University of San Carlos

Office of Population Studies Foundation

Paper Series

No. 8

Childhood Stunting and Schooling Attainment of Filipino Young Adults

Isabelita N. Bas

February 2007

Daniels, M. C., Adair, L. S. (2004). Growth in Young Filipino Children Predicts Schooling Trajectories through High School. The Journal of Nutrition. 1439-1446

Glewwe, P., King, E. (2001). The Impact of Early Childhood Nutritional Status on Cognitive Development: Does the Timing of Malnutrition Matter? The World Bank Economic Review. 15:81-113

Glewwe, P., Jacoby, H. G. (1995). An Economic Analysis of Delayed Primary School Enrollment in a Low Income Country: The Role of Early Childhood Nutrition. The Review of Economics and Statistics. 77:156-159

Guthrie, G. M., Tayag, A. H., Jacobs P. J. (1977). The Philippine Non-verbal Intelligence Test. Journal of Social Psychology 102:3-11

Jamison, D. T. (1986). Child Malnutrition and School Performance in China. Journal of Development Economics. 20:299-309

Mingat, A., Tan J. (1996). The Full Social Returns to Education: Estimates Based on Countries' Economic Growth Performance. World Bank.
Martorell, R. (1995). Results and Implications of the INCAP Follow-up Study. The Journal of Nutrition. 1127-1138

Mendez, M. A., Adair, L. S. (1999). Severity and Timing of Stunting in the First Two Years of Life Affect Performance on Cognitive Tests in Late Childhood. The Journal of Nutrition. 1555-1562

National Statistics Office (2002). 2000 Family Income and Expenditures Survey (FIES) Final Release on Poverty, NSO, Manila

National Statistics Office (2004). Philippines National Demographic and Health Survey 2003, NSO, Manila.

National Statistics Office (2006). 2006 Philippine Yearbook, NSO, Manila.

Perez, L. (2003). Sample Attrition in Cebu Longitudinal Health and Nutrition Study, University of San Carlos-Office of Population Studies. Unpublished document

Childhood Stunting and Schooling Attainment of Filipino Young Adults

Isabelita N. Bas

Abstract

Previous studies have demonstrated the adverse effects of stunting on children's school achievement. This paper focuses on the effects of stunting at two years old on schooling attainment for young adults. The study uses data from the Cebu Longitudinal Health and Nutrition Survey. A birth cohort of children born between May 1983 and April 1984 was followed from the time of their mother's pregnancy until they were 20-22 years old. Schooling attainment is measured in three ways, 1) completed grades or years of schooling 2) completion of high school and 3) completion of college. Linear and logistic regressions are used to determine the association of stunting with schooling attainment, considering other individual, parental, household and community factors. These associations are examined separately for males and females. Results reveal that stunting at age two is associated with lower number of years of schooling and a reduced likelihood of high school and college completion for females. Effects of stunting on schooling attainment are stronger in females but accounting for IQ attenuates the association of stunting with schooling attainment to a greater extent in females than in males.

Introduction

Formal education in the Philippines consists of six years of elementary, four years of secondary, four to five years of tertiary or college and postgraduate education leading to masteral and doctoral degrees. Most, if not all, Filipino young adults aspire to complete a college education. In the Philippines where unemployment rates are high, a college education is viewed as a requirement to land a better paying job. However, not many Filipino children make it to college. Approximately 90.3% of Filipino children within ages seven to 12 were enrolled in elementary and 58.3% of high school aged young Filipino adults were enrolled in secondary level for school year 2002-2003. A lower percentage of college aged young Filipino adults was enrolled in tertiary or college education.

With lower educational attainment, their opportunity to be gainfully employed is limited and their choice of jobs is limited to those with low pay. According to the 2000 Family Income and Expenditure Survey (FIES), about 34% of the families in the Philippines live below the poverty line. Although there are free public schools in the Philippines, other school-related costs prohibit the children from poorer families from being sent to school. Low income is correlated with low rates of high school completion (Brooks-Gunn & Duncan, 1997).

