The Impact of Child Health on Schooling: Evidence from Bangladesh

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Abstract

This paper explores the impact of child health on educational achievement of Bangladeshi children. We control for the potential endogeneity of child health by an instrumental variables approach with the use of instruments that are strong predictors of child health and satisfy the validity test. Our results indicate that the impact of child health on school achievement will be overestimated if endogeneity of child health is ignored. Our results reveal that child health has significant effects on school enrolment and grade attainment, although it does not affect current school attendance. The impact of child health is stronger for school enrolment compared to grade attainment.

Keywords: Child Health, School Attainment, Bangladesh
JEL Classification: I12, I21,O12.

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1 Introduction

Health in childhood has a long lasting effect on schooling (Lawlor *et al.*, 2006; Black *et al.*, 2007; Oreopoulos *et al.*, 2008; Currie and Moretti, 2007), future health and earning (Case *et al.*, 2005; Johnson and Schoeni, 2007; Smith, 2007). Poor health in childhood can affect schooling directly by missing school days and indirectly by affecting cognition. Thus children with poor health are likely to have lower human capital (both in terms of schooling and health), which negatively affects their productivity and income in the future. In fact, health status and school attainment are complementary. Good health and education can lead to a higher future standard of living (Schultz, 1999). Therefore, investment in human capital is crucial for increasing productivity, which in turn enhances economic development.

Bangladesh is a poor country of South Asia with a population of 138 million with 41.3 per cent of its population lived on less than US$1 per day during the 1990-2005 period. The country's infant mortality rate (per 1000 live births) and under-5 mortality rate (per 1000 children) are, respectively, 46 and 69 (United Nations Development Program, 2008). The Bangladesh Demographic Health Survey (BDHS)-2004 notes that 43 per cent of Bangladeshi children under 5 years of age are short for their age or stunted, and 17 per cent are severely stunted. Additionally, 13 per cent of the Bangladeshi children are seriously underweight for their height, or wasted, and one per cent is severely wasted. Forty eight per cent of children are considered underweight (low weight for age), and 13 per cent are classified as severely underweight (ESCAP, 2005).

Early childhood malnutrition is widely perceived to affect various areas of child development including cognitive achievement. In this study we look at the impact of child health and nutrition on educational achievement of Bangladeshi children using a regional data set from Bangladesh. A better understanding of the association between child health and schooling is essential for a rapid expansion of education and economic development in developing countries through increased human capital investment.

An extensive literature reviewed by Pollitt (1990) and Behrman (1996) reported a significant positive association between child health and school performance. For example, Gomes-Neto *et al.* (1997) noted that nutrition and health status strongly affected both grade attainment and student achievement of Brazilian children. They found that the students' short term nutrition had a strong role in cognitive learning although it did not have the same effect on their grade repetition. Another study by Edwards and Grossman (1980) found significant effects of child health on cognitive development in cross sectional analyses while examining the effects of a variety of child health indicators of children 6-11 years of age. Similarly the works of Florencio (1988) on the Philippines and Pollitt *et al.* (1993) on Guatemala have found significant association between child health and child schooling. The studies of Chutikul (1986) in Thailand, Moock and Leslie (1986) in Nepal, Jamison (1986) in China, and Harbison and Hanushek (1992) in Brazil have also found a positive association between grade attainment and child height.

Most of the previous studies. such as Chutikul (1986), Jamison (1986), Moock and Leslie (1986), and Gomes-Neto et al. (1997), did not consider the fact that child health and schooling performance both reflects household decisions regarding investments into children's human capital, which is determined simultaneously in the household. In other words, most previous studies on the impact of child health on schooling did not control for the endogeneity of child health. Some exceptions are Glewwe and Jacoby (1995), Behrman and Lavy (1998), Glewwe *et al.* (2001), Alderman *et al.* (2001), Grira (2004), and Handa and Peterman (2007). Particularly, Glewwe and Jacoby (1995), Behrman and Lavy (1998), and

Grira (2004) controlled for unobserved heterogeneity by taking into account of household and community variables to identify child health. The estimates of child health found from these papers were considerably lower than those that did not control for the endogeneity of child health. These findings suggest that the impact of child health on schooling may be lower than commonly believed.[1] One possible issue is that household and community variables used in cross-sectional studies might be correlated with the unobserved variables affecting child schooling, which in turn could result in biased estimates. To overcome this problem, Alderman et al. (2001) controlled for unobserved heterogeneity using lagged price shocks to instrument earlier nutrition status of a child using longitudinal data from Pakistan.[2] They established a causal relationship between child health and schooling for Pakistani children. The authors found that the relationship between child's earlier health and subsequent schooling is actually much larger than those studies that did not account for behavioural choice. Using the same approach to Alderman et al. (2001), Handa and Peterman (2007), however, did not find any statistically significant relationship between child health and schooling in South Africa. The controversial findings from different studies place a great demand on further exploration of the impact of child health on schooling.

