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Working Paper Series Vol. 2006-24
December 2006

The International Centre for the Study of East Asian Development, Kitakyushu

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Abstract

We examine the importance of child health and nutrition, family background and the characteristics of public primary schools and teachers for enrollment in the first grade using longitudinal data on 1,251 school-age children and families, as well as the ECD (early childhood development)-related providers that serve their communities collected from three regions in the Philippines. The first research question relates to the associations between children's health and nutrition at pre-school age (height for age z scores and hemoglobin levels) and enrollment in the first grade, and whether these associations are robust to standard corrections for the possibility that child health and nutrition represent, in part, omitted variables. Second, we examine the effect of multiple dimensions of school and teacher quality on enrollment with particular attention to whether there are important interactions between family background (mother's schooling, father's schooling) and the accessibility and quality of primary schools and teachers in their associations with enrollment. In a similar vein, we consider whether the importance of children's health and nutrition for enrollment in school is greater in communities where families have access to better schools. Our major findings indicate that 1) children's hemoglobin levels have significant and positive effects on school enrollment that are understated in models that take child health and nutrition as pre-determined and 2) there are important interactions between family background on the one hand and the quality and accessibility of schools on the other that suggest important *complementarities* in their effect on grade 1 enrollment. We do not find important interactions between children's nutrition and the quality of schools and teachers in their relationship with enrollment. The findings suggest the importance of accounting for omitted variables when making inferences about the role of child health and nutrition or schools and teachers for schooling.

Acknowledgements This research was supported by a grant from the International Center for the Study of East Asian Development (ICSEAD), Kitakyushu, Japan; R01-TW05604-01 ("Filipino Early Childhood Development: Longitudinal Analysis") funded by the National Institutes of Health/Fogarty International Center, National Institute of Child Health and Human Development (NICHD), the Office of Behavioral and Social Science Research, the Global Development Network, the Department of Social Welfare and Development (DSWD) of the Government of the Philippines, the World Bank Research Advisory Committee, and the Population Council fellowship fund. We thank all these organizations for support for this project. This paper will be presented at the Population Association of American (PAA) Annual Meetings in Los Angeles on 30 March 2006.

Introduction

Investment in the schooling of children and youth in developing countries is widely recognized as essential for adult productivity and wages, psycho-social and physical health and well-being, and marriage outcomes, and in turn, for encouraging economic development. Poor nutrition is shown to have important negative consequences for children's school performance in the form of delays in enrollment, grade repetition, a higher chance of dropping out, and lower achievement while in school.[1] Recent estimates suggest that delays in primary school enrollment of two years, on the average, cost individuals a substantial 6 percent of their lifetime income (Glewwe and Jacoby 1995). This suggests that there are significant economics benefits, via improved school performance, to be gained from policies that improve child health and nutrition. Such policy considerations are especially relevant for low to middle income countries such as the Philippines, where poor health and nutrition, school enrollment, retention and performance among pre-school and school age children remain an important concern (Office of Population Studies (OPS) 2005; World Bank 2004).

This study addresses three main research questions. First, does better child health and nutrition have a positive effect on schooling outcomes in the form of a higher propensity to enroll in primary school (grade one) among school-age children? Given the ethical considerations, cost, or the limited applicability to a small setting of experimental research, most studies show estimates of the association between child health and nutrition and schooling using observational data. The estimated associations are difficult to interpret as causal because they are likely biased due to omitted variables at the child, family and community level that are correlated with observed variables, including those related to child health and schooling (Behrman 1993, 1996; Glewwe 2005). Such omitted variables include factors that are difficult to measure in surveys, for example, children's genetic endowments, parental interest in early childhood development (ECD), or the commitment of community leaders to ECD and schooling. The studies that address bias in the estimated effect of child health and nutrition on schooling outcomes find that the estimates are quite sensitive in magnitude to statistical corrections (such as instrumental variable procedures) that allow health to be correlated with omitted variables (*e.g.* Alderman et al. 2001a; Behrman and Lavy 1994; Glewwe and Jacoby 1995; Glewwe, Jacoby and King 2001). In this study, we also use the instrumental variable approach and reach a similar conclusion, particularly with regard to the relation between hemoglobin levels of children and primary school enrollment.

To date, few, if any, social science studies have estimated the association between iron deficiency and schooling outcomes. About 40 and 48 percent of children age 0-4 and 5-14 in the developing world are estimated to be anemic as measured by blood hemoglobin concentrations (World Health Organization, 2001). Iron deficiency among children is shown to impair cognitive development and function in a variety of settings (see Grantham-McGregor and Ani 2001; Pollitt 1997 for reviews). A recent experimental study in slum areas of Delhi, India showed that iron supplements administered to two to six year olds reduced pre-school absenteeism by one fifth and had significant positive effects on child weight within the first six months of the program, particularly among poorer communities (Bobonis, Miguel and Sharma 2004).

Our second research question pertains to the effects of multiple dimensions of school and teacher amenities and quality on schooling enrollment. A key element of the aim of fostering economic development through schooling is the effectiveness of schools, in promoting enrollment, retaining students, and imparting knowledge and skills to them, with longer run productivity effects. There is an extensive literature on the effects of school and teacher quality on academic achievement in developing countries.[2] But there are relatively few studies that examine whether and how multiple dimensions of the quality of schools and teachers, including but not limited to access to schools, are related to children's enrollment in school (Alderman et al. 2001b and Lloyd, Mete and Sathar 2005 are exceptions).[3] *A priori,* the characteristics of schools or teachers that are found to be important for achievement (*e.g.* pedagogical practices, teacher salary or schooling) may be less relevant for the enrollment decision than, for example, the price of schooling (including distance, fees and opportunity costs), the outward amenities of schools, or parental knowledge about the types of schools and teachers in their area.

Our third research questions relates to whether there are important interactions between family background and either child health and nutrition, or school and teacher characteristics in their relationship with children's primary school enrollment. There may be *complementary* associations between the characteristics of schools and parental resources in their effect on enrollment. For example, teacher education may have positive associations with enrollment in school, but only for better educated parents who are more likely to learn about the qualifications of the teachers in the school when making the enrollment decision. Or, there may be *substitutions* between family background and school characteristics in their relation with enrollment, for example, if parents with less schooling are more likely to respond to outreach efforts by teachers since they are less able to procure the information imparted by such efforts relative to those with more schooling. There may also be complementarities between school characteristics and child health and nutrition since families that reside in communities with better schools and teachers will, all else constant, realize higher returns from enrolling children in school for any given level of nutrition. This implies the presence of important positive interactions between child nutrition and school and teacher quality in their association with school enrollment. Interactions between the presence and quality of early childhood development (ECD)-related programs (including schools) and family characteristics in their effects on health or schooling outcomes have not been widely investigated in the literature[4]. Interactions between nutrition and school quality, to our knowledge, have not been reported in any study.

We address these three research questions using rich and unique longitudinal data on children's health and nutrition, families, and ECD-related providers (including teachers, and other pre-school service providers) that was collected in collaboration with the Office of Population Studies (OPS) from three regions of the Philippines.

