town or group of villages/towns and in-depth information was collected for the eligible child (aged 7 to 8 at the time of the baseline survey) within each household.[7] The sampled children and their caregivers were interviewed twice: in 2002, when they were aged 7 to 8 years; and, in 2006–7, when they were aged 11 to 12 years.[8] The survey provides information on a variety of aspects related to child development, including child and maternal indicators of perceptions, attitudes and aspirations, child cognitive test scores, child and maternal anthropometric measures, as well as a wide array of information on child, family and other contextual characteristics. Attrition in the samples is exceptionally low: only 1.4 per cent of the children were lost or dropped out in the samples between the two rounds on average, with the Peru sample facing attrition of 3.5 per cent and the Vietnam sample only 0.5 per cent.

5 Clusters are small geographical units. The exact definition depends on the country (districts in Peru, communes in Vietnam, *mandals* in Andhra Pradesh and *woredas* in Ethiopia).

6 The household eligibility criterion consisted in having a child aged 7 to 8 years old at the time of the first survey round.

7 If there was more than one eligible child, the final selection was made at random.

8 They have since been interviewed at the age of 15 and will be surveyed again at the ages of 18 to 19 and 21 to 22 but this paper analyses data relating to their mid- and late childhood.

3.2 Measurements variables

3.2.1 Under-nutrition

Crucial to the analysis is the availability of a valid measurement of early nutritional investments. As a proxy we use physical height observed at the age of 7 to 8. This variable is informative of height at an earlier age, and linear growth retardation at the first few years is, primarily, the result of an inadequate nutrition over an extended period of time – in this case, the period between gestation and the age of 2 (Martorell 1999). Thus, height-for-age at 7 to 8 is reasonably informative of the history of early nutritional investments. We use the growth curves reference for school-aged children recently developed by the World Health Organization (WHO 2007 standards). Based on this growth reference, a child of a given age and gender is catalogued as moderately stunted (chronically malnourished) if her (his) height is ranked two standard deviations below the median height corresponding to a well-nourished child of the same age and gender; severely stunted is the analogous term when child's height is three standard deviations below the norm. For the purpose of calculation, this implies re-expressing height-for-age in terms of height-for-age z-scores. In the Young Lives country samples, the percentage of children classified as moderately stunted at 7 to 8 years old fluctuates around 30 per cent (see Table 1). For the estimations, we chose to use the height-for-age variable in its continuous form (as opposed to the binary variable based on the <-2 SD cut-off point) to fully exploit the information conveyed by this variable.

Table 1. *Young Lives sample poverty levels and nutritional rates by country*

	Peru (1)	India (2)	Vietnam (3)	Ethiopia (4)
Indicators of poverty				
Relative poverty (%)	25.5	6.8	9.5	9.9
Wealth index	0.51	0.34	0.44	0.17
Nutritional status				
Percentage of stunted children				
11–12 years	28.7	32.3	29.7	29.0
7–8 years	26.3	31.6	27.4	31.4

Notes: Relative poverty is defined as the proportion of households with per capita consumption below 50 per cent of country median consumption. The wealth index used comprises information on housing quality, holding of consumer durables and access to services. Source: Young Lives country reports and own estimations.

3.2.2 Measurements of psychosocial traits

Using survey data, we construct a set of indicators that intend to approximate children's competencies in the following non-cognitive dimensions: (a) self-efficacy; (b) self-esteem; and, (c) aspirations. These dimensions have all been found to correlate well with future social and economic opportunities. Within the economic literature, see Bowles et al. (2001) for a summary of the evidence about the relationship between self-efficacy, self-esteem and earnings. On a different front, the psychological literature (Stajkovic and Luthans 1998; Trzesniewski et al. 2003; Goldsmith et al. 1997; Gutman and Akerman 2008) highlights that the selected non-cognitive dimensions are thought to be shaped early in life, to be heavily influenced by experiences and the environment and to become more stable as adolescence is reached. The influence of genes as a determinant has not been ruled out.

The concepts of self-esteem and self-efficacy have been extensively studied in the field of psychology, particularly the former. Self-esteem is related to a person's overall evaluation of her own worth. In turn, self-efficacy is related to a person's sense of agency or mastery over his life. Individuals hold beliefs about whether outcomes are due to their own efforts or the result of luck, fate, or the intervention of others. Individuals who believe that outcomes are due to their own efforts have a high 'internal' locus of control (Maddux 1991), i.e., a high sense of agency.

To measure these two psychosocial traits, we estimated indicators based on respondents' degree of agreement or disagreement with a number of statements. The degree of agreement is measured on a 4-point Likert scale that ranges from strong agreement to strong disagreement. In turn, answers to these statements are used to construct individual average scores on self-efficacy and self-esteem. Statements used for the construction of each index were drawn from the educational psychology literature, although they were adapted and extensively tested during piloting for use with children across different cultures.