Although cross-sectional studies that used household and community variables to instrument child health provided similar trends in the impact of child health on child's schooling performance, longitudinal studies using lagged price shock to instrument child's earlier health provided quite different results across studies (see for example, Alderman et al., 2001, and Handa and Peterman, 2007). The divergence of results in different studies question the validity of instruments to identify child health.

This study improves our understanding on the relationship between child health and schooling in several ways. First, we use an instrumental variable approach, in which parental height variables that affect child health directly but do not affect schooling decision, are selected to identify child health. The point of departure of this study from the existing literature (for example, Grira 2004, Alderman *et al.*, 2001) is the use of the overidentification test, which confirms the validity of our instruments. The first-stage regressions reveal that our set of instrumental variables very strongly correlated with child health, and validity test also confirm the appropriateness of these instruments to predict child health.[3] Second, this study examines the effects of child health on a wide ranges of schooling measures: enrolment, attendance and attainment, whilst previous studies (see for example,Alderman *et al.*, 2001 and Handa and Peterman, 2007) focus mainly on enrolment. We hypothesise that child health affects not only enrolment probability but also school outcome. Our results reveal that child health has significant and expected effects on school enrolment, and grade attainment, although it does not affect current school attendance. Therefore, this study adds considerably to our understanding on the impact of child health on schooling.

The remainder of this paper is organised as follows: Section 2 describes the data source and descriptive statistics. Section 3 explains the choice of econometric methods. Section 4 presents and discusses the results of the study. Finally the paper concludes with a summary of main findings.

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[1] In a case where it is assumed that child health is predetermined rather than determined by household choices in the presence of unobserved factors.

[2] Lagged price shocks are correlated with early childhood health, but uncorrelated with subsequent period price shocks that influence schooling decision in later period.

[3] The first stage F-statistics is 31.41, which is greater than the rule of thumb value of 10 (Staiger and Stock, 1997; Stock *et al.*, 2002) showing that we do not have a weak instrument problem.

2 Data and Descriptive Statistics

The data set used in this study comes from a survey titled 'Micronutrient and Gender Study (MNGS) in Bangladesh'. This survey, which was administered by the International Food Policy Research Institute (IFPRI), collected data from three survey sites: Saturia, Mymensingh and Jessore in 1996-1997. The MNGS sampled a total of 957 households from 47 villages and collected data on 5,541 individuals residing in the sample households. It provided economic, demographic, agricultural, and gender information. The survey also contained information about the schooling, anthropometry, morbidity, reproductive history and mortality, hospitalisations, chronic diseases and use of health care facilities in the household. The data were collected in four rounds. This study restricts the sample only to the children of the first round of the survey, because other rounds included only those adult household members who were away from home at the time of the first round of the survey. These household members only account for a very small proportion of the total sample, hence it is expected that they do not affect the analysis. The present analysis is based on data for children aged 5–17 years living in rural households in which the mother and father are both present.