The Philippine Context

Compared to several other nations in East and Southeast Asia (*i.e.* Indonesia, Thailand, Malaysia and Korea), the Philippines performs below or at par when it comes to primary school enrollment as measured by the net enrollment ratio (NER)[5] (World Bank 2004). Recent estimates indicate that the primary school NER is about 82 per 100, indicating that about one in five school age children are not in school (Department of Education, 2006). The common reasons for NER's below 100 are delays in enrollment and leaving school early. Grade repetition is also a problem since nearly 1 in 10 students in the Philippines repeat the first grade (National Statistics Office (NSO) and ORC Macro 2004; Department of Education, 2005). In 2002-2003, primary school completion rates were estimated at 66 percent of those who enrolled in school (Department of Education, 2005). There is also growing concern about the quality of schooling provided at the primary level. A cross country comparison of student scores on mathematics and science achievement tests administered at the eight grade level ranked the Philippines at the bottom of a list of nine East and Southeast Asian countries (World Bank 2004). Regional variation in NER's indicates that areas such as the Visayas, Central Mindanao and Zamboanga in the central and southern areas of the country lag behind areas in the north (NSO and ORC Macro, 2004). Due to perceived poor school readiness, as well as persistently high rates of infant mortality, malnutrition and infectious disease, in 1999 the Philippine government initiated an ECD program that has the aim of expanding and upgrading the range of health and ECD-related services and information available to pre-school children and their parents (Department of Social Welfare and Development (DSWD) 2002; OPS 2005).

Data

We conduct this analysis using longitudinal data that was collected to evaluate the impact of the ECD intervention on ECD, among other outcomes (see Armecin et al. 2006; OPS 2005). The ECD program was introduced in three regions: Western Visayas, Central Visayas and Central Mindanao, and was targeted toward relatively disadvantaged municipalities as measured by a variety of maternal and child health and schooling indicators. A baseline survey of households was conducted in these three regions and a non-program region (Eastern Visayas) from April 2001 to November 2001. The sampling strategy involved stratifying the barangays[6] in each province into (1) pilot barangays that were supposed to have participated in a pilot phase launched in 1998, (2) program or target barangays in Phase 1 of the project, and (3) non-program barangays or non-targeted barangays in the (pilot and Phase 1) program and non-program municipalities in the region.[7] In each ECD region, five pilot and five non-program barangays were randomly chosen, while the remaining barangays were drawn at random from the program barangays. In the non-program region, sample barangays were randomly chosen from all barangays in the region, with the number of barangays chosen proportionate to the total number of barangays in each province. All means are weighted to account for the sampling scheme.

In each sample barangay, an average of 24 eligible households (*i.e.* households with 0-6 year-old children or households with pregnant women) in the program regions and 14 households in the "control" region were selected. From this baseline survey, children age 0-4 - were selected to be followed up in the succeeding waves of data collection. Children who were 5-6 years were not included in the multi-wave longitudinal evaluation sample because they were too old to get much exposure to the program. Central Mindanao was not included in the longitudinal survey due to cost considerations. The resulting total number of children aged 0-4 years in the respondent households in the baseline survey is 7,922. These children were followed up in two surveys conducted in September 2002 to March 2003, and September 2003 to January 2004. The OPS is collecting the fourth round of data at the time of the writing of this paper. Of the 7,922 children in the first round, 7,188 were successfully reinterviewed in the two subsequent rounds with an attrition rate of about nine percent. Attrition is generally due to outmigration to a non-sample barangay outside of the municipality. Every effort was made to track outmigrants who stayed within the same municipality. Among children who are school age at the latest (third) round, (N = 1,519) only 1.3 percent did not have data in all three rounds of data collected so far. Therefore attrition is a negligible problem for this analysis and is unlikely to bias the estimates.

An innovative aspect of the ECD survey data is the information collected from public pre-school, primary school and other health and ECD-related service providers that can be linked to the children living within the barangays served by these providers. In this paper, we incorporate information obtained from the grade one teachers, and center based day care providers (see below for more detail). As part of the ECD initiative, agencies that administer the project, such as the DSWD have promoted day care workers to 1) provide child care alternatives for families with children between age three and five; 2) educate parents about providing pre-school children with an intellectually stimulating environment to encourage better cognitive and social development and school readiness; and 3) complement the roles of midwives and barangay health workers in providing nutritional supplements and monitoring children's health status. The survey thus contains interviews with four main sets of providers: midwives (who are municipality based), barangay-based health workers and nutrition scholars, day care providers (both home and center based in each barangay), as well as grade one teachers.[8] The sampling strategy involved randomly selecting at least one service provider from each of these four major categories. In the event that more than one provider is present in the barangay, as for grade one teachers, two were randomly chosen. Due to budgetary constraints and the study aim of assessing changes in service environment in the sample areas exposed to the program, data on these providers is available only for children who are in the original baseline (or round 1) sample barangays but were not collected for children that live in households that moved to a barangay outside of the sample after the first or second wave. Only two children in the sample with information on school entry were found in a non-sample barangay after the first round and they are omitted here.

Measurement

Grade 1 enrollment: In the Philippines, children enter grade one generally at age of six and up. The school year begins in June of each year. The information on the child's participation in school is based on the questionnaire administered to mothers.[9] By the latest round, in June 2005 enough children were age six or older to permit the examination of initial school enrollments. After excluding those with missing data on the relevant variables, of the 1,519 available for analysis we are left with 1,251 children with complete data. For the estimates pertaining to hemoglobin, a slightly smaller number (1,227) are available.

Health/Nutrition: We measure children's health and nutrition using height and hemoglobin levels at pre-school age. We calculate z scores for height-for-age that express where a child falls, in terms of standard deviations, compared to the median for a reference (U.S.) population child of the same age and sex using the National Center for Health Statistics standards. Z scores that are more than two standard deviations below the reference population medians for height-for-age are considered to be indicative of stunting. Stunting reflects a history of malnutrition, as well as the disease environment and history of the child, which also affect nutritional status via absorption of nutrients and appetite disruptions (Martorell and Ho 1984). Hemoglobin levels were measured from blood samples taken from children six months of age or older.[10] A hemoglobin level below the cut-off of 11.5 grams per deciliter is considered to be indicative of anemia among children age 5 to 11 years (World Health Organization 2001).

[Table 1 here]

Table 1 shows means for the measures of health and nutrition among children for the analysis sample. Malnutrition is common among children in the sample. About 46 percent of children are stunted and the mean height for age z score is about 1.9 and almost two standard deviations below the reference population median. The mean hemoglobin level is 11.3 and about 54 percent of children are classified as anemic per World Health Organization standards for this age group. About 48 percent of children are enrolled in grade 1. Mothers were asked the reason why the child is not enrolled in primary school (not shown). The most common reason is that the respondent believes the child is too young for school (57 percent of children not enrolled), the child should finish pre-school first (16 percent), the school turned the child away for being too young (6 percent) or quality schools are not available (4 percent). Of those children whose mothers state that the child should finish pre-school first, only 11 out of 129 children are reported to be enrolled in pre-school at the time of the interview. Table 1 also shows considerably higher enrollment among girls compared to boys. These gender differences favoring girls are found in NER's across most regions in the Philippines (NSO and ORC Macro, 2004).

Family Background: We measure the economic status of the household using data on household physical asset ownership, household characteristics, and food consumption. We do not have complete information on household consumption, which is thought to be the appropriate measure of living standards at least compared to annual income because the latter is likely to have substantial transitory components (Montgomery et al. 2000). We thus use data on consumption of purchased and in-kind food[11] and construct a weighted measure of physical assets and housing characteristics, where the weights are obtained by regressing food consumption on these characteristics. Food consumption is likely to be a better indicator of longer-run income constraints than total consumption because the latter has more discretionary components with high income elasticities that are likely to be delayed relative to food when resource constraints are tight. Nevertheless food consumption also is likely to have some transitory components. We eliminate these by constructing a measure of predicted food consumption based on assets and household characteristics. Table 2 shows the means for the included measures of assets and household characteristics. On the average, about one third to 40 percent of children reside in a household with a fan, bed without mattress, dining furniture, or a color television. About one fifth to one quarter live in a household with living room furniture, an electric iron, bed with mattress, and a stove. Ownership of assets such as motor vehicles, ranges, or VCR's is less common. About 59 percent of children live in households with electricity, nearly two thirds in households with a flush or water seal toilet, and about 20 percent in a home where the primary cooking fuel is wood.