In addition to educational cost constraints, poor health may hinder a child's school attainment. Performance in school may likewise be affected as malnutrition during early childhood can reduce cognitive performance later in life (Glewwe & King, 2001). Several studies have investigated the association of health measures with schooling outcomes. For example, childhood stunting, which represents the cumulative effects of chronic undernutrition, has adverse effects on school achievement. Stunting at two years of age is significantly associated with later deficits in the cognitive ability of Filipino children as

measured by lower scores on a non-verbal intelligence administered at ages 8 and 11 years (Mendez & Adair, 1999). Similarly, Daniels & Adair (2004) found height-for-age is a significant predictor of enrollment, grade repetition, and retention in Filipino schools. Taller children were less likely to repeat grades and less likely to drop out during grade school or to be behind in school and were therefore more likely to graduate from high school on time. A study of Jamaica children showed that specific arithmetic ability was poorer for stunted compared to non-stunted children (Chang et al 2002). The non-stunted group had significantly better scores on arithmetic, spelling, word reading, and reading comprehension. In a study of children in China, a one standard deviation reduction in height-for-age was associated with one-third of a year delay in child's schooling (Jamison, 1986).

Much of the previous research has focused on the effects of childhood stunting on schooling of children at ages when they have not yet had the opportunity to complete college. The availability of data that includes information on childhood stunting as well as college attendance and completion, allows for a more comprehensive view of the long- term human capital consequences of early nutritional deficits. This paper aims to examine the association between early childhood stunting and schooling attainment among Filipino young adults. It specifically investigates the relation of stunting at age two, taking into consideration other parental, household, and community variables. It also aims to examine whether the association differs for males and females, and whether IQ measured at age 8 mediates the relationship of stunting to ultimate school attainment.

Data

The study uses data from the Cebu Longitudinal Health and Nutrition Survey (CLHNS). The CLHNS is a community-based sample survey conducted in Metro Cebu, the second largest metropolitan area in the Philippines. A birth cohort of children born between May 1983 and April 1984 in 33 randomly selected barangays (smallest political unit in the Philippines, similar to villages in rural areas or neighborhoods in urban areas) was followed from the time of their mother's pregnancy until 2005 when they were on the average 21 years of age. At 21 years, young adults in the Philippine educational system, should have completed a four-year college course if they progressed through school in an age-appropriate rate.

Community, household and individual level information for these children was obtained during 19 survey rounds; at time of their mother's pregnancy, several days after the child's birth, at two-month intervals until child was two years old (12 interviews), and then in subsequent follow-up surveys in 1991, 1994, 1998, 2002, and 2005. Data from the birth to 2 year surveys, 1991, 1994 and 2005 survey rounds were used in the analysis for this study.

Of the 3,080 single live born and 24 multiple live born children identified in 1983-1984 baseline survey, 1,912 young adults were followed in the 2005 survey while 1,192 were attrited or lost to follow-up. Migration out of the study area accounts for majority of the attrition, while refusals and deaths account for the remaining lost samples (Perez, 2003).

Adair (1999) finds evidence that there is a large potential for catch-up growth in children into the preadolescent years. Despite being stunted at childhood, children who are less severely stunted in early infancy along with other factors were more likely to recover from stunting. This calls for measures that would help children to recover from stunting among which is to improve children's nutrition that is tantamount to improve schooling outcomes.

Acknowledgements

I would like to thank Dr. Linda Adair, Dr. Jere Behrman and Dr. Sharon Ghuman for their generous support. Funding for this study is provided by the National Institute of Health/Fogarty International Center and the National Institute for Child Health and Human Development (NICHD) through RO1-TW05596-01 (Effect of Health on Education and Work in Filipino Youth) under a sub-agreement from the University of North Carolina UNC-CH-5-52769; R01-TW05604-01 (Filipino Early Childhood Development: Longitudinal Analysis); and R03-HD051555-01A1 (Service Providers and Early Childhood Development). I would also like to thank Dr. Socorro A. Gultiano and the staff of USC-Office of Population Studies Foundation for their invaluable support and assistance to this study.