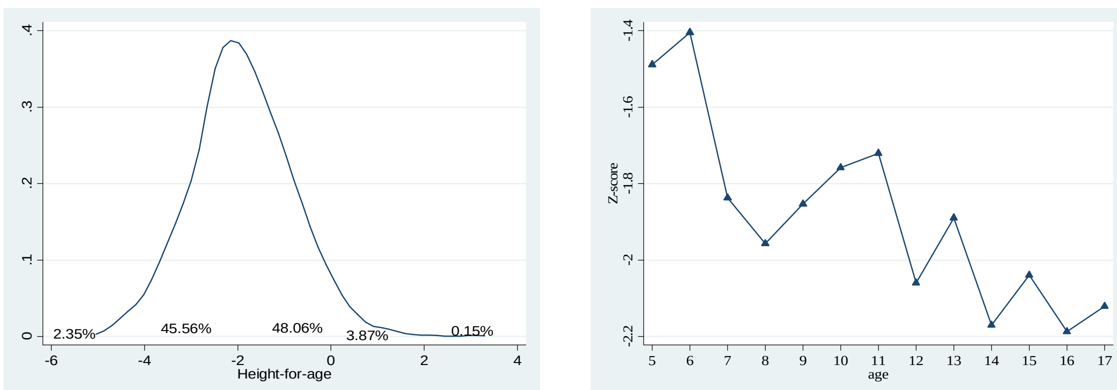
Child health in this study is measured by height-for-age, which is an important indicator of malnutrition (Waterlow, 1972). The Z-score method, recommended by the World Health Organisation (WHO), is used to measure a child's height-for-age. The z-score measures the degree to which a child's measurements deviate from what is expected for that child, based on a WHO/NCHS international reference population. In other words, the height-for-age is expressed as a number of standard deviations above or below the corresponding reference mean for a child of the same age and sex. We do not include in our study the height-for-weight variable because it is less than a perfect measure of child growth for children approaching the teen and adolescent age (Saigal *et al.*, 2001). Moreover the prevalence of wasting (i.e., low height-for-weight) is relatively rare in Bangladesh (Grira, 2004).

Following Kassouf and Senauer (1996), health status of children in this study is categorized according to the following classification of malnutrition: *Normal* if the z-score is greater than -1; *Mild* if the z-score lies in the interval (-2, -1); *Moderate* if the z-score lies in the interval (-3, -2); and *Severe* if the z-score is less than -3. The proportion of children in our sample that are severely, moderately and mildly malnourished are 15 per cent , 33 per cent and 32 per cent respectively , whilst only 19 per cent children are classified as normal according to the reference population (see Table 1).

A kernel density plot of height-for-age shows that majority (i.e., 95.98 per cent) of children in this sample has lower height-for-age compared to the international reference population. The central tendency (i.e, means, mode and median) of the height-for-age distribution of children in the sample is about -2 (i.e., two standard deviations below the average of the reference population) (see Panel (a) of Figure 1).

Table 1: Percentage of children by schooling and health status

Degree of malnutrition	Normal	Mild	Moderate	Severe	Total
School Attendance					
Currently attending school	16.25	26.35	27.18	11.16	80.94
Currently not attending	3.26	6.23	5.92	3.64	19.06
School Enrolment					
Enrolled in due time	11.62	13.59	10.02	1.75	36.98
Enrolled late	6.15	15.95	19.74	10.48	52.32
Never enrolled	1.75	3.04	3.34	2.58	10.71
Grade Attainment					
Having right grade for age	12.22	14.43	10.33	1.9	38.88
Falling behind in school	7.29	18.15	22.78	12.91	61.12
Total	19.51	32.57	33.11	14.81	100.00



(a) Kernel density plot of height-for-age

(b) Average z-score by child's age

Figure 1: Kernel density of height-for-age, and average z-score by child's age

Panel (b) of Figure 1 shows average z-score for height-for-age by child's age. One interesting observation from this figure is that at the age of 6 or below, height-for-age z-score is is close to international reference population (i.e., only 1.5 standard deviation below). However, at the age range from 7 to 17, the height-for-age z-score declines sharply (with some variation). This suggests that the results of our study may differ from those examining only the young age cohorts (e.g., less than five years old).

The descriptive statistics of the variables used in this study, reported in Table 2, shows that children in our sample have mean height-for-age slightly less than two standard deviations below that of the reference population. Table 2 also shows that 79 per cent of the children in the sample is currently attending school and 62 per cent of them are in the right grade. It is shown that whilst 65 per cent of the community has a primary school, the availability of secondary school for girls and both sexes are only 5 and 12 per cent, respectively.