[Table 2 about here]

Table A1 shows the estimates for the regression of food consumption on these assets and household characteristics. These estimates indicate that motor vehicle ownership, owning a bed with mattress, a refrigerator, a range, a VCR, and using wood fuel all have large associations with food consumption, although virtually all the other variables also have significant (and positive) associations. The variables in the model are consistent with about 40 percent of the variance in food consumption. Since this procedure uses information on a large and relatively stabile component of consumption to obtain the weights on the assets and household characteristics , it seems preferable to a common alternative approach of using principal components which assigns weights by creating linear combinations of the variables that capture the most common variance (Filmer and Pritchett 2001). However, in these data, the food consumption weighted index is highly correlated with a principal components index of the asset and housing quality variables shown in Table A1 (r = .93) so there is little practical difference between the two approaches.

We also measure family background using the schooling attainment (in grades) of the mother and father of the child. As shown in Table 2, on the average, women have 8.7 grades of schooling, and fathers about 7.5 grades. We also include the mother's height. Similar to schooling, we take height to reflect, *inter alia*, adult productivities, wealth, genetic factors and prior disease and nutritional environments. At the first round, only about 3 percent of children did not have a mother present for the interview, and 8 percent had a father who was absent. In all the estimates, we replace missing values due to absent parents with zero and include dummy variables to control for their absence. In the interest of parsimony in the presentation in the tables, we do not show the individual coefficient estimates for these dummy variables, which are generally imprecise since most parents are present.

Primary School Availability and Quality: As shown in the last row of Table 2, about 80 percent of children live in a household where a public primary school is within walking distance. This is consistent with the general notion that public primary education is widely accessible in the Philippines (World Bank 2004). The data do not contain information on private primary schools, where a question pursued in previous studies relates to the factors that determine non-random selection of pupils into public compared to private institutions (*e.g.* Glewwe and Jacoby 1994; Glewwe et al. 1995). In the context of the present study, private schools are important in the secondary school enrollment decision, but primary education is dominated by the public sector (Department of Education, 2006). For example, of the children enrolled in grade 1 in the latest round of our data, nearly all attend public primary schools and for nearly 75 percent of children enrolled, the public schools are in the same barangay in which they live. Thus the lack of data on private providers of schooling is not a relevant concern for this study.[12]

Beyond access to schools, detailed characteristics of the schools and the grade one teachers were measured by asking the teachers about amenities available in the schools, basic socio-demographic characteristics (*e.g.* age, sex, residence) human and social capital (*e.g.* schooling and job related training, participation in organizations), salary and benefits, occupational history, and weekly functions and duties on the job. Psychologists on our team also developed and validated a Service Provider Assessment Scale or SPAS (Ledesma, 2002) that was administered to grade one teachers in rounds 2 and 3 to measure their mastery of knowledge related to maternal and child health and child cognitive development, attitudes and values regarding childrearing and parent and community involvement in child care, decision making and problem solving on the job, and their analytical skills in terms of interpreting and plotting basic data.

The school quality measures included in the analysis of this paper are 1) *Basic infrastructure* available in the primary school that serves each barangay; 2) the *Educational and ECD-related materials* available in the school, 3) the extent of *Community contacts of the grade 1 teachers*, 4) *the Student/teacher ratio*, and 5) the *SPAS subtests* on Factual Information and Attitudes and Values. The choice of what variables to include in the analysis was directed by several considerations such as parsimony and including measures that display sufficient variance and do not contain a large number of missing values.[13] We attempted to span constructs that are considered important in the literature (*e.g.* school amenities, student/teacher ratios). Some measures (such as two of the four SPAS subtests, teacher participation in social organizations, teacher training) were excluded because initial explorations revealed that coefficients were not significant in any specifications and estimates for other important variables were robust to their exclusion. Others, such as teachers' schooling or gender or residence in the barangay, display little variance in this context where most teachers are college educated women who live in the barangay they serve. Since there are multiple teachers per barangay, we average the data across the teachers per barangay. Only about 5 percent of the sample of children was missing data on a grade 1 teacher and these observations were not used in the analysis.

Table 3 shows means for the measures of primary school and teacher characteristics. About two thirds to three fourths of children live in a community where the school, on the average, has electricity, toilets, washing areas, has been repaired in the past 3 years and is well-ventilated. A summative index of the eight items on basic infrastructure has a mean of 4.4 and a standard deviation of 1.8, displaying considerable variation across barangays. About 80-90 percent of the children live in a community where the school has a bulletin board, desks, or a nap area. A far lower proportion is observed for anthropometric equipment, drawing materials, a first aid kit or a play area inside the school. A summative index of the 10 items available has a mean of 5.7 with a standard deviation of 1.7. The student to teacher ratio is about 37 (SD = 13). Between one half to 60 percent of teachers report visiting households in the barangay they serve or conducting home visits with families; about 23 percent say they talked to parents in the past week. The mean score on the Factual Information test given to teachers is 29.7.[14] The mean score for the Attitudes and Values test is 34 and indicates that, on average, teachers fall about two points below the score required to demonstrate sound attitudes and values regarding ECD (Ledesma 2002). The Chronbach's alpha values for each of the indices indicate that the teacher Community Contacts and Factual Information test in particular have a relatively high degree of internal consistency.[15]

[Table 3 about here]

Estimation

Standard estimates of the effect of child health and nutrition on schooling enrollment decisions are likely to be biased because families make decisions about health and schooling based on unobserved individual, family and community factors that are difficult to measure and/or control and are likely to be correlated with children's health and nutrition. Better schools and teachers may be located in areas where families are better-off and children are better nourished due to factors (*e.g.* political allocation rules that favor wealthier communities) that are unobserved. Conversely, it is also possible that resources for schools are channeled to disadvantaged areas due to equity considerations. We posit that enrolling in school among school age children is a function of several characteristics including health and nutrition, family background, and school and teacher quality, all measured during pre-school years. In some of the specifications, we allow for interactions between various dimensions of school and teacher quality and children's nutrition, or between aspects of school and teacher quality and family background. Specifically, we estimate the following basic relation:

(1) $E = a_1C^o + a_2C^u + a_3H^o + a_4H^u + a_5F^o + a_6F^u + a_7B^o + a_8B^u + a_9S^o + a_{10}S^u + a_{11}H^oS^o + a_{12}H^uS^u + a_{13}F^oS^o + a_{14}F^uS^u + v$,

where E is a binary indicator for whether a school age child is enrolled in grade 1 at round 3, C is a vector of child demographic characteristics (age and sex), H refers to child health prior to the age range for possible school enrollment, F is a vector of family characteristics (e.g. parents' schooling, height, physical assets), B is a vector of barangay characteristics, S is a vector of school characteristics (including school and teacher quality), the superscript "o" means observed in the data, the superscript "u" means unobserved in the data, v is a random disturbance term, and the a_i's are vectors of parameters that show the impact of the variables in the model on the child's enrollment in grade one. We measure vector B using barangay-level fixed effects in some of the specifications of relation (1) to control for all barangay characteristics (including the ones that may have affected school placement and/or quality through political processes) but allow consistent estimation of the interactive effects of prior child health and nutrition and school and teacher quality, or family background and school and teacher quality, on enrollment.

OLS estimates of relation (1) are unlikely to yield consistent estimates of the main parameter of interest, a_3 (or interactions involving child health such as a_{11}) because the disturbance term (including all the unobserved variables plus v) is likely correlated with H^o and S^o (via H^u and S^u) and thus the interaction between H^o and S^o. Instrumental variable (IV) estimates can permit consistent estimation of the effect of prior child health and nutrition on enrollment if two general conditions are met: 1) the instruments and the endogenous variable, in this case height for age z scores or hemoglobin levels of children, are sufficiently correlated and 2) the relationship between the instruments and school enrollment is only due to the correlation between the instruments and the endogenous variables (Bound, Jaeger and Baker 1995; Wooldridge 2002). As often noted, locating instruments that meet these conditions is difficult.

