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ABSTRACT

Undernutrition and Psychosocial Competencies: Evidence from Four Countries*

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 acquired and what the role played by household investments is in this process. Motivated by suggestions from the medical literature and by the recent literature on human skill formation, this paper uses longitudinal data from children growing up in developing countries to study the role of early nutritional history in shaping this type of skills. 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 aspirations. We find that height-for-age predicts the three observed psychosocial measures. Auxiliary estimations suggest that the relationship found is unlikely to be mediated by the effect that undernutrition can have on academic performance.

JEL Classification: I12, J13, O12 and O15
Keywords: human capital, non-cognitive skills, psychosocial competencies and undernutrition

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1 Introduction

Empirical evidence supports the idea that there are returns to non-cognitive skills in the labour market: they offer better job opportunities and incomes. First, aspects such as attitude, communication skills, motivation and "personality" are high on the list of the characteristics sought by employers (Bowles et al., 2001). Second, contemporaneous, self-reported, measures of self-esteem, self-efficacy and future-orientedness 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). Cunha and Heckman (2008) 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 importance of non-cognitive skills has long been recognized in psychology and other fields (for instance, see Duckworth and Seligman, 2005) and their determinants explored (Mecca et al., 1989), within the economics field not enough attention has been put to the specific type of early household investments that play a role in the acquisition of these skills.

This paper aims to contribute to the 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 countries, where undernutrition is widespread. It is well known nutrition in the first year of a child's life has long-term cognitive implications (Glewwe et

[1] Cunha and Heckman (2008) find that parental investments and 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. Coneus et al. (2011) use data from German children. The authors distinguish between emotional and mental non-cognitive skills and find that emotional skills are determined by past emotional skills, whereas mental skills are determined by past mental skills, cognitive skills and parental investments. 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 the measurement variables used to estimate lagged non-cognitive skills are not the same as those used to measure current non-cognitive skills.

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 (see GranthamMcGregor et al., 1999, pg.67) and having behavioural problem 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 competencies.

To answer this question, we empirically test the relationship between undernutrition and survey-based indicators of self-esteem, self-efficacy and (educational) aspirations. We use the term psychosocial competencies to refer to them.[2] Whilst an incomplete 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). The three indicators are observed at the age of 11 to 12 years.

To measure nutrition we use physical height at the age of 7 to 8 years, conveniently re-expressed in terms of the distance between observed height and a reference height for age and sex (height-for-age z-score). When measured sufficiently early in life physical height conveys information about a child's early nutritional history (Martorell, 1999). In particular, evidence suggests that differences in mean height at the age of 7 across different populations is mainly determined by differences in early nutrition (Habicht et al., 1974).[3] While infection and mother-infant interaction also play a determinant role in early height, the literature seems to agree that in developing countries poor nutrition is the main determinant of early linear growth retardation (GranthamMcGregor et al., 1999).

Methodologically, we measure the relationship between height-for-age at the age of 7 to 8 and psychosocial competencies at the age of 11 to 12 years using ordinary least square (OLS) methods, controlling for child and household characteristics that can be deemed determinants of non-cognitive investments. We use data from around 3,300 children drawn from the Young Lives country surveys in Peru, India, Ethiopia and Vietnam. 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's size, access to basic services, and holding of

[2]Non-cognitive skills is a generic term used to encompass a large range of abilities.

