The Effect of Mother's Education on Child Health: Evidence from Bangladesh

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Abstract

This paper seeks to find the causal effect of mother's education on child health, namely, under 5 stunting, wasting and incidence of being underweight, exploiting the introduction of a stipend program for rural girls in Bangladesh. To solve the endogeneity problem in the relationship between mother's education and child health, the paper uses mother's years of eligibility as an instrument for her years of education. I find that one extra year of mother's education leads to 2 percentage point (11.3 percent) decrease in the incidence of wasting along with 9 and 11 percent increase in weight for age and weight for height standard deviation from a reference median respectively. A reduced form difference in difference analysis shows that 1 more year of eligibility to the program leads to a 1 percentage point (5.9 percent) decrease in incidence of wasting. The paper contributes to the literature looking at intergenerational health effect of girl's schooling and is one of the first studies to consider a broader definition of infant and child health than birthweight and mortality.

1. Introduction

Under five mortality and malnutrition is one of the biggest health care challenges the world currently faces. According to WHO, in 2016 there were 155 million under five children stunted and 52 million wasted. A child is considered stunted if his/her height for age is more than two standard deviations below the WHO Child Growth Standard Median. A child is wasted when he/she has low weight for height. Both stunting and wasting indicate poor nutrition and / or repeated infections. Stunting is associated with poor cognition, poor educational performance, low wage and productivity while wasting may lead to increased risk of death. Given the severe long term adverse effects of stunting and wasting, WHO's Global Targets 2025 includes "40 percent reduction in the number of children under-five who are stunted" and "Reduce and maintain childhood wasting to less than 5 percent". Reduction of Stunting and wasting is also part of multiple Sustainable Development Goal (SDG) targets set by United Nations in 2015 (SDG 1.1; 1.2; 1.3; 2.1; 2.2; 10.4) (World Health Organization, 2017).

Stunting prevalence is the highest (34 percent) in Africa and South-East Asia (World Health Organization, 2017). The highest prevalence of wasting (15.3 percent) is also in South East Asian Region (World Health Organization, 2017). So, the challenge of fighting under five malnutrition is the greatest in developing countries. In Bangladesh, a South-Asian country, more than 54 percent of preschool-age children are stunted[1], more than 17 percent are wasted[2] and under five mortality rate is 5.3 percent (WHO, World Bank, & Ministry of Health and Family Welfare Bangladesh, 2015). This high rate of malnutrition along with introduction of a CCT to increase mother's

[1] FAO Bangladesh country profile: http://www.fao.org/ag/agn/nutrition/bgd_en.stm
[2] FAO Bangladesh country profile: http://www.fao.org/ag/agn/nutrition/bgd_en.stm

schooling makes Bangladesh an ideal country for studying the effects of mother's education on child health where both the level of women's education and child health are poor.

There have been a number of programs worldwide to address the problem of child malnutrition in the developing world. Programs like Oportunidades in Mexico, Chile Solidario in Chile, Familias En Acción in Colombia, Bono De Desarrollo Humano in Ecuador and Programa De Asignación Familiar in Honduras are aimed at increasing health center visits and improve health outcome for children had varying degrees of success (Gertler, 2004) (Behrman & Hoddinott, 2005) (Rivera, Sotres-Alvarez, Habicht, & Villalpando, 2004) and failure (Morris, Olinto, Flores, Nilson, & Figueiró, 2004) (Attanasio, Battistin, Fitzsimons, Mesnard, & Vera-Hernandez, 2005) . Given the fact that lower fertility is shown to have a positive relationship with lower child mortality, efforts were made in countries like Indonesia (Angeles, Guilkey, & Mroz, 2005) to reduce child mortality and improve child health by building more family planning clinics. One other factor that may influence child malnutrition is the parents', specifically mother's education. In a world where governments have unlimited funds, all of these strategies (CCT for under five children to consume more nutritious food, building family planning clinics and improving access to schools) could be employed simultaneously. In reality, governments operate under a budget constraint and there is always an opportunity cost to adopting one policy instead of other available choices. As such it is important to understand the effect of each of these policies in reducing under five children's health, specifically, stunting and wasting and mortality.

Studies have found mother's education to influence child birth outcomes such as infant mortality (Chou, Liu, Grossman, & Joyce, 2010; Breierova & Duflo, 2004; Grépin & Bharadwaj, 2015) and birth weight (Currie & Moretti, 2003; McCrary & Royer, 2006). But unlike the effect of education on own health (Lleras-Muney, 2005; Arendt, 2005; Oreopoulos, 2006; Silles, 2009), the effect of mother's education on child health beyond just mortality and birth-weight lacks convincing evidence. Exploiting the introduction of a stipend program for rural girls in Bangladesh, one of the largest and longest running conditional cash transfer program in the world, this paper seeks to find the causal effect of mother's education on child health, namely, under 5 stunting, wasting and underweight.