References

Alderman, H., Behrman, J., Lavy, V., Menon, R. (2001). Child Health and School Enrollment. The Journal of Human Resources. 36: 185-205.

Alderman, H., Hoddinot, J., Kinsey, B., (2003). Long-term Consequences of Early Childhood Malnutrition, FCND Discussion Paper No. 168

Adair, L. S. (1999). Filipino Children Exhibit Catch-up Growth from Age 2 to 12 Years, The Journal of Nutrition. 1140-1148

Becker, G. S. (1993). Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. National Bureau of Economic Research, The University of Chicago Press: 16-17

Behrman, J. R. (1993). The Economic Rationale for Investing in Nutrition in Developing Countries. World Development. 21:1749-1771

Brooks-Gunn, J., Duncan, G. J. (1997). The Effects of Poverty on Children. The Future of Children. 7:55-71

Carneiro, P., Meghir, C., Parey, M. Intergenerational Effects of Mother's Schooling on Children's Outcomes: Causal Links and Transmission Channels. Paper presented at the Royal Economic Society's Annual Conference at the University of Nottingham

Chang, S. M., Walker, S. P., Grantham-McGregor S., Powell, C. A. (2002). Early Childhood Stunting and Later Behaviour and School Achievement. Journal of Child Psychology and Psychiatry.43:775-783

Discussion

Stunting at two years old is associated with lower schooling attainment in young adulthood for both sexes, however the association is significant only in females. Although the effect of stunting on schooling attainment is stronger in females than in males, accounting for IQ attenuates the association to a larger extent in females. Results show a strong mediation of the effects of stunting on schooling attainment by IQ score. Stunting at two years old is associated with reduced likelihood of high school and college completion among females. No such significant relationship is observed for males.

With disadvantaged health status early on, stunted children might be viewed as bound to achieve less in terms of schooling attainment. Results of this study have shown that children stunted at two years old especially the females complete lower number of years of schooling and their stunted status make them less likely to complete high school as well as college.

Of the covariates considered in the linear and logistic regression analyses, mother's education showed consistent positive association with schooling attainment. Children of mothers with higher number of years of schooling are more likely to complete more years of schooling and more likely to complete high school or college. Mother's education affects their children's human capital, that of the level of education they achieve themselves (Carneiro et al, 2006).

The CLHNS provided data on health status at early age as measured in stunting status at two years old as well as data in schooling attainment at young adulthood. This rich data set of longitudinal information from birth to young adulthood has facilitated investigation of the association of variables collected within a wide span of time.

This study had assumed that the young adults in the sample progressed through school at age-appropriate rate such that at 21 years of age they should have completed a four-year college course. Not all may have done so as some of them may have started late in schooling or have quit school at some time but nevertheless are still pursuing their college studies. For these reason, bias in the result may be observed for the outcome college completion, so it is strongly recommended that a similar study be done using data on schooling attainment at later time reference.

Despite this limitation, the results of this study added evidence that poor health as measured by stunting status affects schooling attainment adversely as it is associated with poor schooling outcomes. Although the results is representative only of the young adults in the Cebu Longitudinal Health and Nutrition Survey rather than the Filipino young adults in general, this has likewise shown that early childhood stunting has unfavorable effects on later schooling as has been found in other studies on health and schooling outcome.

The results of this study highlight the importance of early childhood nutrition. Stunting, an effect of malnutrition, and shown to have adverse effects on later school attainment among Filipinos should be addressed. Improved nutrition in early childhood has important long-term effects in adolescence and adulthood (Martorell, 1995).

The analysis sample for this study included 1,659 young adults consisting of 877 males and 782 females who had complete data on stunting status at age 2, school attainment in young adulthood, IQ measured at age 8 or 11, and all covariates included in the models.

Outcome variables (schooling outcomes). School attainment is measured in three ways. One measure is years of completed schooling as of 2005 survey, measured in number of successfully completed grades or levels of formal education. Values range from 0 to 15 years of completed schooling or five years in college. Another measure is whether the young adult had completed high school or not. A value of 1 is assigned to those who finished high school or more education (10 or more years of schooling), and 0 for those who have less than a complete high school education. College completion is the third schooling outcome of interest in this study. Young adults were grouped into whether they completed 14 or more years of schooling (finished college), or have 13 or less years of schooling. A value of 1 denotes having completed college.