In this analysis, we use the quality of pre-school service providers in round 1 as instruments for child health and nutrition measured in round 2. Namely, we consider providers that work in daycare centers that serve the community in which children live. We do not use information on another category of providers, the "daycare mother", a home based provider, because a substantial number of barangays do not have such a provider. The first stage relation is:

(2) $H = a_1D^o + a_2D^u + a_3KAP^o + a_4KAP^u + a_5J^o + a_6J^u + u$,

where D indicates whether daycare providers are found in the community, KAP refers to the ECD- related values and knowledge of these providers, and J refers to job and basic demographic data (*e.g.* schooling, on the job training in past year).[16] Our supposition is that the characteristics of these providers at the first round 1 may have important correlations with subsequent child health at round 2, but do not enter directly into the enrollment equation through other avenues. However, it is also possible that the activities of providers may have lead to other changes in parent behavior, or time use by families, for example, that also directly affected enrollment behavior. Note that about 60 percent of the children were enrolled in a daycare program during their preschool years as observed either in the first or second round. Thus many children were directly in contact with these providers, suggesting that the characteristics of the latter are potentially good instruments for child health, but also raising the possibility that they enter into the enrollment equation in ways other than those related to child health and nutrition.

In Table 4, we show the means for the instruments. There is information on the daycare provider that serves their community for about 86 percent of children. About 43 percent of providers have completed at least four years of college, about 82 percent are a member of a social or community organization, and nearly 60 percent received job-related training in the year before the survey interview. Providers engaged in collective action or community projects about 13 times in the year before the survey, on average. In round 1, although the SPAS instruments were not administered to providers, they were asked a few questions related to early childhood development (KAP, "Knowledge Attitudes and Practices). We show the average agreement with the items on the KAP test, which we use as instruments (again based on those that display sufficient variance and do not have many missing values). A substantial percentage of providers appear to provide incorrect answers to some (e.g. 1, 4 and 7) but not all the questions.

[Table 4 about here]

Results

Basic Estimates

In Table 5 we summarize the results for the effect of nutrition on school enrollment based on relation (1), using a specification where a_9, a_{11} , and a_{13} are equal to zero. The full set of results is shown in Tables A3-A4 and the first stage estimates for child health and nutrition are in Table A2. The top panel shows coefficient estimates for height-for-age z scores. The OLS estimate for child nutrition is positive and significant with a t-statistic of 5.2. Adding barangay controls to the model increases variance explained from 25 to about 46 percent and the coefficient for height for age increases by about 10 percent, suggesting that there are omitted variables at the community level that are negatively correlated with child nutrition and schooling. The IV estimate in row 3 is imprecisely estimated with a t statistic of .96. The same is true for the IV estimates that include community controls in row 4. This suggests a weak correlations between the instruments and height for age z scores. As shown in the last row, only 2 percent of the variance in the first stage model is explained by the instruments. The overidentification test (or the Hansen J statistic) is rejected and there does not appear to be much value added to the IV compared to the OLS estimates as indicated by the Hausman test statistics[17] (both for the individual coefficient for height for age and the overall model).

[Table 5 about here]

The bottom half of the panel shows the estimated effect of hemoglobin levels on primary school enrollment. The OLS estimate in the first row shows a statistically significant and positive effect on enrollment of .028 (t = 2.2) that is modest in magnitude. The IV estimate is considerably larger than the OLS results at .24 (t = 3.1) and indicates that a standard deviation increase in hemoglobin raises the predicted probability of enrollment by .24. Adding fixed effects to the IV model increases the coefficient to about .27. The Hausman test statistics suggest a rejection of the OLS model in favor of the IV model, and the F statistic for the joint significance of the excluded IV's (3.15) is also significant at the .01 level. The Hansen J statistic is not significant at the .10 level, suggesting that the IV model is identified. The instruments account for 3 percent of the variance in hemoglobin, which is half of the modest 6 percent of variance explained by the overall first stage model shown in Table A2.

In sum, for height for age z scores we make the IV estimates available but we urge caution regarding their viability. For this indicator, we restrict ourselves to the OLS estimates from here on but include barangay fixed effects in the specifications to control for observed and unobserved community characteristics.[18] For hemoglobin, the test statistics indicate that the IV estimates should be preferred, but all of the qualifications that are associated with the use of relatively weak instruments apply (Bound, Jaeger and Baker 1995; Staiger and Stock 1997; Stock and Yogo 2002).

Interactions between Family Background and School Characteristics

In Table 6, we turn to the second research question regarding the association between school and teacher quality and school enrollment, as well as the interactions between measures of family background and the characteristics of primary schools and teachers. In the interests of parsimony and to avoid multicollinearity, we did not include all the possible interactions between mother's schooling, father's schooling, and mother's height on the one hand, and the school and teacher variables on the other. Instead, we focus on the interactions involving mother's schooling because much previous literature suggests that mother's schooling is of particular importance (*e.g.* Caldwell 1979; Desai and Alva 1998; Glewwe 1998).

[Table 6 about here]

The results for models 1 and 2 indicate that the six measures of school quality have a mix of positive and negative associations with grade 1 enrollment (model 1). The student to teacher ratio has a statistically significant and negative relation with enrollment, as does the teacher score on the Factual Information test. The F statistic for all the school quality variables is significant at the .05 level in model 1, but this is no longer the case once municipality level controls are included in model 2. (Note that we include municipality rather than barangay fixed effects to obtain estimates for the school variables that are common across children within a barangay and are time invariant). In model 3, we allow a_{13} in relation (1) to be non zero, and estimate interactions between mother's schooling and school characteristics. A joint F test that all the interactions are zero is not rejected. In model 4, which adds community (or barangay) fixed effects to model 3, all the interactions are significantly different from zero ($p<.05$). Two of the six individual estimates for the interactions are statistically significant at this level, and indicate that the association between the basic infrastructure available in schools and grade 1 enrollment is larger for children whose mothers have more schooling. The pupil to teacher ratio has larger negative effect on enrollment for mothers with more schooling.

The final aspect of interactions between school and family background characteristics relates to school accessibility rather than quality. A consistent finding that is evident in Tables A3-A5, and in Table 6, is that the association between being near a school and being enrolled in grade 1 is larger for children whose parents, particularly fathers, have more schooling. The two interactions between each parent's schooling and having a school within walking distance are positive and statistically different from zero either at the 5 or 10 percent level in most of the models shown in these tables. The coefficient for the interaction between father's schooling and school accessibility is often significant at the .05 level, but only in models that include controls for barangay, suggesting the importance of controlling for omitted community level variables that correlated with the variables in the model.

Interactions between Nutrition and School Characteristics

Tables A5-A6 show the estimates where we allow a_{11} in relation (1), or the interaction between child nutritional status and school quality variables, to be non-zero. Since nutrition and school quality are endogenous variables, we avoid introducing additional bias by including the full set of possible interactions between all the school variables and nutrition. Instead, we choose two indicators of quality: the teacher's contact with the community she serves, and the pupil to teacher ratio. Alternate specifications that included other measures of school quality did not yield appreciably different results. Table A5 pertains to height for age z scores, and shows that are no important interactions between the school indicators and child nutrition. A joint test of the two interactions included is not significant at the 10 percent level. Table A6 shows the analogous estimates for hemoglobin, where this indicator is treated as endogenous. Here, there are also no important interactions between hemoglobin and school quality in model 1. In model 2, which includes community fixed effects, the estimates are imprecise, possibly due to the large number of community controls included. We experimented with municipality controls (24 in total), which did not change the results appreciably.