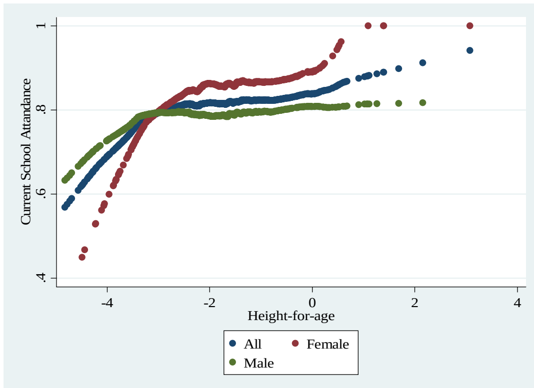
The Relationship between Child Health and Schooling

Figure 2 shows the relationship between schooling status and child health (height-for-age) using locally weighted polynomial regressions (lowess). Particularly, the left panel of Figure 3 shows a monotonically

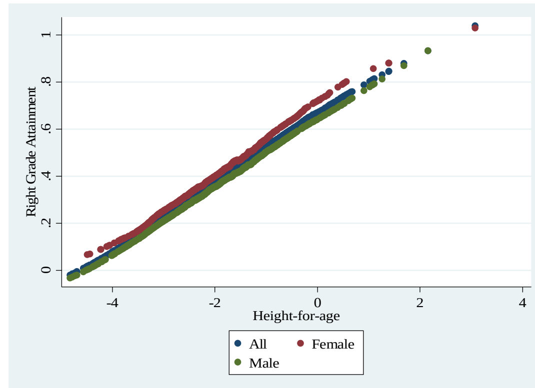
Table 2: Descriptive statistics

Variable Description	Median	Mean	Std.	Min	Max
Height-for-age (z-score)	-1.94	-1.90	1.08	-4.82	3.08
School attendance (1=if the child is currently attending school)	1.00	0.79	0.41	0.00	1.00
Enrolment status (1=enrolled in time, 2= enrolled late and 3=never enrolled)	2.00	1.75	0.64	1.00	3.00
Grade attainment (1=if the child is not in right grade for his/her age)	1.00	0.62	0.49	0.00	1.00
Child's age (in years)	11.00	11.16	3.46	5.00	17.00
Gender of the child (female=1)	0.00	0.39	0.49	0.00	1.00
Total household member	6.00	6.51	2.77	2.00	19.00
Log of household expenditure	2.91	2.96	0.35	1.54	4.38
Father can read and write (1=yes)	0.00	0.44	0.50	0.00	1.00
Mother can read and write (1=yes)	0.00	0.23	0.42	0.00	1.00
Primary school (1= if there is a primary school in the community)	1.00	0.65	0.48	0.00	1.00
Secondary girls' school (1= if there is)	0.00	0.05	0.21	0.00	1.00
Secondary boys; and girls' school (1= if there is)	0.00	0.12	0.33	0.00	1.00
Father height (in centimetre)	162.3	162.1	5.40	144.2	179.1
Mother height (in centimetre)	149.9	149.8	5.23	133.4	167.1
Mymensingh district (1=yes)	0.00	0.32	0.47	0.00	1.00
Jessore district (1=yes)	0.00	0.35	0.48	0.00	1.00
Saturia district (1=yes)	0.00	0.33	0.47	0.00	1.00

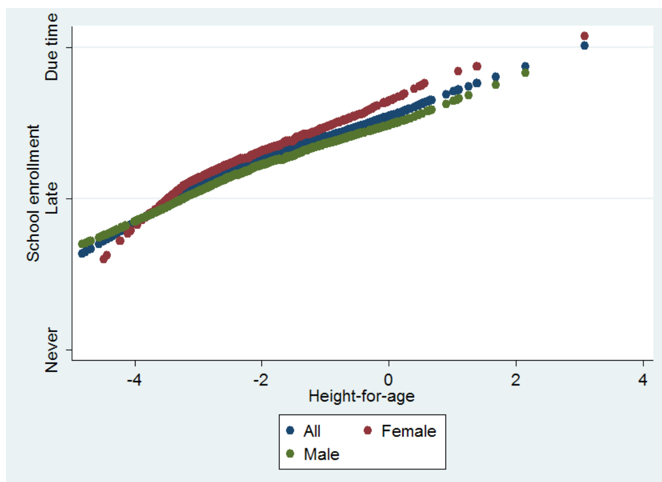
increasing relationship between current school attendance and height-for-age. In addition, the relationship between health and school attendance appears to be stronger for girls. Particularly, it seems that above the threshold of z-score equal to -3, the rate of school attendance for girls is higher than that of boys whilst the story is reversed if the z-score is less than -3. The main message from this panel is that the school attendance rate of girls is more sensitive to changes in height-for-age than that of boys. The left panel of Figure 3 shows almost a perfect linear relationship between child health and grade attainment with very little difference between boys and girls. Particularly, for the same group of "height-for-age", girls show slightly better school attainment than boys. All three lines in this graph almost represent 45^0 lines, showing near perfect linear relationship between the probability of right grade attainment and z-score of height-for-age. Regarding the enrolment status (i.e., due time, late and never enrol), there is also a clear trend that children are more likely to enrol in due time if they possess a good health (proxy by height-for-age). In addition, for the same height-for-age, girls are more likely to enrol than boys. However, for those whose z-score of height-for-age is -4 or below, girls are more likely to never enrolled than boys. The possibilities of late enrolment, however, are quite similar for boys and girls.