Exposure variable. The stunting status of young adults when they were two years of age is the main exposure variable for this study. Length was measured by highly trained staff using a custom length board or infantometer. Stunting is defined as a length-for-age Z-score more than 2 standard deviations below the median, based on the new World Health Organization growth reference.

Covariates. Other explanatory variables were data taken from the baseline survey and at the time the child was two years old. Variables from the baseline survey include birth order (1-18), maternal and paternal education (years of formal education completed), maternal height, and place of residence (urban-rural). Asset and hygiene index are variables taken at the time when the children were two years of age. An index of asset is the summary count of the presence of electricity and household appliances, ownership of dwelling unit and vehicles. Hygiene index or environmental cleanliness index is the summary of the presence of in-house toilet, little or no excreta in the yard or little or no garbage in the neighborhood, and food area ranked as very clean.

IQ is a hypothesized mediator of the relationship of stunting to schooling outcomes. IQ was measured using the Philippine Non-Verbal Intelligence test. This is a cognitive test consisting of 100 items designed to assess analytic or reasoning skills of the children (Guthrie et. al, 1977). The test was administered during the 1991 survey when participants were 8.5 years of age on average.

Methods

To determine whether the characteristics of the young adults included in the analysis sample differ from the baseline sample of single live births, one-way anova was used to compare means of selected continuous baseline variables of those included versus excluded. For categorical variables, comparisons were based on Chi-square tests.

Linear regression model is used to model the association of stunting at age two and completed years of schooling, controlling for other parental, household, and community characteristics. Regressions were likewise run for three models; with the exposure variable only (unadjusted), with the inclusion of the covariates (adjusted for covariates), and with the inclusion of the covariates and IQ score (adjusted for covariates and IQ).

Logistic regression is used to separately model the likelihood of high school completion and college completion. Logistic regressions were run with the exposure variable only, with the inclusion of the covariates, and with the inclusion of the covariates and IQ score.

All models were stratified by gender.

Results

Since the study uses data of a birth cohort of children during the baseline, 1991 and 2005 survey, selectivity bias was assessed. Table 2 shows the baseline socio-demographic characteristics of young adults included in the analysis sample (N=1,659), compared to those who were lost to follow-up or excluded owing to missing data (N=1,421). Those excluded from the analysis had lower birth weights and heights, had higher parental education and higher asset index than those included. A smaller percentage of those excluded, as compared to those who stayed in the sample, owned the houses they dwelt in.

As noted earlier, those excluded from the analysis include those who had died (n=155 deaths in the first two survey years), as well as those who left the Metro Cebu area or were missing key data. Outmigration and refusals as cause of attrition might explain the higher parental education and socio-economic status of attrited children as better educated and relatively well-off sample women are more likely to move out of sample areas or refuse the interviews. Outmigration likewise seems to explain the lower percentage of house owners among those excluded, as those not owning their dwelling units are more likely to relocate or move out.

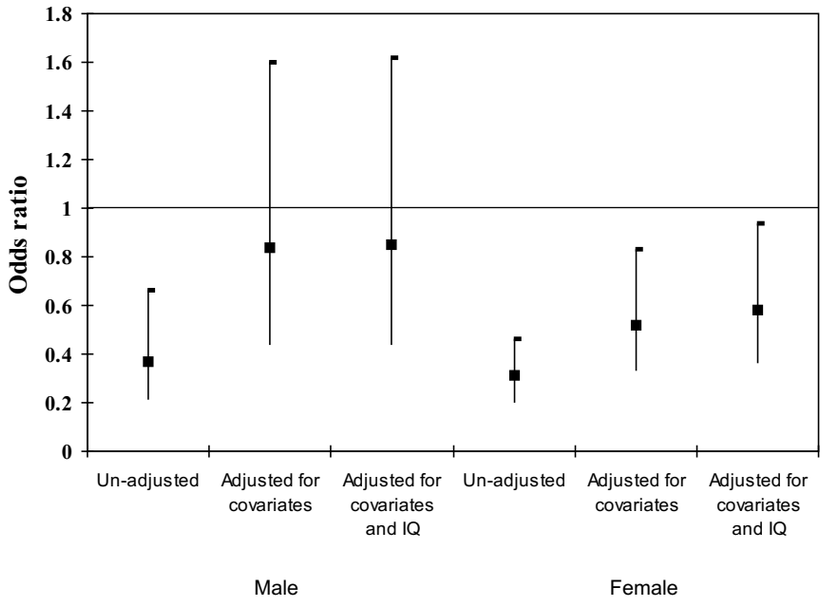
Although the excluded individuals are significantly different in some characteristics, there is no reason to believe that the relationship of early stunting to school achievement would be different in those lost to follow-up. Variables which explain attrition have been included in the models of interest.