Additional Considerations[19]

The ECD Program: About two thirds of the children live in a barangay that received the ECD program. In a basic IV specification where hemoglobin was treated as endogenous, we tested for interactions between hemoglobin, family background, child sex, and living in an area that received the ECD program. We did not find that such interactions are significantly different from zero taken as a set. We also tested for interactions between measures of school and teacher quality and living in a treatment area, and did not find important interactions here either.

Gender: There are consistent and significant negative associations between being a boy and primary school enrollment in all the models. To assess whether such gender differences are due to differential effects of nutrition, family background or school availability for boys and girls, in the IV specification for hemoglobin, we included interactions of sex with hemoglobin levels, family background characteristics and school availability. We found that taken as a set, these interactions are not significantly different from zero. We also re-estimated the model in Table 6 with interactions between child sex and all the six measures of school and teacher school quality. The interactions are not different from zero in the model without community controls but once such controls are added, they are jointly significant at the .05 level. These estimates (not shown) indicate that the largest estimated interactions (relative to the standard errors) occur between gender and the teacher score on one of the SPAS subtests and the teacher contacts with the community. Both indicate that the positive effect of these elements of schools and teachers on enrollment is larger among boys than for girls with control for community fixed effects.

Conclusion

In this analysis, we examine the effect of children's health and nutrition on primary school enrollment in the Philippines. We use longitudinal data on school age children, families, pre-school health and ECD-related service providers, and schools and teachers collected in three regions of the Philippines. We correct our estimate of the effect of child health and nutrition on schooling for bias due to omitted variables using instrumental variables in the form characteristics of pre-school ECD-related providers. We find that height for age z scores and hemoglobin levels of children during pre-school years have statistically significant and positive impacts on grade 1 enrollment. The assumptions required for the instrumental variables we use to provide consistent estimates of the endogenous variables seem to hold for hemoglobin levels. For this indicator, the instrumental variable estimate is considerably larger in magnitude than the OLS estimate. This suggests that there are important omitted variables that are negatively correlated with child health and nutrition that lead to underestimates of the effect of hemoglobin levels on schooling enrollment. The findings suggest the need for further social science research on iron-deficiency anemia among women and children and its correlates (*e.g.* family background, nutritional intake and child care practices) and implications for other dimensions of health and well-being including school enrollment, retention, and achievement in low and middle income countries including the Philippines.

We also consider the effect of multiple dimensions of school and teacher quality on public primary schools at pre-school age on subsequent school enrollment. The pupil to teacher ratio has a negative and significant effect on enrollment. The teachers' scores on a Factual Information test have a negative effect on enrollment as well, a finding that is inconsistent with the notion that teacher skills should be positively associated with enrollment in school. A likely explanation for this result is that teachers with better skills are selectively placed in areas that are disadvantaged. We also explored the possibility of interactions between school and teacher characteristics and child nutrition. We find no evidence that the association between nutrition and school enrollment, including when nutrition is treated as endogenous, depends on the quality of schools and teaches in the community.

There are important interactions between family background and school characteristics in their association with enrollment. The positive effect of school infrastructure on children's schooling enrollment is significantly larger among those whose mothers have more years of schooling. The negative effect of higher student to teacher ratios on enrollment is larger among children whose mothers have more schooling. And the positive effect of the accessibility of schools on enrolling in school is significantly larger for children with parents who have more schooling. These findings indicate important *complementarities* between family resources and school accessibility and school quality in their import for primary school enrollment. Policies that aim to change behavior related to schooling performance among children thus may have differential effects depending on the schooling levels among families, and may amplify rather than narrow existing inequalities in resources. All these results are either not apparent or are weaker in magnitude in models that do not control for all omitted community variables, particularly at the barangay level. Along with the other findings, this emphasizes the importance of accounting for omitted child, family and community characteristics, to the extent possible, when assessing the effects of ECD-related programs and ECD, including nutrition, on the schooling outcomes of children.

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Notes

[1] See for example Alderman et al. 2001a; Behrman and Lavy 1994; Bobonis, Miguel and Sharma 2004; Daniels and Adair, 2004; Fentiman, Hall and Bundy 2001; Glewwe and Jacoby 1995; Glewwe, Jacoby and King 2001; Jamieson, 1986; Maluccio et al. 2005; Miguel and Kremer 2004; Montresor et al. 2001; Moock and Leslie, 1986. Also see Behrman 1993, 1996 and Glewwe 2005 for reviews.

[2] See, for example Bacolod and King, 2003; Behrman and Birdsall 1983, 1985; Case and Deaton 1999; Glewwe and Jacoby 1994; Glewwe et al. 1995, 1996; Harbison and Hanushek 1992; Kingdon 1996 and Park and Hannum, 2001. Also see Fuller 1987; Fuller and Clarke 1994; Glewwe, 2002, Hanushek 1995 and Velez, Schiefelbein and Valenzuela, 1993 for reviews.

[3] The factors found to have statistically significant positive effects on primary school enrollment at the .10 level or better are the presence of a school in the village and the "share of teachers residing in the village" (Lloyd, Mete and Sathar 2005, p. 707) and expenditures per school (Alderman et al.2001b). The latter study also found that the student to teacher ratio had a negative effect on enrollment.

[4] See Ghuman et al., 2005 for a recent review. In a conceptually similar vein, Bacolod and King (2003) employ quantile regression to show that the benefits of lowering student to teacher ratios or hiring teachers with more years of experience in terms of higher math achievement test scores are greater among pupils who are high achievers.

[5] The NER is the ratio of the number of school age children enrolled in school to the total

school age population.

[6] A barangay is the smallest political unit in the Philippines and is akin to a district or village.

[7] This classification was based on a list of program barangays provided by the Project Management Office (PMO) and verified with the DSWD field offices in the respective areas.

[8] Child development workers, a provider installed in communities that participated in the ECD program, were also interviewed. Since the non-program region does not contain information on these providers, we do not use information on these providers in the analysis.

[9] Although such data is also available from caretakers (generally grandmothers) of children whose mother is not available for interview, we exclude this information since important data on anthropometrics was not collected from caretakers. Few children are missing parent data (Table 2) and we include dummy variable to control for this in the estimates.

[10] Children less than age six months are generally not included because among full-term infants the risk of iron deficiency in this age range is relatively low due to adequate iron provisions from the perinatal period (World Health Organization 2001). Hemoglobin levels were determined by diluting blood samples with a cyanmethemoglobin reagent in a spectrophotometer and using the proportional relationship of the absorbance of the reagent with the concentration of hemoglobin to determine the latter quantity. This method is one of two generally recommended as best for assessing hemoglobin levels in surveys (World Health Organization 2001).

[11] Although the data permit including household schooling and medical expenditures, we avoid including these components of expenditure because *a priori* these would seem to be determined simultaneously with schooling decisions and child nutrition.

[12] Of course one could examine the correlates of the choice between not enrolling in grade one, enrolling in the public school in the same barangay, and enrolling in the public school in the next barangay.

[13] The difficulties that arise when estimating the effect of child health on schooling also apply here since omitted variables (*e.g.* teacher motivation) may be correlated with the indicators of school quality in the model, thus biasing the parameter estimates (Glewwe 2002). For example, the teacher's willingness to visit homes in the barangay may depend on such unobserved levels of motivation, thus leading to an upward bias in the coefficient estimate. In future versions of the paper we will explore addressing this source of bias using IV's, for example, related to the prior and current job and demographic characteristics of grade one teachers.

[14] At the moment, this subtest has no passing score (Ledesma 2002) but further work to standardize and norm these scores is planned for the future. Teachers score about 1-2 points higher on this subtest than daycare providers and child development workers.