(a) School Attendance



(b) Grade Attainment



(c) School Enrolment

Figure 2: *Lowess* estimates of school attendance, enrolment and grade attainment by child health

3 Method

Our basic model on the impact of child health on schooling is:

$$S_i = \alpha_0 + \alpha_1 H_i + \alpha_2 X_i + \epsilon_i \tag{1}$$

where S_i is an indicator for child schooling; H_i is the health status of a child which is measured by height-for-age; and X_i is a set of exogenous variables that includes child age, gender, number of pre-school and school-aged children in the household, parental education, and the presence of primary and high school in the community.

We employ several measures of child's schooling. First we consider S_i as a dichotomous variable which is equal to 1 if a child was attending school during the survey. With this form of S_i, equation (1) is estimated by a probit model. Although about 81 per cent of children in the sample were attending school during the survey (see, Table 1) this does not consider all possibilities of enrolment. For example, 10.71

per cent of children were never enrolled, 52.32 per cent were enrolled late and about 37 per cent were enrolled by the due time Therefore, we also consider an ordered form of S_i; that is $S_i = 1, 2, 3$ if a child is enrolled by the age of 6 years, enrolled later than 6 years of age, and never enrolled respectively. In this circumstance, equation (1) is estimated by an ordered probit model to see the effects of child's health on his/her school enrolment.

We hypothesise that child health not only affects his/her school enrolment or attendance, but also affects his/her grade attainment. Malnourished children might have lower progress in school because of missed school days, and lack of concentration in preparing home work. Therefore, we also measure child's grade attainment in school. A commonly used measure of grade attainment is "schooling-for-age" (SAGE), which measures schooling attainment relative to age (i.e. whether a child is in the right grade for his/her age). This measure also considers late enrolment. For example, children who are enrolled late will not be in the right grade for their age. This measure of school attainment is widely used in the literature (for example,Psacharopoulos and Patrinos, 1997; Ray and Lancaster, 2005; and Khanam and Ross, 2008) as a reliable measure of school outcome in the developing countries. Psacharopoulos and Patrinos (1997), and Ray and Lancaster (2005) defined SAGE as follows:

$$SAGE = \{Current\, grade/(Age - E)\} \times 100 \tag{2}$$

where E represents the country-specific usual school entry age, which is 6 years in Bangladesh. The $SAGE$ might take values of 100 or higher (i.e., the attainment of the highest possible grade attained to date) to 0 (i.e. never attended school).[4] A score of less than 100 indicates that the child is 'falling behind' in their education. Based on Patrinos and Psacharopoulos (1997), and Ray and Lancaster (2005), we converted $SAGE$ to a dichotomous variable, such as S_i that takes the value of 1 if a child has below normal progress (i.e., $SAGE < 100$), and 0 otherwise. The dummy form of $SAGE$ is more useful than the original $SAGE$ score as estimates found from the dummy $SAGE$ can be intuitively interpreted as the probability of attaining the right grade or falling behind in schooling progress. It is surprising that there are only 38.88 per cent of children in our data set who are in the right grade for their age (see, Table 1).

A household is likely to take decision regarding investment into child schooling and health simultaneously. Therefore, the child health variable in equation (1) might be endogenous. The estimation of equation (1) considering child health as an exogenous variable might provide inconsistent estimates and hence the results might be biased. One way to overcome this potential endogeneity problem is to select a set of covariates that affect child health without affecting child schooling as instrumental variables. We, therefore, estimate child health in the first stage using all exogenous variables as follows:

$$H_i = \beta_0 + \beta_1 Z_i + \epsilon i \tag{3}$$

where, Z_i is a set of exogenous variables that include X and a set of instruments for child health, which includes mother and father height. There are some other candidates for instrumental variables such as the availability and accessibility of doctors and other health facilities, and hygiene practices of the households. However, these factors might be correlated with the disturbance term of the schooling equation. Also, inclusion of these variables as instruments lead to the over-identification issue, and hence only parents'

[4] A score of more than 100 indicates that the child has attended more years of school possible for his age. It is possible because although official enrolment age in Bangladesh is 6 years, some parents enrol their children earlier.

height are used to identify child health.