For self-esteem, the statements explored in the Young Lives survey focused largely on positive and negative dimensions of pride and shame. They are effectively an adapted version of the Rosenberg Self-Esteem Scale (Rosenberg 1965), more focused on specific dimensions of children's living circumstances (housing, clothing, work, school): 'I feel proud to show my friends or other visitors where I live', 'I am ashamed of my clothes', 'I feel proud of the job done by the head of my household', 'I am often embarrassed because I do not have the right books, pencils or other equipment for school', 'I am proud of my achievements at school', 'I am embarrassed by/ashamed of the work I have to do', 'I am ashamed of my shoes', 'I am worried that I don't have the correct uniform' and 'The job I do makes me feel proud'. The self-esteem index is the average score of the above items (with negative statements recoded in the inverse order).

In the case of self-efficacy, we focused on five statements explored in the Young Lives survey: 'If I try hard, I can improve my situation in life', 'Other people in my family make all the decisions about how I spend my time', 'I like to make plans for my future studies and work', 'I have no choice about the work I do – I must do this sort of work' and 'If I study hard at school, I will be rewarded by a better job in future'. The self-efficacy index is the average score of these items. Histograms of both indicators are reported in Figure A1 in the appendix.[9]

One concept often assessed in the context of psychological tests is internal consistency (sometimes called reliability or homogeneity). The notion is that, in a homogenous psychological test, items measure the same thing (Cronbach 1951). The Cronbach's alpha, a statistic based on the correlation of different items of the same test, is deemed a test of internal consistency in the sense that a relatively high alpha (above 0.70) supports the notion that there is a common factor behind answers to different items. In our analysis we obtain values of 0.89 and 0.95 for the self-efficacy and self-esteem indicators in the pooled sample, respectively.

Another competence that interests us is related to a child's aspirations. Quaglia and Cobb (1996) define aspirations as the 'ability to identify and set goals for the future, while being inspired in the present to work toward those goals'. As with self-esteem and self-efficacy, this dimension is considered to be shaped early in life and is correlated with better economic and

9 Both indicators are standardised to have mean 0 and variance 1 within each country.

social outcomes during adulthood (Gutman and Akerman 2008). Because of the age-period in which the sampled children are observed we focus on educational aspirations as the outcome of interest, measured by asking the child how far she hopes to get in educational terms.[10] The answer is expressed in equivalent years of education, asking for the highest grade of education that the child hopes to complete. Table 2 gives the mean educational aspirations for each country with the standard deviation in brackets. A histogram of this variable is reported in Figure A1 for the pooled sample.[11]

Table 2. *School aspirations: descriptive statistics*

	Peru (1)	India (2)	Vietnam (3)	Ethiopia (4)	All (5)
Mean	15.14	15.06	15.64	15.42	15.33
SD	(1.83)	(3.00)	(2.48)	(2.73)	(2.60)
n	640	860	936	855	3,291

Notes: School aspirations are expressed in terms of the number of years of schooling the child hopes to get.

4. Main results

Table A1 (in the appendix) reports simple pair-wise correlations between height-for-age and the three selected psychosocial indicators. Results are reported by country and for the pooled sample. In the pooled sample, the correlation is positive and statistically significant for all the psychosocial dimensions included. On a country-by-country basis, we find that height-for-age is positively correlated to school aspirations in all countries; and to self-esteem and self-efficacy in Peru, India and Vietnam. In all cases, the sign of the effect is positive, as expected.

To empirically assess the role of nutritional status in later acquisition of psychosocial competencies, we proceed to regress each of the selected measurements on lagged height-for-age as in equation 5, which is reported again for convenience:

$$S^P_{ij,t} = \beta H_{ij,t-1} + X_{ij,t}\Gamma + \alpha_j + \mu^1_{ij,t}$$

$S^P_{ij,t}$ stands for non-cognitive skills measured at 11 to 12 years (aspirations, self-efficacy and self-esteem) of child i from cluster j measured in period t; $H_{ij,t-1}$ stands for height-for-age at 7 to 8 years; we use community fixed effects to deal with community heterogeneity represented by α_j; the elements incorporated in $X_{ij,t}$ in the baseline specification are: (a) child's gender, age, birth order, disability status and mother tongue; (b) caregiver's relationship to the child, age, years of education, ethnicity (caste in India), marital status and disability status; and, (c) household size, gender of the head of the household, housing quality (wall, floor and roof building materials) and access to services (water, electricity and toilet facilities).

10 The exact question was: 'Imagine you had no constraints and could stay at school as long as you liked. What level of formal education would you like to complete?'