[15] Chronbach's alpha ranges from 0 to 1 and is a function of the average inter-item correlation and the number of items in a scale.

[16] In cases where there is no provider we replace the variables with a value of zero but include in the first stage specifications the indicator for presence of provider.

[17] The Durbin-Wu-Hausman F statistic is a test of the null hypothesis that an OLS regression would yield consistent estimates, or that the endogenous variable is uncorrelated with the error term (Wooldridge 2002). The Hansen J chi-square statistic tests the null hypothesis that the excluded instruments are valid instruments in that they are uncorrelated with the error term in relation(1).

[18] We also used food prices for identification as in Alderman et al. 2001a and Glewwe and King, 2001. We considered food prices for basic commodities such as milk, rice, and corn and interactions of these prices with child sex, and each parent's schooling, in addition to barangay fixed effects (to control for their deviation from long run prices) but the test statistics indicated that the models were not identified nor were they appreciably different from an OLS estimator as indicated by Hausman test statistics.

[19] Due to the difficulties involved in collecting valid cost information from public primary schools, we are unable to calculate cost-benefit ratios associated with different dimensions of school and teacher inputs (*i.e.* reduced student teacher ratios or improved infrastructure) as policy instruments for encouraging school enrollment in this version of the paper.

Table 1. Means and Standard Deviations for Child Variables

	Mean	SD
Sex (1 = Male)	.542	.499
Age Distribution (months)		
72 to 78	.428	.491
79 to 84	.391	.491
84+	.180	.393
Height-for-Age Z Score[a]	-1.87	.962
Stunted	45.7	.499
Hemoglobin (grams/deciliter) [a]	11.3	1.14
Anemic	.537	.500
Enrolled in Grade 1[b]		
Boys	.418	.494
Girls	.552	.50
Total	.48	.499
N	1,251	

Note: table refers to those of school age at latest round (see text).
a Measured at round 2. For hemoglobin and percentage anemic, N = 1,227
b Measured at round 3.

Table 2. Means and Standard Deviations for Family Background Variables

Variable	Mean	SD
Parents		
Mother's schooling (grades)	8.74	3.89
Father's schooling (grades)	7.52	4.15
Mother's height (cm)	146.5	27.8
Mother's age	32.1	8.68
Mother present	.972	.182
Father present	.923	.231
Family Physical Assets		
Food expenditures (pesos):	747.3	435.3
Own Land (on which house stands)	.331	.463
Bicycle	.189	.384
Motor Vehicle (car, jeep, motor cycle)	.073	.245
Living room set	.265	.436
Dining room set	.331	.482
Bed with mattress	.183	.315
Bed without mattress	.397	.475
Electric iron	.250	.389
Electric fan	.332	.429
Sewing machine	.059	.210
Refrigerator	.170	.332
Stove	.188	.357
Range	.055	.192
Color television	.301	.426
VCR	.095	.254
Household Characteristics		
Number of rooms	2.70	1.24
Number of persons	6.40	2.29
Have electricity	.592	.499
Flush/water seal toilet	.621	.491
Use wood fuel for cooking	.813	.371
Public primary school within walking distance	.80	.353

Note: all characteristics are measured at the first round when children are of pre-school age.

Table 3. Means and Standard Deviations for Primary School and Teacher Variables

Variable	Mean	SD
Schools		
Basic Infrastructure		
Has electricity	.749	.461
Piped water inside	.268	.412
Piped water outside	.275	.449
Toilet inside	.625	.465
Washing area for children inside	.660	.450
Exterior clean	.453	.445
Well ventilated	.772	.392
Repaired/upgraded in last 3 years	.604	.471
Sum (0-8)	4.41	1.82
Chronbach's Alpha	.60	
Education/ECD Related Materials		
Height measure	.521	.479
Weighing scale	.302	.478
Bulletin board	.889	.237
Desks	.791	.340
Chairs	.712	.313
Toys	.735	.401
Drawing materials (paper, pencils, crayons)	.423	.481
First aid kit	.474	.454
Nap area	.831	.418
Play area inside	.082	.272
Sum (0-10)	5.76	1.66
Chronbach's Alpha	.60	
Student/Teacher Ratio	37.1	12.8
Teachers		
Community Contacts		
Talks to parents	.227	.348
Conduct follow up/home visits	.497	.461
Visits households in community weekly	.589	.455
Sum (0-3)	1.31	1.04
Chronbach's Alpha	.75	
Service Provider Assessment Scale		
Factual Information Score (11 – 39)	29.7	4.53
Chronbach's Alpha	.79	
Attitudes, Values, Beliefs Score (21 – 45)	34.0	3.53
Chronbach's Alpha	.51	

Note: all variables measured during pre-school years at round 2.

Table 4. Means and Standard Deviations for Pre-School Service Provider Variables

Variable	Mean	SD
Daycare Workers		
Data available[a]	.856	.351
Salary per month (pesos)	2,492.4	1811.7
Completed years of college or more	.43	.456
Member of a social organization	.816	.403
Number of times engaged in collective actions in past year	12.6	13.1
Received job related training in past year	.588	.485
Knowledge-Attitude-Practice (KAP) Statements (agreement)		
1. A child with high fever should never be given a bath	.641	.435
2. When a newborn child is healthy and without problems, there is no need to bring the child to the clinic for check ups	.177	.365
3. Prenatal care is only important for women who are pregnant for the first time.	.151	.332
4. Children who are afraid of their parents behave better.	.572	.485
5. Children learn faster if teachers are strict.	.319	.457
6. It is not good for a child to ask a lot of questions.	.126	.350
7. A child who enters grade 1 without knowing the alphabet nor how to count will have difficulty in class	.875	.285

Note: all variables measured at round 1.

a For 46 percent of children with missing data, there is no daycare center in their community. For the remaining cases, data is generally missing because the provider was not available for interview or the center had no provider (personal communication, OPS).

Table 5. Summary of Effect of Child Nutrition on Grade 1 School Enrollment from Alternate Models (x-standardized regression coefficients)

Nutrition Indicator	Height for Age Z Score		
	Coefficient (t statistic)	Model R-square	Test Statistics (p-value)
1. OLS	.071 (5.2)	.25	
2. OLS (with fixed effects)	.079 (5.42)	.46	
3. IV	.081 (.95)	.25	33.7[a] (.0007)
4. IV (with fixed effects)	.060 (.96)	.45	
Difference (1-3)	-.010		
Hausman (t statistic)	.115		.012[b] (.912)
F statistic (for IV's)			2.43*
Partial R square (for excluded instruments)		.02	
	Hemoglobin		
	Coefficient (t statistic)	Model R-square	Test Statistics (p-value)
1. OLS	.028 (2.16)	.23	
2. OLS (with fixed effects)	.014 (.86)	.44	
3. IV	.243 (3.1)	.06	17.4[a] (.135)
4. IV (with fixed effects)	.268 (2.78)	.27	
Difference (1-3)	-.215		
Hausman (t statistic)	2.78		9.46[b] (.002)
F statistic (for IV's)			3.15*
Partial R square (for excluded instruments)		.03	

See Tables A3 and A4 for full set of estimates.
Robust standard errors with 1235 (height for age Z score) and 1212 (hemoglobin) household clusters.
a Hansen J chi-square statistic with p-value in parentheses (test for overidentification).
b Durbin-Wu-Hausman Chi-Square statistic with p-value in parentheses.