[3]Evidence from different studies show that during the preadolescent period (e.g., 7, 10, 11 years of age) mean height of well-nourished children is similar regardless of ethnic backgrounds). See Haas and Campirano (2006) and Habicht et al. (1974).

durable goods (among other aspects). In addition, the estimation includes community fixed effects to account for the role of time-invariant community characteristics. This basic initial setup controls for some of the key correlates of early undernutrition, 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 psychosocial competencies 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 rather than the long-term implications of investing in early nutrition. For instance, stunted children could have poorer psychosocial competencies simply because they are more likely to be bullied by taller peers. If this is the case, a similar relationship could be found even in populations of healthy children.[4] While this possibility can not be ruled out with the information at hand, we deal with this concern by re-estimating the model splitting children in two groups, separating those with a low height-for-age from the rest. Since at these ages variation in the lower tail of the height-for-age distribution is primarily driven by nutritional differences, it follows that the association of interest should matter more or should only matter in the former sub-sample. In addition, as a further check we re-estimate 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 relationship could be mediated by

[4]We thank Ingo Outes-Leon for first pointing out this possibility.

other factors. As suggested by the nutrition literature, height-for-age predicts both age of school enrolment (Glewwe and Jacoby, 1995) and academic performance (Alderman et al., 2006; Glewwe et al., 2001). In turn, the two can have an effect on a child's psychosocial competencies. We bring this aspect into the discussion by presenting results from auxiliary regressions that include lagged levels of reading skills, writing skills and age of school enrolment. Under assumptions (see Section 5.1.2), this allows partialling-out the effect that nutrition is likely to have on academic performance and delayed enrolment.

The main results are as follows. 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 predicts higher levels of school aspirations, self-efficacy and self-esteem at the age of 11 to 12 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%, 5.8% and 3.4% of a standard deviation, respectively (extended specification). We do not reject the hypothesis that the coefficients obtained are the same across the four study countries, reinforcing our prior hypothesis that there is an underlying mechanism linking the two variables. We also show that the height-psychosocial relationship is driven mainly by differences in the lower tail of the height-for-age distribution, which reinforces the interpretation of the results as being informative of the linkages between undernutrition and psychosocial competencies. In terms of the possible channels of transmission, results from auxiliary estimations suggest that only a small part of the relationship can be expected to be mediated by academic performance. Although these results can not be interpreted in a causal sense, that they persist after controlling for a wide number of factors suggest that undernutrition could play a direct role in the acquisition of psychosocial competencies. Finally, our results indicate that household consumption per capita and maternal psychosocial competencies are important correlates of a child's psychosocial competencies, which is consistent with Dercon and Krishnan (2009).

This paper is organized as follows. Section 2 presents the related literature. Section 3 describes the empirical methodology. Section 4 describes the data and provides a discussion on the validity and stability of the psychosocial indicators used in the estimations. Section 5 presents the main findings and robustness checks. Section 6 concludes.

2 Literature review

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; GranthamMcGregor et al., 1991, 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 in a human capital accumulation model. Non-cognitive skills is a generic term, used to encompass aspects such as socioemotional skills, perseverance, attention, motivation and self-confidence. In these models, it is assumed 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 US, finding evidence of self-productivity and complementarity across both types of skills. Recent studies find similar evidence in other countries (Coneus et al., 2011; Helmers and Patnam, 2011).

The role of early undernutrition in skills formation is of relevance in the context of developing countries, where food security, lack of access to clean water and basic health services remain an important challenge. While the impact of undernutrition on cognitive skills formation has received considerable attention in the economic literature and in other fields, to our knowledge the possible implications of nutrition on the acquisition of non-cognitive skills has only been suggested in the medical literature. GranthamMcGregor et al. (1999) review studies that suggest that early undernutrition affects psychosocial development at a very early age. The most influential is a longitudinal study that started in 1986-1987 in Kingston, Jamaica. The study selected 129 stunted children and 84 non-stunted children. The latter group was matched to the former by age, sex and neighborhood. Meeks et al. (1999) find that by age 12 to 24 months, stunted children from this study reported more apathy, less willingness to explore, were less happy and more fussy than the matched non-stunted children. Follow-up studies Chang et al.