11 Variables are standardised to have mean 0 and variance 1 within each country.

The nutrition marginal effects obtained from estimating this baseline specification are reported in Table A2 (see appendix), columns 1 to 3, for the pooled sample and for each of the study countries. Focusing on the pooled sample, we find that height-for-age remains associated with school aspirations, self-efficacy and self-esteem. Because variables on both sides of the regression are standardised with mean 0 and variance 1, the nutrition marginal effects can be interpreted in terms of the proportion of the standard deviation of the outcomes explained by height-for-age. An increase of one standard deviation in height-for-age, keeping everything else constant, tends to increase school aspirations, self-efficacy and self-esteem by 10.4 per cent, 6.4 per cent and 5.1 per cent of the standard deviation of school aspirations, self-efficacy and self-esteem scores, respectively. F-tests are reported to assess the null hypothesis that the nutrition effect is the same across countries. The hypothesis is only rejected in one case (school aspirations) at the 10 per cent level and as additional controls are added – see section 5 – the hypothesis is never rejected. This reinforces the notion that there is an underlying mechanism linking height-for-age and non-cognitive skills that is common across countries.

5. Robustness checks and other considerations

There are different reasons why the first set of results might be overstating the overall effect of nutritional status on the development of non-cognitive skills. First, malnutrition is more likely to arise in the context of materially deprived families and poverty could also play a role in shaping psychosocial competencies. Since the baseline specification imperfectly controls for household monetary resources, it could be the effect of household income level acting as a constraint in the rate of return of child investments and not a child's own nutritional history that is driving the previous findings. Second, related to the nature of the unobservables discussed in section 2.2 (above), the unobserved household psychosocial environment could bias the result if it is correlated with the household health environment. Third, we also consider the possibility that height-for-age could be correlated with concurrent, short-term nutritional problems (low or, indeed, high weight relative to age/height). We are not aware of a relationship between concurrent nutritional deficits and psychosocial outcomes. There is evidence in the opposite direction however, linking obesity to the development of social skills (Cawley and Spiess 2008). In either case, we would like to disentangle concurrent nutritional problems from the nutritional history of a child. It is the latter that is of interest in this investigation.

To deal with these possibilities we present results for an extended specification. To disentangle more effectively the effect of past under-nutrition on non-cognitive skills from the effect that living in a poor household has on the same outcomes, we include contemporaneous household consumption expenditure (in per capita terms, expressed in logs) and also add controls for household vulnerability to a variety of economic shocks (natural disasters, changes in food availability, livestock died, crop failed, livestock stolen, crop stolen, job loss, loss of family income, severe illness or injury of one member of the family).[12] To deal with the potential influence of household psychosocial environment we

12 Reported when the child was aged 7 to 8 years.

resort to proxy variables. We add caregiver psychosocial indicators to proxy for the household environment in which the child develops her psychosocial competencies. These indicators are analogous versions to those defined for the child, constructed on the basis of statements reflecting the caregiver's competencies in the areas of self-esteem and self-efficacy. In the case of educational aspirations, it measures the number of years of education the caregiver hopes her child will achieve. Finally, to control for short-term nutritional deficits we add contemporaneous child body mass index as a control in the estimation.

A summary of the nutrition effects re-estimated after adding these additional controls is presented in Table A2, columns 4 to 6. Also, Table A3 reports the marginal effects of a selected set of controls for the pooled sample estimations, with all the variables standardised to have mean and variance equal to 0 and 1 (respectively). Coefficients are of a lesser magnitude, as expected. Comparing the baseline specification to the extended one, the point estimates of the nutrition effects in the pooled sample reduce from 0.104 to 0.078 for school aspirations, from 0.064 to 0.058 for self-efficacy and from 0.051 to 0.034 for self-esteem. In all cases, results remain statistically significant at standard levels.[13]

Two other results are worth highlighting. First, household consumption expenditure is found to be a strong correlate of non-cognitive skills (Table A3). Since household income plays a role in the determination of nutritional status, it is natural that some of our previous results might lose strength once we control for it. Second, maternal non-cognitive skills (the caregiver is, typically, the mother) turn out to be the most important correlate of the child's non-cognitive skills. These results are consistent with Dercon and Krishnan (2009). The standardised coefficients for each of the selected maternal indicators (maternal aspirations for the child, self-esteem and self-efficacy respectively) on the analogous child indicators are 0.385, 0.272 and 0.107, respectively. Caution is needed, however, in interpreting this result. Since maternal aspirations are measured contemporaneously to the child psychosocial measures, there could be a problem of reverse feedback.[14] Therefore, one should not give a causal interpretation to this result.