We estimate equations (3) and (1) using the conditional recursive mixed process estimator using the *cmp* procedure in STATA developed by Roodman (2007), which is suitable for a large family of multi-equation systems where dependent variable of each equation may have different format (i.e., binary, categorical, and bounded or unbounded continuous). Since our model is a recursive process, consisting of two-stage structural equations, the analysis is essentially a full information maximum likelihood (FIML) estimator.

An Issue with the Construction of the $SAGE$ Variable

The formula for $SAGE$ presented in equation (2) above highlights several issues when using data on young children. For children who are in their first year of schooling, a strict interpretation of $SAGE$ will give an infinite value since the denominator is zero (since $Age - E = 0$). Further, if a child starts school before they reach the minimum age, then $SAGE$ potentially can be greater than 100. In Bangladesh, the official enrolment age is six years, which indicates that by the age of six years a child should be enrolled but some parents may send their child to school at an earlier age. The sample used in this study suggests that 57 per cent of children among the five-year-olds are actually enrolled in school. Therefore, we should not use $E = 6$ for the entire sample of this study (i.e., children aged 5-17) to construct $SAGE$. If E = 6 is used then $SAGE$ will take a negative value for five-year-old children and infinite for six-year-old children. Therefore, E should be less than the minimum age of children considered in the sample. In this case, one could argue that E = 4 could be used for the entire sample. However, if E = 4 is used for the entire sample, there will be more children who are falling behind in schooling than the actual ones, i.e. this will understate the number of children who are following the 'standard' education pattern. For example, if E = 4 is used in the $SAGE$ equation, then only 4.9 per cent of children are in the right grade for their age, which does not seem logical. Hence, E = 4 and E = 5 are considered for the children five years old and six years old respectively and E = 6 for the remainder in constructing $SAGE$ variable. If this procedure is used then 37.7 per cent (544 children out of 1,441) of children are in the right grade for their age, which is more acceptable than that of 4.9 per cent of children in the correct grade. In addition, this procedure shows that about 62.2 per cent of children are falling behind ($SAGE < 100$) their correct grade, among them 11.3 per cent are completely falling behind ($SAGE = 0$).

4 Results

This section presents the estimates of equation (1), examining the relationship between child health (proxied by height-for-age in this study) and the current school attendance, enrolment and grade attainment. As mentioned previously, it is possible that the child health is endogenous in the relationship with education, because a household might take a decision to invest in child health and schooling simultaneously. We mitigate this issue by using an instrumental variable approach, where the child's height-for-age is instrumented by mother and father height. The first-stage estimates (reported in the Appendix) show that mother and father heights significantly affect child health, measured by height-for-age. Most importantly, the instruments are jointly significant ($F = 31.41$), indicating that we do not have a weak instrument problem. The Amemiya-Lee-Newey test also did not reject the null hypothesis of no over-identification in all regressions.

4.1 *Current School Attendance*

Table 3: The effects of child health on school attendance(binary probit)

Variables	Coeff.	Std. Err	Marginal Effect
Child health	0.122	0.093	0.043
Child's age	**-0.026	0.013	-0.009
Gender of the child	*0.151	0.090	0.051
Total household member	0.010	0.016	0.004
Log of household expenditure	**0.291	0.134	0.102
Father can read and write	***0.333	0.094	0.105
Mother can read and write	*0.251	0.129	0.081
Primary school	0.083	0.092	0.030
Secondary girls' school	**0.868	0.435	0.221
Secondary boys' and girls' school	0.222	0.154	0.073
Mymensingh district	***0.514	0.126	0.152
Jessore district	-0.016	0.103	-0.006
Constant	0.045	0.468	

*Notes: ***, **, & * indicates 1%, 5% and 10% level of significance respectively; N=1317; Overall significance:* $\chi^2(25) = 270$, *p-val=0.00 ; over-identification test* $\chi^2(1) = 4.664$, *p-val=0.127*