(2002); Walker et al. (2007) led to similar conclusions. By age 17 those that were early stunted reported more anxiety, more depressing symptoms and lower self-esteem compared to matched non-stunted children (Walker et al., 2007). The Jamaican study is particularly prone to omitted variable problems. Few controls were available[5] and the sample size was relatively small. However, it adequately motivates the notion that undernutrition can have effects on the accumulation on non-cognitive skills. The mechanism, as the authors note, is unclear. The relationship could be of a biological nature or could be explained by the effect of undernutrition on cognitive skills, which in turn might affect non-cognitive skills.

In this paper, we are interested in the relationship between undernutrition and non-cognitive skills. Note that this essentially consists in extending the skills formation model proposed by Cunha and Heckman (2007, 2008) to account for the role of lagged health and nutrition. From here onwards we use the term psychosocial competencies to refer to our selected indicators to more precisely reflect their nature.

3 Empirical strategy

We aim at testing the relationship between psychosocial competencies 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*. We estimate this relationship 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[6] j we estimate the following linear equation,

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

where $S^P_{ij,t}$ is a psychosocial 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 $\mu^1_{ij,t}$ is the error term. This type of estimation is commonly used in the early childhood development literature. For an early reference, see Rosenzweig and Schultz (1983).

[5]Covariates available were (as labeled by the authors): childs age and sex, hunger, housing, mother's PPVT, occupation, father present in home, victim of crime, witnessed violence. Covariates were offered stepwise. Estimations in Walker et al. (2007) included 2 to 3 controls

[6]Community and cluster are used as synonymous throughout the paper.

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, following a discussion similar to that presented by Alderman et al. (2006) to discuss the role of unobservables in the estimation of the nutrition–cognition nexus, consider the following disaggregation of the error term from equation 1: $\mu^1_{ij,t} = c^1_i + h^1_i + \epsilon^1_{ij,t}$, where c^1_i and h^1_i stand for child and household unobserved, time-invariant, characteristics that determine non-cognitive investments and $\epsilon_{ij,t}$ is iid noise. Specifically, c^1_i is meant to represent a child's inherent abilities, whereas h^1_i captures the psychosocial environment of the household. Next, consider the following definition for lagged nutrition,

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

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

In this investigation, we can only deal with these sources of endogeneity in an imperfect manner. In particular, we lack the means to deal with endogeneity due to child-level unobservable variables, –a challenge solved by Alderman et al. instrumenting early nutrition with child-specific exposure to shocks during the first few years of life. On the other hand, we make use of the vast information available in the Young Lives surveys (see next section) in two ways. Primarily, 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 unobservable variables we resort to proxy variables of the household psychosocial enviroment. The variables considered for this purpose are enumerated later on, once the data is presented.

An additional aspect is that of missing inputs. It is of interest to elucidate whether the relationship between undernutrition and psychosocial competencies could be mediated by the effect of undernutrition on cognitive dimensions. We discuss this aspect in Section 5.1.

4 Data characteristics

4.1 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, twenty clusters were selected from each country; at random in Peru and based on a number of predetermined criteria in the other three countries.[7] 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.[8] For simplicity, we will treat the terms cluster and community as equals.

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 studied 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. The sampled children and their caregivers were interviewed twice: in 2002, when they were 7 to 8 years; and, in 2006-7, when they were 11 to 12 years.[9] 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 wide array of information on child, family and other contextual characteristics. Attrition in the samples is exceptionally low: only 1.4% 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% and the Vietnam sample only 0.5%.

[7]Clusters are small geographical units. The exact definition depends on the country (districts in Peru, communes in Vietnam, mandals in Andhra Pradesh and weredas in Ethiopia).

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

[9]They have since been interviewed at the age of 15.

4.2 Measurements variables

4.2.1 Undernutrition

It is well established that preschool-aged children have the same physical growth potential, regardless of genetic or ethnic backgrounds, and that linear growth retardation at the first few years is mainly the result of an inadequate nutrition over an extended period of time (Martorell, 1999). The World Health Organization (WHO) estimates growth standards for children aged less than 5 years old, which are used to assess chronic malnutrition. Similarly, WHO estimates growth references for school-aged children and adolescents. The existence of a growth reference for school-aged children is based on the evidence that shows limited variation in the mean height of well nourished children from different ethnic backgrounds up to puberty. See, for instance, Haas and Campirano (2006). To use these growth curves, height is transformed into height-for-age z-scores that measure the distance between a given child and the norm child for the corresponding age. An infant or a child with a height-for-age z-score below -2 (that is 2 standard deviations below the median, healthy child) is classified as chronically malnourished.