5.1 The role of relative height

As a final check, we consider an alternative interpretation of our results that, were it to be valid, would alter our conclusions. Given that we use height-for-age as a measure of long-term nutritional status, it is possible that our results could just be reflecting the impact of relative height on non-cognitive skills instead of the long-term implications of investments in early nutrition. This line of interpretation takes seriously the role of peers in determining a child's non-cognitive skills. For instance, if relatively short children are more likely to be bullied at school, this could explain why stunted children (if they are indeed a minority) have poorer non-cognitive skills. But, were this to be the case, a similar relationship between height-for-age and non-cognitive skills could be found even in populations of healthy children. While it is impossible to entirely rule out this possibility with the available information, we try to take it into account by re-estimating our model for sub-samples where only children living

13 In a previous version of this paper current school attendance was added as an additional control in the extended specification. The logic of its inclusion was that it is at school where a child socially interacts with other children of her age, which implies that not being enrolled could be correlated both with malnutrition and psychosocial dimensions of the child. The problem with this control was its endogenous nature. Although not included in this version of the paper, it is important to mention that, when included, the nutrition effect for self-efficacy reduces to 0.034 (from 0.037) and it becomes borderline insignificant at the 10 per cent level.

14 A mother's aspirations for her child could be contaminated by the child's own aspirations.

in communities where stunted children are not a minority are included. Doing this reduces the likelihood that stunted children could be treated differently because of their relative height. The average community in the sample includes 50 children and many of these children are, in practice, school peers. For our purpose, we focus on communities where more than 25 per cent of children are stunted (results with a 10 per cent threshold are also reported). Estimation results are reported in Table A4 (in the appendix). Results remain very similar in these alternative specifications in terms of the point estimates.

5.2 The role of cognitive achievement

To be consistent with the human capital model sketched in section 2, it is important to discuss whether part of the nutrition effect on skills could be exerted indirectly through the effect that nutrition has on schooling dimensions that in turn can act as inputs of non-cognitive skills. This is likely to be the case. Compared to well-nourished children, malnourished children are more likely to spend less time in school due to delayed enrolment (Glewwe and Jacoby 1995) and are more likely to attain a low academic performance (Alderman et al. 2006; Glewwe et al. 2001). In turn, these aspects can arguably have a detrimental effect in the acquisition of non-cognitive skills due to the existence of complementarities across skills. This implies that the nutrition effect might be partially or entirely explained by the effect of nutrition on the age of school enrolment and/or on cognitive skills.

Whether or not this is the case is problematic to assess empirically. First, adding cognitive outcomes into the estimation amplifies the endogeneity problem. Second, the cognitive and schooling-related dimensions to be included should be observed some time between $t-1$ (7 to 8 years) and t (11 to 12 years) to avoid the problem of reverse feedback. Unfortunately, this intermediate period is not observed in our data. We only have information from two cognitive outcomes measured in $t-1$: writing skills and reading skills. We also observe the age of school enrolment.

With these caveats in mind, we report results adding these lagged cognitive outcomes as controls. Our justification is that height-for-age at the age of 7 to 8 conveys information mainly about nutritional investments that take place during the early childhood period, whereas the acquisition of writing and reading skills as well as the timing of school enrolment reflect investments that happen at a later stage. Although the assumption is strong, under this scenario the nutrition effect obtained after introducing these variables into the estimation can be considered informative.

To proceed, we create binary variables that take the value of 0 if the child has a low (undesirable) level of a certain input (low reading skills, low writing skills or school enrolment off-age) and 1 otherwise. A child is considered to have high reading skills if able to read sentences (as opposed to only words or letters, or not being able to read at all) and high writing skills if able to write without difficulty and without errors.[15] While these are crude measures of schooling achievement, they are relevant in the context of low-income countries, where a significant proportion of children are unable to read and write properly. The proportions of children with low reading and writing skills in the pooled sample are 41 per cent and 49 per cent, respectively. Similarly, 25 per cent of the sampled children are off-age (i.e., they were enrolled in school after the norm-age).

15 In each country, children were asked to read letters, words and sentences from a card and to write sentences under the supervision of the interviewer.

Results are reported in Table A5.[16] Both reading and writing skills at the age of 7 to 8 years are found to be predictors of the selected psychosocial indicators. The nutrition effect obtained in the extended specifications is smaller in both cases: moving from 0.083 to 0.071 in the case of school aspirations; from 0.054 to 0.047 in the case of self-efficacy; and, from 0.031 to 0.021 in the case of self-esteem. With the caveats mentioned above, if these new coefficients are interpreted as net of the effect that early nutrition has on cognitive skills then the change in the point estimates does not seem to be large enough to claim that the nutrition effect is mediated through a cognitive achievement channel.

We focused on the cognitive channel of transmission to be consistent with our conceptual model. However it is important to highlight that there could be other pathways through which the nutrition effect found is mediated that can not be explored because of data constraints. In particular, it is possible that well-nourished children attract more skills-related investments within the household and at school. Although the analysis only makes it possible to estimate the overall effect of nutrition on the acquisition of psychosocial competencies, and, thus, it is not possible to fully elucidate if there are biological effects (i.e., effects of under-nutrition on brain structure, which governs behaviour), we believe our results significantly improve the understanding of the process of skills formation in the context of developing countries while at the same time highlighting a relatively unknown long-term implication of under-nutrition.