Table 6. OLS Regression Estimates for Grade 1 Enrollment with School Quality and Interactions of School Quality with Family Background, N = 1,251

Model	1	2	3	4
Age				
72 to 78 months	--	--	--	--
79 to 84 months	.337*	.334*	.337*	.317*
	(.028)	(.028)	(.028)	(.028)
84 months+	.569*	.578*	.567*	.561*
	(.032)	(.032)	(.032)	(.034)
Sex (male)	-.104*	-.103*	-.105*	-.110*
	(.025)	(.025)	(.025)	(.024)
Mother's height	.004+	.004~	.005+	.005+
	(.002)	(.002)	(.002)	(.002)
Mother's age	-.036~	-.040+	-.036~	-.015
	(.019)	(.019)	(.019)	(.019)
Mother's age squared	.0004~	.0005~	.0004~	.0001
	(.0002)	(.0003)	(.0002)	(.0002)
Mother's schooling	.006	.005	.040	.009
	(.008)	(.008)	(.038)	(.041)
Father's schooling	-.001	-.002	-.001	-.009
	(.008)	(.008)	(.008)	(.008)
Expenditure Quartiles				
Bottom fourth	.055	.045	.060	.053
	(.040)	(.040)	(.040)	(.041)
25 to 50	-.030	-.027	-.023	-.033
	(.039)	(.039)	(.039)	(.041)
50 to 75	.013	.009	.018	.002
	(.038)	(.038)	(.038)	(.038)
Upper fourth	--	--	--	--
Public primary school within walking distance	-.123	-.142~	-.146~	-.149
	(.080)	(.081)	(.082)	(.092)
School within walking dist * father's schooling	.011	.012	.011	.016+
	(.008)	(.008)	(.008)	(.008)
School within walking dist * mother's schooling	.009	.010	.013	.008
	(.009)	(.009)	(.009)	(.009)
Schools				
Basic Infrastructure	-.004	-.008	-.024	--
	(.007)	(.007)	(.017)	
ECD/Education Related Materials	.005	.009	.045+	--
	(.008)	(.009)	(.021)	
Pupil/Teacher Ratio	-.003*	-.002+	-.001	--
	(.001)	(.001)	(.002)	
Teachers				
Community Contacts	.022~	.015	.070+	--
	(.012)	(.013)	(.029)	
Factual Information Score	-.008+	-.007+	-.002	--
	(.003)	(.003)	(.007)	
Attitudes and Values Score	.004	.004	-.0007	--
	(.004)	(.004)	(.009)	
Interactions of School Quality with Mother's Schooling				

School Infrastructure			.002 (.002)	.005+ (.002)
ECD/Education Related Materials			-.005+ (.002)	-.003 (.002)
Pupil/Teacher Ratio			-.0002 (.0002)	-.0006+ (.0003)
Teacher Contacts			-.005~ (.003)	-.002 (.003)
Teacher Factual Information Score			-.0005 (.0008)	.0003 (.0008)
Teacher Attitudes/Values Score			.0004 (.001)	.0004 (.001)
Barangay (municipality) fixed effects	No	Yes	No	Yes
F or Chi Square (interactions of school availability with family background)	2.92~	3.41+	3.57+	3.51+
F (interactions of school quality*mother's schooling)	n.a.	n.a.	1.43	2.10+
F (school quality main effects)	3.1*	1.93~	1.46	n.a.
R squared	.25	.27	.25	.45

n.a. not estimated or not applicable. Model 2 includes municipality fixed effects.
Note: standard errors corrected for clustering at household level.
~p<.10; +p<.05; *p<.01. Controls for presence of mother and father included (not shown).

APPENDIX

Table A1. First Stage OLS Regression Estimates for Household Physical Assets

Physical Asset/Household Characteristic	Coefficient	t-statistic (absolute value)
Own Land (on which house stands)	11.4	1.02
Bicycle	29.8	2.16
Motor Vehicle (car, jeep, motor cycle)	160.6	7.3
Living room set	10.4	.72
Dining room set	34.8	2.85
Bed with mattress	152.9	8.33
Bed without mattress	38.9	3.39
Electric iron	49.3	2.75
Electric fan	40.4	2.37
Sewing machine	84.1	3.86
Refrigerator	117.9	5.72
Stove	73.7	3.85
Range	195.3	7.25
Color television	56.8	3.36
VCR	145.1	6.49
Housing Characteristics		
Number of rooms	-.509	.11
Number of persons	50.4	20.9
Have electricity	30.9	2.36
Flush/water seal toilet	38.8	3.24
Use wood fuel	-142.8	7.99
R squared	.40	
N (number of households)	5,999	
Predicted Expenditure	683.2	321.1
Correlation with food expenditures	.58 (p <.01)	

Table A2. First Stage OLS Regression Estimates for Child Health/Nutrition

	Height-for-Age Z	Hemoglobin
Age		
72 to 78 months	--	--
79 to 84 months	.019	.102
	(.054)	(.071)
84 months+	.049	.098
	(.068)	(.092)
Sex (male)	-.127+	-.092
	(.049)	(.064)
Mother's height	.055*	.003
	(.007)	(.006)
Mother's age	.005	.020
	(.035)	(.052)
Mother's age squared	-.0001	-.0005
	(.0005)	(.0007)
Mother's schooling	.004	.005
	(.021)	(.021)
Father's schooling	.040	.031
	(.020)	(.019)
Expenditure Quartiles		
Bottom fourth	-.103	-.036
	(.084	(.101)
25 to 50	-.238*	-.199~
	(.081)	(.107)
50 to 75	-.156+	-.197+
	(.077)	(.099)
Upper fourth	--	--
Public primary school within walking distance	-.163 (.163	.068 (.218)
School within walking dist * father's schooling	-.026 (.020)	-.018 (.021)
School within walking dist * mother's schooling	.043+ (.022)	.006 (.023)
Pre-School Provider Characteristics		
Provider available	-.331+	-.283
	(.150)	(.197)
Salary per month	.00005*	-.00001
	(.00001)	(.00001)
Has college education	-.086	.032
	(.061)	(.085)
Member of a social organization	.117~ (.069)	-.146 (.092)

Number of times engaged in collective actions in past year	-.002 (.002)	-.0004 (.002)
Received job related training in past year	.075 (.055)	.123~ (.071)
Knowledge-Attitude-Practice (KAP) Statements		
1. A child with high fever should never be given a bath	-.127+ (.061)	-.034 (.079)
2. When a newborn child is healthy and without problems, there is no need to bring the child to the clinic for check ups	-.017 (.084)	-.267+ (.104)
3. Prenatal care is only important for women who are pregnant for the first time.	-.011 (.092)	-.148 (.113)
4. Children who are afraid of their parents behave better.	.035 (.059)	-.173+ (.081)
5. Children learn faster if teachers are strict.	.039 (.062)	.173+ (.082)
6. It is not good for a child to ask a lot of questions.	.056 (.090)	.152 (.094)
7. A child who enters grade 1 without knowing the alphabet nor how to count will have difficulty in class	.123 (.105)	.224 (.147)
R-square (model)	.22	.06
N	1251	1227

Note: standard errors corrected for clustering at household level. ~p<.10; +p<.05; *p<.01. Controls for presence of mother and father included (not shown).