We use height-for-age z-scores at the age of 7 to 8 as our proxy variable for early nutrition.[10] The percentage of children classified as moderately stunted using this indicator fluctuates between 26 and 31 per cent in the country samples. As expected, the poorest samples (Ethiopia and India, those with the lowest wealth indexes) report the highest levels of stunting (see table 1). Although conceptually an earlier measure of height-for-age - i.e., between 3 and 5 years - would be a better measurement variable to capture early nutritional investments - e.g., due to the possibility of nutritional catch-up -, it is important to note the following. First, the study that shows that all preschool-aged children have the same growth potential used data from children up to 7 years of age (Habicht et al., 1974). In that sense, by the standards of the related literature, our indicator seems to have been measured early enough to be informative of nutritional investments. Second, our indicator was observed before puberty, a stage when genetic disparities in physical height across ethnic groups become more pronounced. Third, there is little evidence of faltering or appreciable nutritional catch-up before adolescence (Martorell, 1999). Fourth, to statistically test whether physical height at the age of 7-8 conveys information from the first few years of life, we used data from other cohort tracked by the Young Lives project, and find that the correlation between height at age 6-24 months and height at 7-8 years of age is 0.69. Overall, we think this gives sufficient ground to use

[10]Latest standard, WHO reference released in 2007.

height-for-age 7-8 as an indicator of early nutritional investments.

Table 1: YL sample poverty levels and nutritional rates by country

	Peru	India	Vietnam	Ethiopia
	(1)	(2)	(3)	(4)
Wealth index	0.51	0.34	0.44	0.17
Percentage of stunted children at 7-8 years	26.3	31.6	27.4	31.4

Notes: 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.

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 WHO cut-off points for moderately stunted) to fully exploit the information conveyed by this variable. The choice of a cutoff point below 2 standard deviations is based on an statistical criterion (Pelletier, 2006). The advantage of using this variable in its continuous form is that it exploits the fact that, on the left side of the distribution, lower values of height-for-age are associated to chronic malnutrition of a higher degree.

4.2.2 Measurements of psychosocial competencies

Using survey data, we construct a set of indicators that intend to approximate children's competencies in the following 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 another hand, 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). The self-esteem index is the average score of nine items.[11] Similarly, the self-efficacy index is the average score of five items.[12] In both cases, negative statements are recoded in inverse order. Histograms of both indicators are reported in Figure 1 in the appendix.[13]

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 as 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

[11]The items are: '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'.

[12]'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'.

[13]Both indicators are standardized to have mean 0 and variance 1 within each country.

goals'. In the child development literature, the role of aspirations and its link with educational outcomes has long been emphasised (Bandura et al., 2001; Cohen et al., 2009). A recent study in a developing country tests the relevance of aspirations for girls' achievement, including in education, and how they can be boosted, using a natural experiment (Beaman et al., 2012).

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.[14] 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 1 for the pooled sample.[15]

Table 2: School aspirations: descriptive statistics

	Peru	India	Vietnam	Ethiopia	All
	(1)	(2)	(3)	(4)	(5)
Mean	15.14	15.06	15.64	15.42	15.33
S.D.	(1.83)	(3.00)	(2.48)	(2.73)	(2.60)
n	640	859	936	855	3290

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

5 Main Results

Table 3 (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 with school aspirations in all countries; and with self-esteem and self-efficacy in Peru, India and Vietnam. In every case, the sign of the coefficient 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 mea-

[14] 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?'