6. Conclusions

Empirical evidence and common sense indicate that non-cognitive skills are rewarded in the labour market, in the same way that cognitive skills are. Although it is relatively well understood how cognitive skills are produced, the analogous process for non-cognitive skills has hardly been explored. Based on suggestions from the medical literature, we test the role of nutrition in shaping non-cognitive skills during early stages of the life cycle. We find evidence of a robust, positive, correlation between height-for-age measured during mid-childhood (7 to 8 years of age) and non-cognitive skills measured during the last stage of childhood (age 11 to 12, just before adolescence begins).

Although we are only equipped to show association, in our specification we control for a wide range of potential confounders. Even if poverty is ultimately likely to govern the process, the nutrition effect estimated is net of the direct effect that monetary poverty has on non-cognitive skills (which is also found to be strong). Results also control for maternal non-cognitive skills, which reduces the probability that the nutrition–skills linkage found is the result of an inter-generational mechanism whereby poor mothers with low non-cognitive skills raise malnourished children with low non-cognitive skills. Finally, we find that the nutrition effect is unlikely to be explained by the effect that nutrition has on schooling achievement.

16 Note that the sample is smaller than that used in the previous estimations. This is because of missing observations in the reading and writing tests (84 missing observations). Despite this, the same patterns found when using the original sample are also found in this new sample.