Table 2. Baseline socio-demographic characteristics of sample children

Characteristic	Excluded (*n*=1421)	Included in analysis sample (*n*=1659)	*P* value[1]
	Means ± SD		
Birth weight, *g*	2955.0 ± 455.3	3018.7 ± 413.2	0.000
Birth length, *cm*	49.0 ± 2.1	49.1 ± 2.0	0.042
Maternal height, *cm*	150.6 ± 5.0	150.5 ± 5.0	0.875
Maternal age, *y*	26.0 ± 6.0	26.2 ± 6.0	0.462
Maternal education, *y*	7.4 ± 3.4	6.9 ± 3.2	0.000
Paternal education, *y*	7.6 ± 3.3	7.1 ± 3.4	0.000
Asset index	2.6 ± 2.0	2.4 ± 1.9	0.014
	% (*n*)		*P* value[2]
Stunted	75.5 (1073)	53.3 (885)	0.000
Electricity	54.2 (770)	46.3 (768)	0.000
Piped water	10.3 (146)	4.9 (81)	0.000
Toilet in home	73.0 (1037)	61.5 (1020)	0.000
Urban household	80.5 (1144)	73.0 (1211)	0.000
Owns house	56.7 (806)	73.6 (1,221)	0.000

[1] Correspond to one-way ANOVA over-all F-test statistic
[2] Based on Pearson's chi-square test

Figure 1. Odd ratios of the logistic runs of outcome completion of college



The odds ratios of stunting at two years old and of that of the other covariates included in the logistic regression analysis for outcome college completion is shown in Table 6. Other parental, household and community characteristics are associated with increased likelihood of completing college.

Table 6. Odds ratios and confidence interval of outcome completion of college

	Unadjusted		Adjusted		Adjusted for IQ	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Males						
Stunting at 2 yrs old	0.38 (0.21, 0.66)	0.001	0.84 (0.44, 1.60)	0.586	0.85 (0.44, 1.62)	0.615
Birth order			0.85 (0.71, 1.02)	0.085	0.86 (0.72, 1.04)	0.125
Mother's grade			1.19 (1.07, 1.34)	0.002	1.17 (1.04, 1.31)	0.009
Father's grade			0.99 (0.89, 1.11)	0.887	0.96 (0.85, 1.07)	0.443
Asset index			1.04 (0.88, 1.22)	0.652	1.02 (0.87, 1.20)	0.771
Hygiene index			1.22 (0.99, 1.49)	0.056	1.24 (1.01, 1.53)	0.044
Urban			2.40 (0.81, 7.11)	0.113	2.27 (0.76, 6.74)	0.140
Mother's height			1.04 (0.98, 1.10)	0.187	1.05 (0.99, 1.11)	0.136
IQ score					1.05 (1.02, 1.08)	0.000
Females						
Stunting at 2 yrs old	0.31 (0.20, 0.46)	0.000	0.52 (0.33, 0.83)	0.006	0.58 (0.36, 0.94)	0.026
Birth order			1.01 (0.90, 1.13)	0.834	1.04 (0.93, 1.17)	0.472
Mother's grade			1.14 (1.05, 1.24)	0.001	1.13 (1.04, 1.23)	0.005
Father's grade			1.16 (1.06, 1.26)	0.001	1.14 (1.04, 1.24)	0.003
Asset index			1.19 (1.04, 1.35)	0.009	1.20 (1.05, 1.37)	0.007
Hygiene index			1.07 (0.93, 1.22)	0.343	1.03 (0.90, 1.18)	0.683
Urban			0.88 (0.50, 1.55)	0.661	0.83 (0.47, 1.46)	0.514
Mother's height			0.99 (0.95, 1.04)	0.716	0.99 (0.95, 1.04)	0.694
IQ score					1.05 (1.03, 1.07)	0.000