Table A3. OLS Regression Estimates for Grade 1 School Enrollment and Height for Age Z Scores (N = 1,251)

Model	1 OLS	2 OLS	3 IV	4 IV
Height for Age Z Score	.074*	.082*	.084	.062
	(.014)	(.015)	(.088)	(.065)
Age				
72 to 78 months	--	--	--	--
79 to 84 months	.339*	.322*	.339*	.318*
	(.028)	(.031)	(.028)	(.031)
84 months+	.559*	.560*	.558*	.557*
	(.031)	(.037)	(.031)	(.038)
Sex (male)	-.095*	-.104*	-.094*	-.105*
	(.024)	(.027)	(.027)	(.028)
Mother's height	-.0003	.0003	-.0008	.001
	(.002)	(.003)	(.005)	(.002)
Mother's age	-.033~	-.013	-.033~	-.015
	(.019)	(.021)	(.019)	(.025)
Mother's age squared	.0005	.0001	.0004	.0001
	(.0003)	(.0003)	(.0002)	(.0003)
Mother's schooling	.008	.013	.008	.012
	(.008)	(.009)	(.008)	(.009)
Father's schooling	-.005	-.013	-.005	-.013
	(.008)	(.008)	(.008)	(.009)
Expenditure Quartiles				
Bottom fourth	.076+	.056	.077~	.048
	(.038)	(.046)	(.040)	(.048)
25 to 50	-.0004	-.025	.002	-.032
	(.0002)	(.045)	(.044)	(.049)
50 to 75	.032	-.005	.033	-.004
	(.037)	(.042)	(.040)	(.045)
Upper fourth	--	--	--	--
Public primary school within walking distance	-.086	-.111	-.084	-.132
	(.078)	(.101)	(.079)	(.104)
School within walking dist * father's schooling	.013	.020+	.013	.020+
	(.008)	(.009)	(.008)	(.009)
School within walking dist * mother's schooling	.006	.0004	.006	.002
	(.008)	(.010)	(.009)	(.011)
Barangay fixed effects	No	Yes	No	Yes
F or Chi Square (interactions of school availability with family background)	2.46~	2.74~	4.96~	2.85~
R squared	.25	.46	.25	.45

a – instruments are shown in Table 4.
Robust standard errors corrected for clustering at household level. ~p<.10; +p<.05; *p<.01. Controls for presence of mother and father included (not shown).

Table A4. OLS Regression Estimates for Grade 1 Enrollment and Hemoglobin (N = 1,227)

Model	1	2	3	4
	OLS	OLS	IV[a]	IV[a]
Hemoglobin	.025+	.012	.215*	.237*
	(.011)	(.014)	(.069)	(.085)
Age				
72 to 78 months	--	--	--	--
79 to 84 months	.335*	.312*	.312*	.305*
	(.028)	(.031)	(.033)	(.036)
84 months+	.550*	.545*	.535*	.542*
	(.033)	(.038)	(.038)	(.041)
Sex (male)	-.107*	-.115*	-.089*	-.087*
	(.025)	(.028)	(.028)	(.031)
Mother's height	.004	.005~	.003	.002
	(.002)	(.003)	(.002)	(.002)
Mother's age	-.031	-.006	-.033	-.038~
	(.019)	(.021)	(.021)	(.024)
Mother's age squared	.0004	.0006	.0005	.0005~
	(.0003)	(.0003)	(.0003)	(.0003)
Mother's schooling	.008	.012*	.009	.006
	(.009)	(.010)	(.009)	(.010)
Father's schooling	-.002	-.009	-.010	-.011
	(.008)	(.009)	(.008)	(.010)
Expenditure Quartiles				
Bottom fourth	.075+	.046	-.079~	.071
	(.039)	(.047)	(.043)	(.048)
25 to 50	-.007	-.034	.028	.035
	(.039)	(.046)	(.046)	(.050)
50 to 75	.023	-.013	.056	.056
	(.038)	(.043)	(.043)	(.048)
Upper fourth	--	--	--	--
Public primary school within walking distance	-.106	-.138	-.129	-.151
	(.080)	(.103)	(.083)	(.099)
School within walking dist * father's schooling	.012	.019+	.017+	.018~
	(.008)	(.009)	(.008)	(.010)
School within walking dist * mother's schooling	.009	.004	.008	.008
	(.009)	(.010)	(.009)	(.011)
Barangay or Municipality fixed effects	No	Yes	No	Yes
F or Chi Square (interactions of school availability with family background)	2.90+	2.82~	7.78+	3.23+
R squared	.23	.44	.06	.27

a – instruments are shown in Table 4. Robust standard errors corrected for clustering at household level. ~p<.10; +p<.05; *p<.01. Controls for presence of mother and father included (not shown). Controls for community in IV models are for municipality.

Table A5. OLS Regression Estimates for Grade 1 Enrollment with Height for Age Z Score and School Quality Interactions, N = 1,251

Model	1	2
Height for Age Z Score	.111+	.112+
	(.042)	(.044)
Age		
72 to 78 months	--	--
79 to 84 months	.334*	.322*
	(.028)	(.027)
84 months+	.561*	.559*
	(.031)	(.033)
Sex (male)	-.095*	-.105*
	(.024)	(.024)
Mother's height	.0004	.0002
	(.002)	(.002)
Mother's age	-.038+	-.013
	(.019)	(.019)
Mother's age squared	.0005~	.0002
	(.0002)	(.0003)
Mother's schooling	.005	.013
	(.008)	(.008)
Father's schooling	-.005	-.013~
	(.008)	(.008)
Expenditure Quartiles		
Bottom fourth	.057	.054
	(.039)	(.041)
25 to 50	-.009	-.026
	(.038)	(.041)
50 to 75	.021	-.006
	(.038)	(.038)
Upper fourth	--	--
Public primary school within walking distance	-.108	-.111
	(.078)	(.090)
School within walking dist * father's schooling	.013	.020+
	(.008)	(.008)
School within walking dist * mother's schooling	.008	.0004
	(.008)	(.009)
School/Teacher Quality		
Teacher Community Contact	.028~	--
	(.014)	
Pupil/Teacher Ratio	-.005+	--
	(.002)	
Interactions with Child Nutrition		
Teacher Community Contacts	.005	-.002
	(.005)	(.009)
Pupil/Teacher Ratio	-.001	-.0007
	(.001)	(.001)
Barangay fixed effects	No	Yes
F (school availability*family background)	2.74~	3.5+
F (interactions of school quality*nutrition)	1.0	.27

R squared	.26	.46

n.a. not estimated or not applicable.
Standard errors corrected for clustering at household level. p<.10; +p<.05; *p<.01.
Controls for presence of mother and father included (not shown).

Table A6. OLS Regression Estimates for Grade 1 Enrollment with Hemoglobin and School Quality Interactions, N = 1,227

Model	1	2
Hemoglobin	.277	.823
	(.176)	(1.69)
Age		
72 to 78 months	--	--
79 to 84 months	.306*	.220
	(.036)	(.185)
84 months+	.535*	.453+
	(.041)	(.198)
Sex (male)	-.086*	-.032
	(.031)	(.167)
Mother's height	.004	.002
	(.002)	(.004)
Mother's age	-.036	-.025
	(.024)	(.038)
Mother's age squared	.0005	.0005
	(.0003)	(.0006)
Mother's schooling	.005	.008
	(.011)	(.024)
Father's schooling	-.011	-.037
	(.010)	(.055)
Expenditure Quartiles		
Bottom fourth	.064	.077
	(.048)	(.133)
25 to 50	.022	.143
	(.049)	(.350)
50 to 75	.048	.162
	(.047)	(.338)
Upper fourth	--	--
Public primary school within walking distance	-.146	-.203
	(.096)	(.269)
School within walking dist * father's schooling	.018~	.036
	(.010)	(.037)
School within walking dist * mother's schooling	.008	-.001
	(.011)	(.026)
School/Teacher Quality		
Teacher Community Contact	.906~	.124
	(.545)	(1.8)
Pupil/Teacher Ratio	-.016	-.046
	(.048)	(.161)
Interactions with Child Nutrition		
Teacher Community Contact	-.078	-.005
	(.048)	(.155)
Pupil/Teacher Ratio	.001	.002
	(.004)	(.014)
Barangay fixed effects	No	Yes
F or Chi Square (interactions of school availability with family background)	3.23+	.57

F (interactions of school quality*nutrition)	1.31	.02
R squared	.25	.44

Hemoglobin values are predicted from regression shown in Table A2.
n.a. not estimated or not applicable.
Note: standard errors corrected for clustering at household level.
~p<.10; +p<.05; *p<.01. Controls for presence of mother and father included (not shown).