[15] Variables are standardized to have mean 0 and variance 1 within each country.

surements on lagged height-for-age as in equation 2 which is reported again for convenience:

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

where $S^{P}_{ij,t}$ stands for psychosocial competencies 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).

The height-for-age coefficients obtained from estimating this baseline specification are reported in Table 4, PANEL A (see appendix) for the pooled sample and for each of the studied 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 standardized 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%, 6.4% and 5.1% 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 coefficient is the same across countries. The hypothesis is only rejected in one case (school aspirations) at the 10% confidence level and as more controls are added –see subsection 5.1– 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.

5.1 Robustness checks and other considerations

There are different reasons why the relationship between height-for-age and non-cognitive skills might be overstated by previous results. 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 what is driving the previous findings.

Second, related to the nature of the unobservable factors discussed in 3, 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). We are not aware of a relationship between concurrent nutritional deficits and psychosocial outcomes. However, there is evidence in the opposite direction, 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. The latter is of interest to us.

To deal with these possibilities we present results for an extended specification. To disentangle more effectively the effect of past undernutrition on psychosocial competencies 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 the availability of food, livestock died, failed crop, stolen livestock, stolen crop, job loss, loss of family income, severe illness or injury of one member of the family[16]). To deal with the potential influence of household psychosocial environment we resort to proxy variables. We add caregiver psychosocial indicators (the caregiver is, typically, the mother) to proxy for the household environment in which the child develops her psychosocial competencies. These indicators are analogous versions of 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 to achieve. Finally, to control for current nutritional deficits we add contemporaneous child body mass index as a control in the estimation.

A summary of the results obtained after adding these additional controls (extended specification) is presented in Table 4, PANEL B. Also, Table 5 reports the marginal effects of a selected set of controls for the pooled sample estimations, with all the variables standardized to have mean and variance equal to 0 and 1 (respectively). The resulting nutrition 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

[16]Reported when the child was aged 7 to 8 years.

for self-efficacy and from 0.051 to 0.034 for self-esteem. In all cases, results remain statistically significant at standard levels.[17]

Two other results are must be highlighted. First, household consumption expenditure is found to be strongly correlated with psychosocial outcomes (Table 5). 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 psychosocial competencies turn out to be the most important correlate of the child's competencies. These results are consistent with Dercon and Krishnan (2009). The standardized coefficients for each of the selected indicators (caregiver's 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, to interpret the result. Since maternal aspirations are measured contemporaneously to the child psychosocial measures, there could be a problem of reverse feedback.[18] Therefore, one should not give a causal interpretation to this result.

5.1.1 The role of relative height

As a final check, we consider an alternative interpretation of our results that 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 psychosocial outcomes instead of the long-term implications of investments in early nutrition. This line of interpretation takes the role of peers in determining a child's non-cognitive skills seriously. 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 psychosocial outomes. But, were this to be the case, a similar relationship could be found even in populations of healthy children. While it is not possible to entirely rule out this possibility with the available information, we do the following. Since differences in height-for-age are assumed to convey information about nutritional differences mostly in the

[17] 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 being 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 coefficient for self-efficacy reduces to 0.034 (from 0.037) and it becomes borderline insignificant at the 10 per cent level.

[18] A mother's aspirations for her child could be contaminated by the child's own aspirations

lower tail of its distribution, we split the pooled sample in two, separating those with a height-for-age below -1 from the rest. Results are reported in Table 4 for both the baseline and the extended specification. We find what one would expect under this line of reasoning. The height-for-age coefficients are larger for the sub-sample of children with low height-for-age and only in this case there is statistical significance. In other words, being taller is good only insofar as this makes a child moving from stunting to non-stunting levels.

As a final check, we re-estimate the model for sub-samples where only children living 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% of children are stunted (results with a 10% threshold are also reported). Estimation results are reported in Table 6 (in the appendix). Results remain very similar in these alternative specifications in terms of the point estimates.