Table 5. Odds ratios and confidence interval of outcome completion of high school

	Unadjusted		Adjusted		Adjusted for IQ	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Males						
Stunting at 2 yrs old	0.54 (0.41, 0.71)	0.000	0.86 (0.63, 1.19)	0.370	0.90 (0.65, 1.26)	0.544
Birth order			0.95 (0.89, 1.01)	0.114	0.97 (0.91, 1.04)	0.389
Mother's grade			1.21 (1.14, 1.29)	0.000	1.16 (1.09, 1.24)	0.000
Father's grade			1.00 (0.99, 1.00)	0.773	1.00 (0.99, 1.01)	0.784
Asset index			1.11 (1.00, 1.23)	0.046	1.09 (0.98, 1.21)	0.119
Hygiene index			1.07 (0.98, 1.17)	0.114	1.06 (0.96, 1.16)	0.253
Urban			0.94 (0.66, 1.32)	0.704	0.86 (0.60, 1.23)	0.415
Mother's height			1.01 (0.98, 1.04)	0.594	1.01 (0.98, 1.04)	0.595
IQ score					1.06 (1.04, 1.07)	0.000
Females						
Stunting at 2 yrs old	0.43 (0.30, 0.62)	0.000	0.60 (0.41, 0.89)	0.011	0.72 (0.48, 1.08)	0.117
Birth order			1.03 (0.95, 1.11)	0.456	1.06 (0.98, 1.15)	0.170
Mother's grade			1.14 (1.05, 1.24)	0.001	1.13 (1.04, 1.23)	0.005
Father's grade			1.09 (1.01, 1.18)	0.022	1.06 (0.98, 1.15)	0.134
Asset index			1.09 (0.95, 1.26)	0.197	1.09 (0.95, 1.25)	0.239
Hygiene index			1.08 (0.96, 1.20)	0.135	1.06 (0.95, 1.18)	0.292
Urban			0.68 (0.45, 1.03)	0.066	0.64 (0.41, 0.98)	0.039
Mother's height			1.00 (0.97, 1.04)	0.764	1.01 (0.97, 1.05)	0.726
IQ score					1.05 (1.03, 1.07)	0.000

Figure 2 shows the odds ratios of the logistic regression results for the outcome college completion. If stunting at two years old is made to explain college completion, the result shows that for both sexes stunted children are less likely to complete college. Males who were stunted at two years old has 62% reduced likelihood of completing college while stunted females has 69% reduced likelihood of completing college.

Accounting for the covariates, stunting at two years old is shown to be associated with reduced likelihood of college completion. Stunted males have 16% reduced likelihood of completing college while stunted females have 46% reduced likelihood, however, the association is observed to be significant (P=0.006) only in females. IQ score when entered into the logistic regression analysis with the covariates did not substantially change the odds ratios, 0.84 to 0.85 for males and 0.52 to 0.58 for females. Stunting at two years old remained to be significantly associated (P=0.026) with the likelihood of completing college in females.

Table 3 shows the profile of the 877 male and 782 female young adults included in the analysis. Mean values for continuous variables and percentages for dichotomous and categorical variables are presented with P values to indicate differences between males and females. The young adults were on the average 21 years of age at time of the 2005 survey. More than half of them, 53.6% females and 53.1% males, were stunted when they were two years old. Females obtained significantly higher IQ scores than males (52.2 vs. 50.8). There is no significant difference between males and females with regard to stunting status, parental education, birth order and mother's height.