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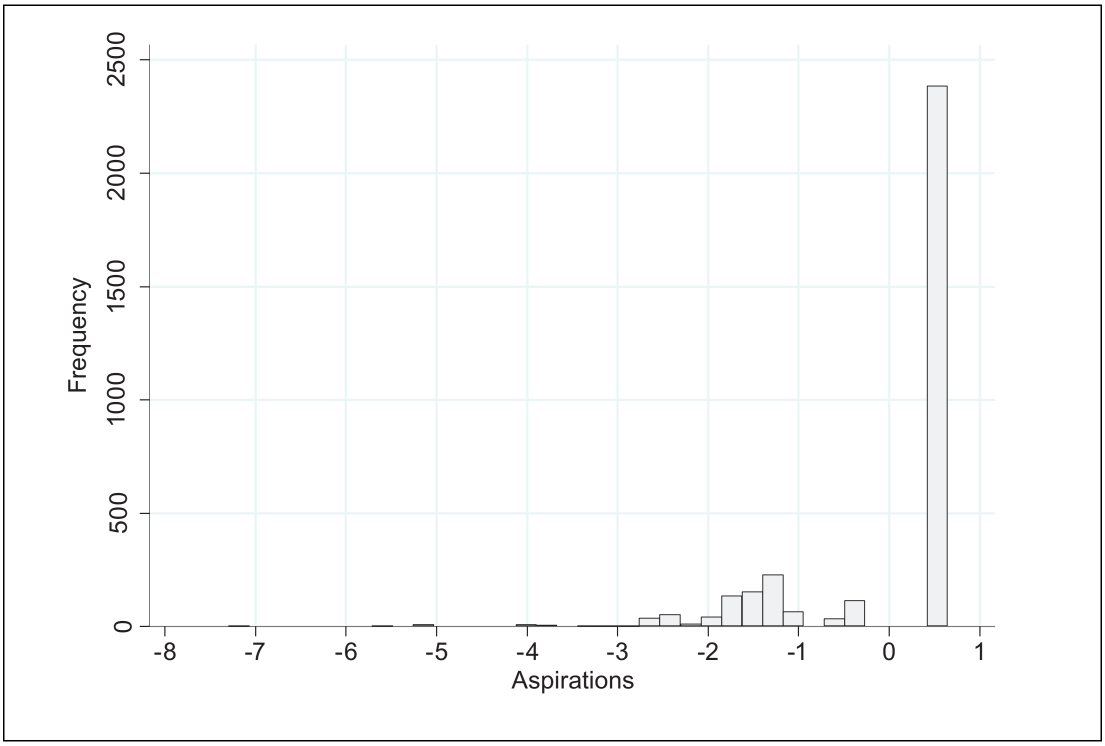
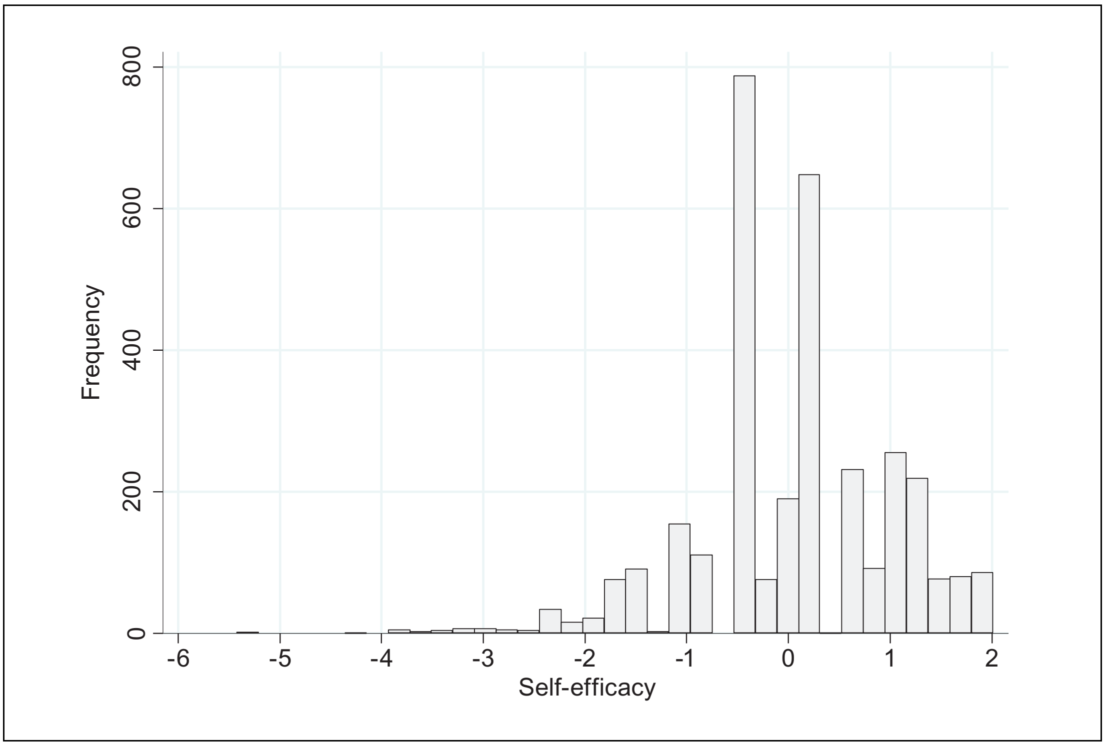
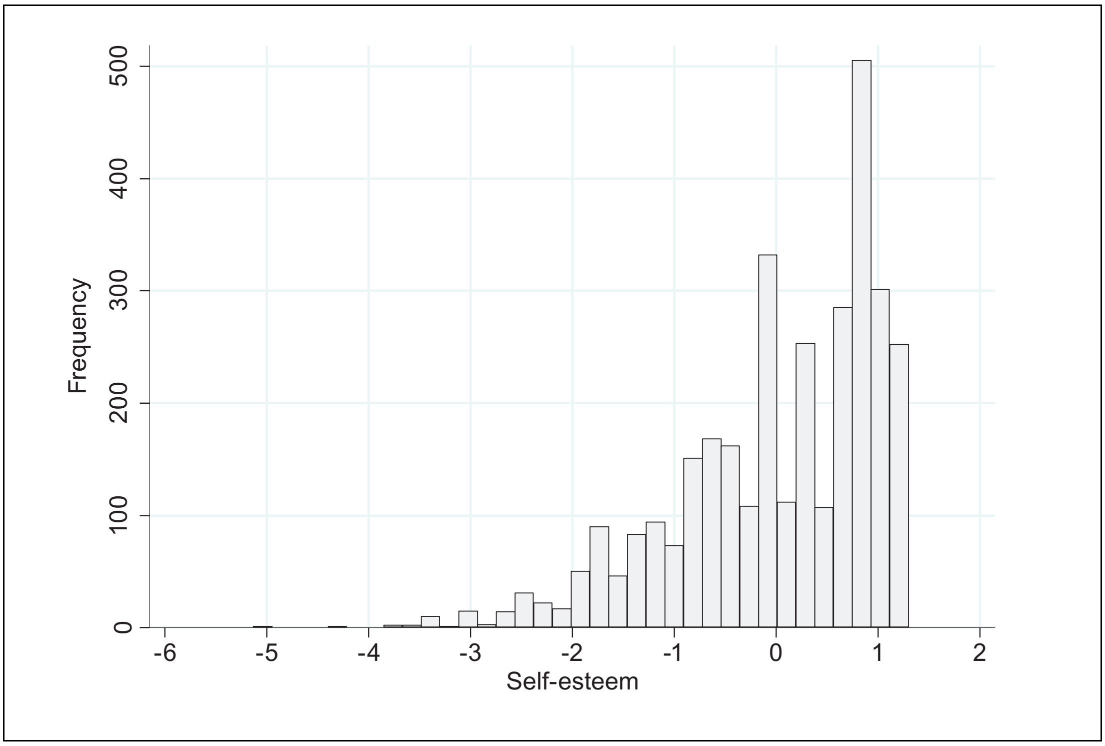
Appendix: Supporting figures and tables

Figure A1. *Aspirations, self-efficacy and self-esteem: histograms for the pooled sample*







Note: All variables were standardised to have mean 0 variance 1 in each country.