5.1.2 The role of academic performance

It is important to discuss whether part of the relationship observed can be explained by the effect that nutrition has on schooling dimensions that in turn can act as inputs of psychosocial outcomes. 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 have a low academic performance (Alderman et al., 2006; Glewwe et al., 2001), In turn, delayed school enrolment and low academic performance can affect aspirations and self-esteem.

Whether or not this is the case, it is problematic to assess empirically. First, adding academic performance and delayed enrolment into the estimation amplifies the endogeneity problem. Second, we would like to observe academic performance some time between $t-1$ (7 to 8 years) and t (11 to 12) to avoid the problem of reverse feedback. Unfortunately, we only observe academic performance (reading and writing skills) at ages 7 to 8. Nevertheless, we still find it useful to include them as controls. Our justification is that height-for-age at ages 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 coefficient 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 she is 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.[19] 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 proportion of children with low reading and writing skills in the pooled sample are 41% and 49%, respectively. Similarly, 25% of the sampled children are off-age (i.e., they were enroled in school after the norm-age).

Results are reported in Table 7.[20] 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 coefficient 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, the change in the point estimates does not seem to be large enough to claim that the relationship found is mediated by academic performance or by delayed enrolment.

We focused on these channels because they are known in the literature. However it is important to highlight that there could be other pathways through which the relationship 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.

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

[19]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.

[20]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.

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 self-efficacy, self-esteem and aspirations 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 these three indicators observed 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 association 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 psychosocial competencies, which reduces the probability that our findings are mediated by an inter-generational mechanism whereby poor mothers with low skills raise malnourished children with low skills. Finally, we find that the relationship found is unlikely to be explained by the effect that nutrition has on academic performance and delayed enrolment.

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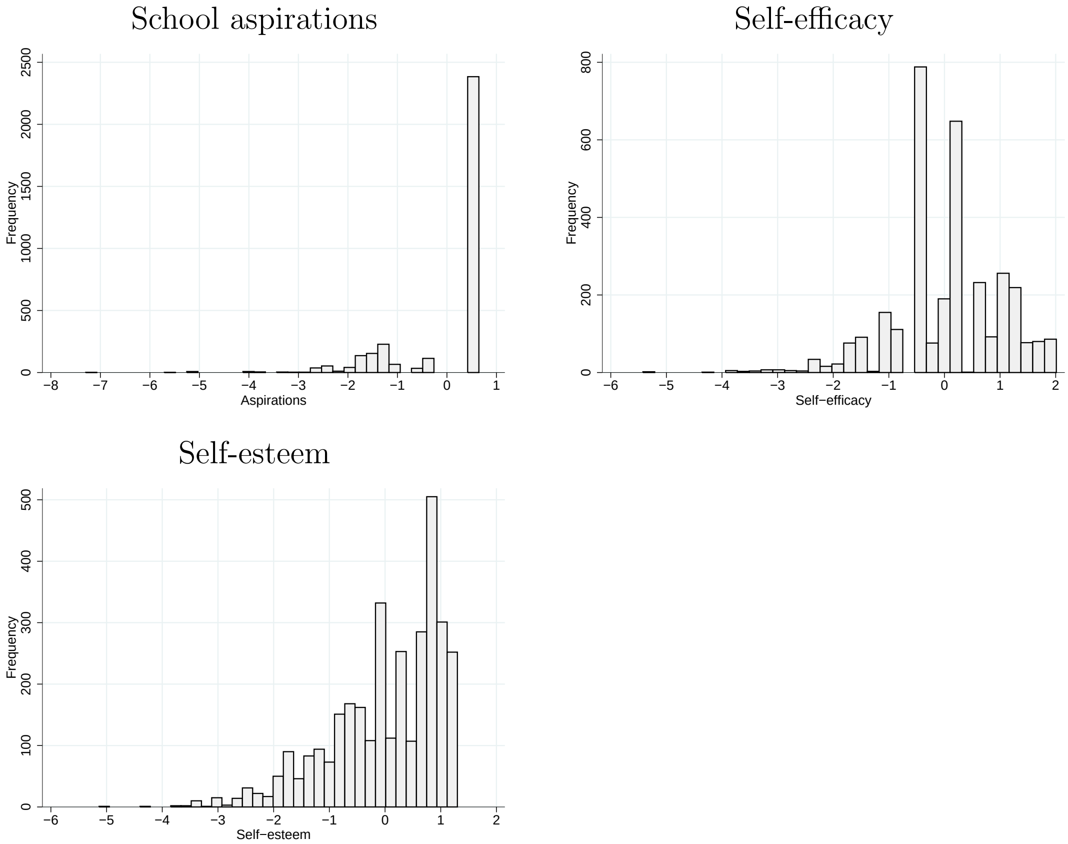
A Supplementary figures and tables