Significant differences in schooling attainment between the sexes are observed. The males had about one year less schooling on average than females, 9.0 and 10.2 years respectively. Fewer males (60.6%) than females (78%) had completed high school education or more. Only 6.8% of the males completed college while 16.9% of the females did. As shown in the distribution of the young adults by educational level attained, about 15% of the sample has attained elementary level of education. More than half of them have reached high school level and about a quarter have college level of education. A few male young adults have not completed a year of formal schooling.

Table 3. Profile of young adults included in the analysis sample

Characteristics	Total *N*=1659	Males *N*=877	Females *N*=782	*P* value
Age (mean years)	20.9	20.9	20.9	0.499
Stunted at age 2 (%)	53.4	53.6	53.1	0.831
IQ at age ~8 (mean score)	51.4	50.8	52.2	0.020
Mother's education (mean years)	6.9	6.9	6.8	0.606
Father's education (mean years)	7.6	8.3	6.9	0.246
Birth order (mean)	3.4	3.4	3.4	0.784
Mother's height (mean)	150.5	150.6	150.5	0.627
Years of schooling (mean)	9.6	9.0	10.2	0.000
Completed high school or more (%)	68.8	60.6	78.0	0.000
Completed 4 yrs of college or more (%)	11.6	6.8	16.9	0.000
Level of education attained % (n)				0.000
With no schooling	0.4 (6)	0.7 (6)	0 (0)	
With elementary	15.2 (253)	21.1 (185)	8.7 (68)	
With high school	57.0 (945)	54.8 (481)	59.3 (464)	
With college	27.8 (461)	24.1 (211)	32.0 (250)	

Linear regression. Table 4 shows the regression coefficients and the confidence interval of the linear regression results from the three models. The schooling outcome, years of completed schooling regressed on stunting status at age two is presented in the unadjusted model. The second model is the regression the schooling outcome with all the identified covariates; birth order, parental education, asset and hygiene index, place of residence, and mother's height. The third model was the regression of the schooling outcome with all the covariates and IQ score.

The linear regression analysis of the unadjusted model shows that stunting at two years old is associated with lower number of completed years of schooling for both sexes, of which the regression coefficients did not differ widely between males and females (-1.31 for males and -1.39 for females). Stunting at two years old is associated with about a year decrease in the number of completed years schooling for both males and females.

Adjusting for covariates, the association is still significant (P=0.000) in females but is no longer observed in males. Stunting at two years old along with other factors is associated with decreased years of schooling. The effect of stunting is stronger in females than in males. Accounting for IQ with the covariates, the effect of stunting on years of schooling is attenuated and the association is consistently significant (P=0.008) in females. IQ seems to mediate the effect of stunting on years of schooling, lessening the effect by a higher percentage in females than in males. The regression coefficients decreased from 0.66 to 0.45, a 31.8% decrease of the effect of stunting in females. A 23.1% decrease is observed in males, or a decrease from 0.39 to 0.30 in the regression coefficients.

Moreover, maternal education (P=0.000) and hygiene index (P=0.039) are positively associated with years of schooling for males. In addition to maternal education (P=0.000), paternal education (P=0.001) and asset index (P=0.002) have positive association with females' years of schooling. The full model explains about 33% of the variability of years of schooling of the young adults.

Table 4. Linear regression coefficients and confidence interval of outcome years of schooling