Our results from school attendance equation show that child health does not significantly affect their school attendance (see, Table 3) although it still has the expected positive sign. However, if the endogeneity issue is ignored, the coefficient of child health is significant at 10 per cent and the corresponding marginal effects show that a one unit increase in height-for-age increases the probability of attending school by 2.5 percentage points. This finding suggests that the impact of child health on schooling may be overestimated if the endogeneity issue is not taken into account. This insignificant coefficient on child health in school attendance equation is not surprising, because child health measured by height-for-age reflect long-term nutritional status of a child, whereas school attendance measures whether or not a child is currently attending school.

Although our main focus is on the effect of child health on school attendance, there are some noteworthy results. Another important determinant of school attendance is the education of parents; the attendance rate is significantly higher for children having a father and/or mother who can read and write. Our results also show that children from wealthier families (proxied by log of household expenditure) have a significantly (at 5 per cent) higher rate of school attendance. The availability of girls' secondary school in the community also increases the probability of enrolment by 22.1 percentage points compared to the communities that do not have secondary school. The probability of school attendance in Mymensignh is higher by 15.2 percentage points (significant at one per cent) compared to the children from Saturia district.

4.2 *School Enrolment*

Another form of equation 1 is estimated for the probability of enrolment, which is a categorical variable taking the value of: 1) if a child is enrolled in due time (by the age of 6), 2) if a child is enrolled late (not enrolled by the age of 6), and 3) if the child is never enrolled. Our results show that child health has a significant effect on the probability of enrolment. The marginal effects reveal that a one unit increase in child's height-for-age reduces the probability of never being enrolled by 7.0 percentage points, whilst increases the probability of enrolment in due time and late enrolment by 5.6 and 1.4 percentage points respectively (see, Table 4). These results are in line with other cross-sectional studies such as Glewwe and Jacoby (1995), Behrman and Lavy (1998) and Grira (2004) that account for endogeneity of child health. If we estimate the school enrolment equation by considering child health as an exogenous variable, the magnitude of this variable is higher than an endogenous case.[5] Again, children in wealthier families or having a mother and/or father who can read and write have a higher probability of being enrolled in due time. Compared with communities without secondary school, children in those with the availability of either girls' secondary school or mixed-sex secondary school have higher probability of enrolling in due time. However, the magnitude of the girls' school is almost double than that of the mixed school, which is some how reflecting the effects of the dominance Muslim culture in the study areas (i.e., parents are more willing to send daughters to girls' secondary school than mixed-sex school). In addition, children in both Mymensingh and Jessore have a higher probability of enrolling in due time than those in Saturia.

Table 4: The effects of child health on school enrolment (ordered probit)

			Marginal effects		
Variables	Coeff.	Std. Err	Due enrolled	Late enrolled	Never enrolled
Height for age	***-0.235	0.078	0.056	0.014	-0.070
Child's age	*0.020	0.010	-0.005	-0.001	0.006
Gender of the child	-0.081	0.068	0.020	0.003	-0.023
Total household member	-0.018	0.012	0.004	0.001	-0.005
Log of household expenditure	***-0.445	0.105	0.106	0.026	-0.132
Father can read and write	***-0.286	0.073	0.077	-0.003	-0.075
Mother can read and write	***-0.407	0.092	0.116	-0.015	-0.101
Primary school	0.044	0.178	-0.011	-0.002	0.013
Secondary girls' school	***-0.575	0.109	0.174	-0.043	-0.131
Secondary boys' and girls'school	***-0.358	0.093	0.100	-0.009	-0.091
Mymensingh district	***-0.388	0.085	0.110	-0.013	-0.097
Jessore district	***-0.447	0.074	0.129	-0.021	-0.109
μ_1	***-1.714	0.178			
μ_2	0.079	0.109			

*Notes: ***, **, & * indicates 1%, 5% and 10% level of significance respectively; N=1317; Overall significance:* $\chi^2(25) = 359$, *p-val=0.00; Over-identification test* $\chi^2(1) = 4.07$, *p-val=0.157*

4.3 *Grade Attainment*

Table 5 shows that child health has an expected and significant (at 10 per cent) effect on grade attainment. The marginal effects show that a one unit increase in height-for-age will reduce the probability of falling behind in school by 3.5 percentage points. If the endogeneity of child health is ignored, then the impact of child health (the magnitude of coefficient is -0.354 and statistically significant at one per cent) on grade attainment is higher.