Table A1. *Simple pair-wise correlations: non-cognitive skills at age 11 to 12 and height-for-age at age 7 to 8*

	n	School aspirations (1)	Self-efficacy (2)	Self-esteem (3)
Pooled sample	3,291	0.164 (0.028)***	0.07 (0.018)***	0.101 (0.026)***
Country samples				
Peru	640	0.131 (0.048)***	0.102 (0.053)*	0.284 (0.063)***
India	860	0.126 (0.037)***	0.051 (0.023)**	0.088 (0.034)**
Vietnam	936	0.232 (0.078)***	0.083 (0.024)***	0.096 (0.046)**
Ethiopia	855	0.15 (0.033)***	0.052 (0.046)	−0.020 (0.05)
F-test of equality of coefficients*				
F		2.22	0.54	3.59
p-value		0.092	0.674	0.017
Core controls		No	No	No
Cluster fixed effects		No	No	No
Additional controls		No	No	No

Note: Variables are standardised to have mean 0 and variance 1. Each cell represents a different regression. Robust clustered standard errors are reported in brackets; *, **, *** denote significance at 10%, 5% and 1% levels.
*The null hypothesis of the test is that the nutrition effect is the same across countries.

Table A2. *OLS results: non-cognitive skills at age 11 to 12 and height-for-age at age 7 to 8 (main results)*

	n	Baseline specification			Extended specification		
		School aspirations (1)	Self-efficacy (2)	Self-esteem (3)	School aspirations (4)	Self-efficacy (5)	Self-esteem (6)
Pooled sample	3,291	0.104	0.064	0.051	0.078	0.058	0.034
		(0.018)***	(0.018)***	(0.018)***	(0.019)***	(0.019)***	(0.017)**
Country samples							
Peru	640	0.079	0.037	0.103	0.06	0.045	0.097
		(0.047)*	(0.065)	(0.039)***	(0.046)	(0.066)	(0.042)**
India	860	0.058	0.052	0.04	0.037	0.041	0.027
		(0.039)	(0.019)***	(0.027)	(0.044)	(0.025)	(0.029)
Vietnam	936	0.109	0.109	0.066	0.067	0.091	0.029
		(0.029)***	(0.034)***	(0.038)*	(0.027)**	(0.038)**	(0.037)
Ethiopia	855	0.129	0.048	0.013	0.117	0.043	0.012
		(0.031)***	(0.036)	(0.042)	(0.038)***	(0.036)	(0.037)
F-test of equality of coefficients*							
F		2.64	0.70	0.59	1.98	0.81	0.85
p-value		0.055	0.557	0.624	0.123	0.494	0.471
Core controls		Yes	Yes	Yes	Yes	Yes	Yes
Cluster fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
Consumption expenditure		No	No	No	Yes	Yes	Yes
Household shocks		No	No	No	Yes	Yes	Yes
Child's BMI		No	No	No	Yes	Yes	Yes
Maternal non-cog. skills		No	No	No	Yes	Yes	Yes

Note: Variables are standardised to have mean 0 and variance 1. Each cell represents a different regression. Robust clustered standard errors are reported in brackets; *, **, *** denote significance at 10%, 5% and 1% levels. Core controls include: housing quality index, access to services index, caregiver's age, caregiver's highest grade of schooling reached, whether caregiver is the mother, caregiver's disability status, gender of the head of the household, household size, child's age, child's gender, child's disability status, child's birth order, area of residence (urban/rural), child's mother tongue, mother's mother tongue and mother's caste (in India).

*The null hypothesis of the test is that the nutrition effect is the same across countries.

Table A3. *OLS pooled sample, detailed: non-cognitive skills at age 11 to 12 and height-for-age at age 7 to 8*

	Baseline specification			Extended specification		
	School aspirations	Self-efficacy	Self-esteem	School aspirations	Self-efficacy	Self-esteem
	(1)	(2)	(3)	(4)	(5)	(6)
Height for age z-score, age 7–8	0.104 (0.018)***	0.064 (0.018)***	0.051 (0.018)***	0.078 (0.019)***	0.058 (0.019)***	0.034 (0.017)**
Caregiver's years of schooling	0.089 (0.023)***	0.043 (0.021)**	0.132 (0.022)***	0.039 (0.022)*	0.024 (0.021)	0.082 (0.02)***
Access to services	0.097 (0.027)***	0.063 (0.03)**	0.102 (0.026)***	0.049 (0.027)*	0.039 (0.03)	0.07 (0.026)***
Log-consumption per capita				0.073 (0.02)***	0.048 (0.02)**	0.07 (0.019)***
Caregiver's aspirations for child				0.385 (0.032)***		
Caregiver's self-efficacy					0.107 (0.026)***	
Caregiver's self-esteem						0.272 (0.025)***
Obs.	3,291	3,291	3,291	3,291	3,291	3,291
R^2	0.151	0.103	0.165	0.265	0.116	0.239
Core controls	Yes	Yes	Yes	Yes	Yes	Yes
Cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Consumption expenditure	No	No	No	Yes	Yes	Yes
Household shocks	No	No	No	Yes	Yes	Yes
Child's BMI	No	No	No	Yes	Yes	Yes
Maternal non-cog. skills	No	No	No	Yes	Yes	Yes

Note: Variables are standardised to have mean 0 and variance 1. Each cell represents a different regression. Robust clustered standard errors are reported in brackets; *, **, *** denote significance at 10%, 5% and 1% levels.