	Unadjusted		Adjusted for covariates		Adjusted for covariates and IQ	
Variables	Coef (95% CI)	*P*	Coef (95% CI)	*P*	Coef (95% CI)	*P*
Males						
Stunting at 2 yrs old	-1.31 (-170, -0.91)	0.000	-0.39 (-0.78, 0.01)	0.055	-0.30 (-0.67, 0.07)	0.109
Birth order			-0.04 (-0.13, 0.04)	0.308	-0.00 (-0.08, 0.07)	0.936
Mother's grade			0.32 (0.25, 0.39)	0.000	0.24 (0.18, 0.31)	0.000
Father's grade			-0.00 (-0.01, 0.00)	0.592	-0.00 (-0.01, 0.00)	0.564
Asset index			0.11 (-0.00, 0.23)	0.060	0.07 (-0.04, 0.18)	0.185
Hygiene index			0.14 (0.03, 0.25)	0.012	0.11 (0.01, 0.21)	0.039
Urban			0.22 (-0.21, 0.66)	0.313	0.11 (-0.30, 0.51)	0.607
Mother's height			0.02 (-0.02, 0.06)	0.256	0.02 (-0.01, 0.06)	0.254
IQ score					0.08 (0.07, 0.10)	0.000
R-squared						33.5%
Females						
Stunting at 2 yrs old	-1.39 (-1.74, -1.03)	0.000	-0.66 (-1.00, -0.32)	0.000	-0.45 (-0.79, -0.12)	0.008
Birth order			0.00 (-0.07, 0.08)	0.924	0.03 (-0.04, 0.11)	0.349
Mother's grade			0.19 (0.12, 0.25)	0.000	0.16 (0.10, 0.23)	0.000
Father's grade			0.15 (0.08, 0.21)	0.000	0.11 (0.05, 0.18)	0.001
Asset index			0.18 (0.07, 0.29)	0.002	0.17 (0.07, 0.28)	0.002
Hygiene index			0.12 (0.02, 0.22)	0.015	0.08 (-0.01, 0.17)	0.091
Urban			-0.24 (-0.62, 0.14)	0.217	-0.30 (-0.66, 0.07)	0.112
Mother's height			-0.00 (-0.04, 0.03)	0.837	-0.00 (-0.04, 0.03)	0.832
IQ score					0.06 (0.04, 0.07)	0.000
R-squared						32.6%

Logistic regression. Figure 1 shows the odds ratios of the logistic regression results for the outcome high school completion. The unadjusted model shows that stunted children are less likely to complete high school. A male young adult's likelihood to finish high school is reduced by 46% if he was stunted at two years old, while a female young adult's likelihood to finish high school is reduced by 57% if she was stunted at two years old.

Adjusting for covariates, stunting at two years old is significantly associated with high school completion for females. Although the odds ratios still show a reduced likelihood of high school completion in stunted children of both sexes (14% for males and 40% for females), the association is found to be significant (P=0.011) only in females. Accounting for IQ score along with the other covariates, no substantial change in the odds ratios is observed and the association is no longer significant for either of the sexes. For females the change in odds ratios is greater, from 0.60 to 0.72. For males, a change from 0.86 to 0.90 in odds ratios is observed.

Figure 2. Odd ratios of the logistic runs for outcome high school completion

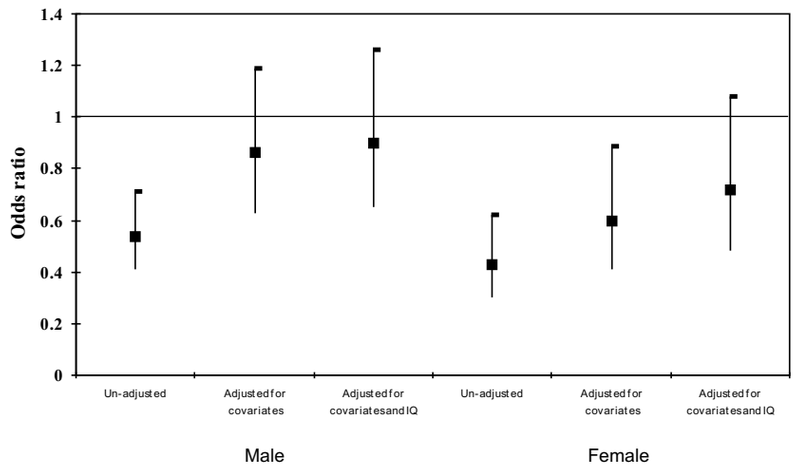


Table 5 has the odds ratios of stunting at two years old and of all the covariates included in the logistic regression for outcome high school completion. Parental education, asset index, hygiene index, place of residence and the IQ score are positively associated with the likelihood of completing high school.