Figure 1: Histograms



Pooled sample. All variables were standardized to have mean 0 variance 1 in each country.

Table 3: Simple pair-wise correlations: non-cognitive skills at age 11 to 12 and height-for-age at age 7 to 8

	n	School aspirations	Self efficacy	Self esteem
		(1)	(2)	(3)
Pooled sample	3290	0.164	0.07	0.101
		(0.028)***	(0.018)***	(0.026)***
Country samples				
Peru	640	0.131	0.102	0.284
		(0.048)***	(0.053)*	(0.063)***
India	859	0.126	0.051	0.088
		(0.037)***	(0.023)**	(0.034)**
Vietnam	936	0.232	0.083	0.096
		(0.078)***	(0.024)***	(0.046)**
Ethiopia	855	0.15	0.052	-.020
		(0.033)***	(0.046)	(0.05)
F-test eq. of coeff.				
F		2.22	0.54	3.59
p-value		0.092	0.674	0.017

Variables are standardized to have mean 0 and variance 1. Each cell represents a different regression. Robust standard errors, clustered at the community level; *, **, *** denote significance at 10%, 5% and 1% levels.

Table 4: OLS results: non-cognitive skills at age 11 to 12 and height-for-age at age 7 to 8 (main results)

	n	School aspirations	Self efficacy	Self esteem
		(1)	(2)	(3)
PANEL A: Baseline specification				
Pooled sample	3290	0.104	0.064	0.051
		(0.018)***	(0.018)***	(0.018)***
Country samples				
Peru	640	0.079	0.037	0.103
		(0.047)*	(0.065)	(0.039)***
India	859	0.058	0.052	0.04
		(0.039)	(0.019)***	(0.027)
Vietnam	936 11	0.109	0.109	0.066
		(0.029)***	(0.034)***	1(0.038)*
Ethiopia	855	0.129	0.048	0.013
		(0.031)***	(0.036)	(0.042)
Pooled sample				
Height-for-age < -1	2176	0.117	0.072	0.082
		(0.042)***	(0.030)**	(0.032)**
Height-for-age $\geqq -1$	1114	0.038	0.061	0.072
		(0.048)	(0.061)	(0.046)
PANEL B: Extended specification				
Pooled sample	3290	0.078	0.058	0.034
		(0.019)***	(0.019)***	(0.017)**
Country samples				
Peru	640	0.06	0.045	0.097
		(0.046)	(0.066)	(0.042)**
India	859	0.037	0.041	0.027
		(0.044)	(0.025)	(0.029)
Vietnam	936	0.067	0.091	0.029
		(0.027)**	(0.038)**	(0.037)
Ethiopia	855	0.117	0.043	0.012
		(0.038)***	(0.036)	(0.037)
Pooled sample				
Height-for-age < -1	2176	0.081	0.070	-0.047
		(0.038)**	(0.030)**	(0.124)
Height-for-age $\geqq -1$	1114	0.047	0.042	0.018
		(0.048)	(0.061)	(0.019)
F-test eq. of coeff.				
Baseline specification				
F		2.64	0.70	0.59
p-value		0.055	0.557	0.624
Extended specification				
F		1.98	0.81	0.85
p-value		0.123	0.494	0.471