[5]The coefficient of the height-for-age variable is -0.273 and significant at one per cent. The marginal effect show that a one unit increase in height-for-age increase the probability of due and late enrolment respectively by 6.5 and 1.5 percentage points whilst decreases the probabilty of never enrolment by 8.0 percentage points.

Table 5: The effects of child health on grade attainment (binary probit)

Variables	Coeff.	Std. Err	Marginal Effects
Child health	*-0.164	0.092	-0.035
Child's age	***0.148	0.012	0.032
Gender of the child	-0.018	0.081	-0.004
Total household member	-0.016	0.014	-0.003
Log of household expenditure	***-0.694	0.125	-0.149
Father can read and write	***-0.233	0.087	-0.057
Mother can read and write	***-0.578	0.106	-0.164
Primary school	0.108	0.090	0.025
Secondary girls' school	***-0.549	0.197	-0.154
Secondary boys and girls' school	***-0.389	0.124	-0.102
Mymensingh district	***-0.418	0.114	-0.111
Jessore district	***-0.670	0.101	-0.196
Constant	***1.176	0.438	

*Notes: ***, **, & * indicates 1%, 5% and 10% level of significance respectively; N=1317; Overall significance:* $\chi^2(25) = 457$, *p-val=0.00; Over-identification test* $\chi^2(1) = 0.066$, $p - val = 0.797$

The positive and significant (at one per cent) effect of child age is not surprising in a country like Bangladesh. An older child is more likely to fall behind in grade attainment due to increased opportunity costs of schooling. One possible reason is because an older child can earn money from outside work or help their parents in housework/agricultural activities. Other significant determinants have similar behaviour as in other schooling measures: children from educated parents (i.e., proxied by being able to read and write) or wealthier households have a lower probability of falling behind in grade attainment. The availability of girls' secondary school has a stronger effect to grade attainment than mixed-sex secondary school, which also have a significantly lower rate of falling behind compared with that of communities without secondary school. Likewise, children from the Mymensingh and Jessore samples have a lower probability of falling behind compared to those from the Saturia district.

5 Conclusion

In this paper we examine the impact of child health on educational achievement of Bangladeshi children. Most of the existing literature on child health and schooling (e.g., Glewwe & Jacoby, 1995; Alderman, et al., 2001; and Handa & Peterman, 2007) focus mainly on delayed enrolment, this study extends the analysis with two additional measures: current school attendance and school attainment. We control for the potential endogeneity of child health by an instrumental variables approach. Our chosen instrumental variales (i.e., heights of father and mother) are strong predictors of child health, and satisfy the validity test. Our results indicate that the impact of child health on school achievement will be overestimated if the endogeneity of child health is ignored. We also show a significant effect of child health on schooling attainment, in particular on school enrolment and grade attainment, of Bangladeshi children even after controlling the issue of endogeneity of child health. The impact of child health is stronger for school enrolment compared to grade attainment. Other important determinants of schooling are parents' education, income of the household and the availability of secondary school, especially girls' secondary school in the community.

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Appendix

Table A1. Strength of instrumental variables

Variables	Coeff.	Std. Err
Father's height	***0.027	0.006
Mother's height	***0.035	0.006
Constant	***-11.568	1.231

*Notes: This is the regression of the endogenous variable (height-for-age) and the instrumental variables (parents' height); ***, **, & * indicates 1%, 5% and 10% level of significance respectively; N=1131;F(2,1128)=31.41, p-value=0.00*

Table A2. First stage regression estimates

Variables	Coeff.	Std. Err
Child's age	***-0.057	0.009
Gender of the child	-0.053	0.063
Total household member	-0.009	0.012
Log of household expenditure	***0.435	0.091
Father can read and write	-0.018	0.067
Mother can read and write	0.002	0.086
Secondary girls' school	*0.265	0.151
Secondary boys' and girls' school	**0.191	0.094
Mymensingh district	0.033	0.087
Jessore district	***0.389	0.073
Primary school	-0.0005	0.068
Father's height	***0.029	0.006
Mother's height	***0.028	0.006
Constant	***-11.514	1.220

*Notes: ***, **, & * indicates 1%, 5% and 10% level of significance respectively; N=1317*