Table A4. *OLS pooled sample: the role of relative height*

	Communities where more than 25% of children are stunted			Communities where more than 10% of children are stunted		
	School aspirations	Self-efficacy	Self-esteem	School aspirations	Self-efficacy	Self-esteem
	(1)	(2)	(3)	(4)	(5)	(6)
Height-for-age z-score, age 7–8	0.074 (0.025)***	0.06 (0.026)**	0.05 (0.025)**	0.084 (0.02)***	0.061 (0.02)***	0.042 (0.017)***
Obs.	1,768	1,768	1,768	3,051	3,051	3,051
R^2	0.279	0.132	0.258	0.267	0.12	0.245
Core controls	Yes	Yes	Yes	Yes	Yes	Yes
Cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Consumption expenditure	Yes	Yes	Yes	Yes	Yes	Yes
Household shocks	Yes	Yes	Yes	Yes	Yes	Yes
Child's BMI	Yes	Yes	Yes	Yes	Yes	Yes
Maternal non-cog. skills	Yes	Yes	Yes	Yes	Yes	Yes

Note: Variables are standardised to have mean 0 and variance 1. Robust standard errors, clustered at the sentinel site level;*, **, *** denote significance at 10%, 5% and 1% levels. Core controls include: housing quality index, access to services index, caregiver's age, caregiver's highest grade of schooling, whether caregiver is the mother, caregiver's disability status, gender of the head of the household, household size, child's age, child's gender, child's disability status, child's birth order, area of residence (urban/rural), child's mother tongue, mother's mother tongue and mother's caste (in India).

Table A5. *OLS pooled sample, detailed: non-cognitive skills at age 11 to 12, schooling achievement at age 7 to 8 and height-for-age at age 7 to 8*

	School aspirations (1)	Self-efficacy (2)	Self-esteem (3)	School aspirations (4)	Self-efficacy (5)	Self-esteem (6)
Height for age z-score, age 7–8	0.083 (0.019)***	0.054 (0.02)***	0.031 (0.017)*	0.071 (0.019)***	0.047 (0.02)**	0.021 (0.017)
High reading skills, age 7–8				0.188 (0.054)***	0.121 (0.05)**	0.132 (0.057)**
High writing skills, age 7–8				0.096 (0.037)***	0.07 (0.038)*	0.092 (0.04)**
Child started school at the norm-age				0.08 (0.058)	0.024 (0.058)	0.065 (0.06)
Obs.	3,206	3,206	3,206	3,206	3,206	3,206
R^2	0.267	0.118	0.236	0.276	0.122	0.242
Core controls	Yes	Yes	Yes	Yes	Yes	Yes
Cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Consumption expenditure	Yes	Yes	Yes	Yes	Yes	Yes
Household shocks	Yes	Yes	Yes	Yes	Yes	Yes
Child's BMI	Yes	Yes	Yes	Yes	Yes	Yes
Maternal non-cog. skills	Yes	Yes	Yes	Yes	Yes	Yes

Note: Variables are standardised to have mean 0 and variance 1. Robust standard errors, clustered at the sentinel site level;*, **, *** denote significance at 10%, 5% and 1% levels. Core controls include: housing quality index, access to services index, caregiver's age, caregiver's highest grade of schooling, whether caregiver is the mother, caregiver's disability status, gender of the head of the household, household size, child's age, child's gender, child's disability status, child's birth order, area of residence (urban/rural), child's mother tongue, mother's mother tongue and mother's caste (in India).

Young Lives is an innovative long-term international research project investigating the changing nature of childhood poverty.

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Save the Children – Bal Raksha Bharat, India

Sri Padmavathi Mahila Visvavidyalayam (Women's University), Andhra Pradesh, India

Grupo de Análisis para el Desarollo (Group for the Analysis of Development), Peru

Instituto de Investigación Nutricional (Institute for Nutritional Research), Peru

Centre for Analysis and Forecast, Vietnamese Academy of Social Sciences, Vietnam

General Statistics Office, Vietnam

Save the Children, Vietnam

The Institute of Education, University of London, UK

Child and Youth Studies Group (CREET), The Open University, UK

Department of International Development, University of Oxford, UK

Save the Children UK (staff in the Policy Department in London and programme staff in Ethiopia).

Young Lives
An International Study of Childhood Poverty

Department of International Development
University of Oxford
3 Mansfield Road, Oxford OX1 3TB, UK
Tel: +44 (0)1865 281751
Fax: +44 (0)1865 281801
Email: younglives@younglives.org.uk

www.younglives.org.uk