Variables are standardized to have mean 0 and variance 1. Robust standard errors, clustered at the community level; *, **, *** denote significance at 10%, 5% and 1% levels. The baseline specification includes child and household level controls and community fixed effects. See the full list of variables in Section 5. The extended specification adds the following control variables: log household consumption expenditure (per capita), contemporaneous child body mass index, caregiver psychosocial competencies and whether the household was affected by different shocks when the child was aged 7 to 8 years or younger.

Table 5: OLS pooled sample, detailed: non-cognitive skills at age 11 to 12 and height-for-age at age 7 to 8

	School aspirations	Self efficacy	Self esteem
	(1)	(2)	(3)
PANEL A: Baseline specification, pooled sample, selected controls			
Height for age z-score, age 7-8	0.104	0.064	0.051
	(0.018)***	(0.018)***	(0.018)***
Caregiver's years of schooling	0.089	0.043	0.132
	(0.023)***	(0.021)**	(0.022)***
Access to services	0.097	0.063	0.102
	(0.027)***	(0.03)**	(0.026)***
PANEL B: Extended specification, pooled sample, selected controls			
Height for age z-score, age 7-8	0.078	0.058	0.034
	(0.019)***	(0.019)***	(0.017)**
Caregiver's years of schooling	0.039	0.024	0.082
	(0.022)*	(0.021)	(0.02)***
Access to services	0.049	0.039	0.07
	(0.027)*	(0.03)	(0.026)***
Log-consumption per capita	0.073	0.048	0.07
	(0.02)***	(0.02)**	(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)***
n	3290	3290	3290

Variables are standardized to have mean 0 and variance 1. Robust standard errors, clustered at the community level; *, **, *** denote significance at 10%, 5% and 1% levels. The baseline specification includes child and household level controls and community fixed effects. See the full list of variables in Section 5. The extended specification adds the following control variables: log household consumption expenditure (per capita), contemporaneous child body mass index, caregiver psychosocial competencies and whether the household was affected by different shocks when the child was aged 7 to 8 years or younger.

Table 6: OLS pooled sample: The role of relative height

	School aspirations	Self efficacy	Self esteem
	(1)	(2)	(3)
PANEL A: Extended specification, communities where % of stunted children is above 25			
Height-for-age z-score, age 7-8	0.074	0.06	0.05
	(0.025)***	(0.026)**	(0.025)**
n	1768	1768	1768
PANEL B: Extended specification, communities where % of stunted children is above 10			
Height-for-age z-score, age 7-8	0.084	0.061	0.042
	(0.02)***	(0.02)***	(0.017)**
n	3051	3051	3051

Variables are standardized to have mean 0 and variance 1. Robust standard errors, clustered at the community level; *, **, *** denote significance at 10%, 5% and 1% levels.

Table 7: 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	Self efficacy	Self esteem
	(1)	(2)	(3)
PANEL A: Extended specification, pooled sample			
Height for age z-score, age 7-8	0.083	0.054	0.031
	(0.019)***	(0.02)***	(0.017)*
PANEL B: Extended specification, pooled sample, controlling for schooling achievement			
Height for age z-score, age 7-8	0.071	0.047	0.021
	(0.019)***	(0.02)**	(0.017)
High reading skills, age 7-8	0.188	0.121	0.132
	(0.054)***	(0.05)**	(0.057)**
High writing skills, age 7-8	0.096	0.07	0.092
	(0.037)***	(0.038)*	(0.04)**
Child started school at the norm-age	0.08	0.024	0.065
	(0.058)	(0.058)	(0.06)
n	3206	3206	3206

Variables are standardized to have mean 0 and variance 1. Robust standard errors, clustered at the community level; *, **, *** denote significance at 10%, 5% and 1% levels.