This paper advances the literature in three ways. First, it estimates the effect of mother' education on under five child health by looking at stunting, wasting and incidence of being underweight. While there have been a number of studies estimating the causal effect of parent's education on birth-weight (Currie & Moretti, 2003; McCrary & Royer, 2006), infant mortality (Chou, Liu, Grossman, & Joyce, 2010; Breierova & Duflo, 2004; Grépin & Bharadwaj, 2015), age of marriage or pregnancy (Hong & Sarr, 2013; Hahn, Islam, Nuzhat, Smyth, & Yang, 2015; Alam, Baez, & Carpio, 2011) and Fertility (Angeles, Guilkey, & Mroz, 2005; Long & Osili, 2008), to my knowledge there has been none estimating the effect of mother's education on under 5 child health, namely stunting, wasting and incidence of being underweight. Second, it is the first to provide credible causal estimates of the effect of mother's education on under 5 child mortalities in a country with a very low level of female education and a high level of under 5 child malnutrition. Chou, Liu, Grossman, & Joyce (2010) and Breierova & Duflo (2004) study this effect in Taiwan and Indonesia respectively both of which had higher rates of female education and lower rates of under 5 death and malnutrition at the beginning of the program compared to Bangladesh. So, this study is set in a context where the issue of child malnutrition is the most pressing. One paper that is set in a country with similarly high malnutrition is Grépin & Bharadwaj (2015). It uses the post liberation change in school attendance rule in Zimbabwe to identify the effect of maternal secondary education on child survival. But the paper also notes that there were several concurrent social and institutional changes in the health-care sector in the then just-liberated country. This may have biased the results and over-estimated the effect of mother' schooling on child survival. Studies that look at broad conditional cash transfer programs on child health also fail to isolate the effect of mother's education as the programs have multiple conditions such as school attendance, vaccination and nutrition; some of which may affect child health positively. The Female School Stipend Program is a unique CCT in the sense that the primary condition of receiving the stipend is to remain in school and does not include other health and nutrition related conditions. The third and final contribution of the paper is that it is the first evaluation of inter-generational effect of FSSSP, one of the earliest and longest running CCTs in the world.

2. Literature Review

The effect of education on health has been studied extensively in literature. The Grossman model postulates that people produce health by using medical care as an input and education, health status and income affect the production of health by affecting its shadow price (Grossman, 1972). Education can improve health by prompting an individual to put in more input in the form of medical care and exercise (Allocative efficiency) or more educated people may simply be better and more efficient producers of health with the same amount of inputs (Productive efficiency). There are a number of causal studies that show a convincing positive relationship between education and self-health (Lleras-Muney, 2005; Oreopoulos, 2006; Silles, 2009). There have been fewer studies investigating the relationship between parent's education and child health, and the results have been mixed. Some of the studies in developed countries include Lindeboom et al. (2009), Currie and Moretti (2003), McCrary and Royer (2006), Silles (2009) while few explore developed country such as Chou et al. (2010), Lucia Breierova and Esther Duflo (2004), Grepin and Bharadwaj (2015).

2.1. Causal Impact of Education on Self-Health

There are a number of studies exploiting the minimum compulsory schooling laws as exogenous variation in years of schooling to identify the effect of years of schooling on health. Most of these studies are on developed countries. Lleras-Muney (2005) uses the change in state compulsory schooling law from 1915 to 1939 as exogenous variation to identify reduced mortality rates between 1960 to 1970 and 1970 to 1980 using instrumental variable and regression discontinuity design. Both Oreopoulos (2006) and Silles (2009) use the mandatory years of schooling law change in the UK from 14 to 15 in 1963 and then to 16 in 1973 and use eligibility of year cohorts as IV to show education improves self-reported health. Braakmann (2011) uses the same schooling requirement laws in UK but finds no effect of education on self-assessed health. Clark and Royer (2013) also uses the two British compulsory schooling laws and uses an RD design and also finds no evidence of education affecting self-assessed health.

2.2. Causal Impact of Parents' Education on Child Health

Chou, Liu, Grossman, and Joyce (2010) exploits a Taiwanese law extending compulsory education from 6 to 9 years in 1968 and the opening of 150 new junior high schools from 1968 to 1973 as an exogenous shock to education to identify its effect on infant mortality. The study uses the interaction of compulsory years of schooling increase and county specific new school openings as an IV for years of schooling. They find that parent's schooling decreases infant mortality. A similar methodology of exploiting the interaction of cohort and intensity of intervention as an IV for years of schooling was used by Breierova and Duflo (2004) to estimate the effect of parent's education on child mortality in Indonesia. They exploit two rounds of primary school construction program during 1973-1974 and 1978-1979. In this case, again, program intensity is defined by the number of schools built in each district. They find both mother and father's education to have negative effects on infant mortality.

Osili and Long (2008) used a similar method to Breierova and Duflo (2004) in Nigeria where they estimated the effect of female schooling on fertility. In 1976, Nigeria introduced a nationwide program that provided tuition-free primary education and increased the number of primary school classrooms at differential rates among the 19 states of the country. The paper used the interaction between year of birth and program intensity, measured by the per capita amount of federal funds given to each state for classroom construction, as an IV for mother's years of schooling. The authors found that an increase in mother's education by one year reduces fertility by 0.26 births. This is relevant to child health because it is hypothesized in literature that lower number of children is associated with increased health (Becker & Lewis, 1973).

Angeles, Guilkey and Mroz (2005) used a maximum likelihood procedure to estimate the effect of mother's education and existence of health centers providing family planning on fertility in Indonesia. The paper uses a discrete time hazard model for age at marriage and education level of spouse and a logit model for fertility experience starting at age 10 while allowing availability of family planning services in the place of residence when a girl is 7 and later in her life to have separate effects. The primary finding of the paper is that the presence of family planning program in young woman's area leads to higher educational attainment and lower fertility. The authors also find that effect of higher education on reduced fertility is overestimated if endogeneity of education and marriage is not controlled for. This shows that endogeneity of education is crucial to control for if we want to estimate the effect of it on fertility and by extension child health.

Most Recently Grepin and Bharadwaj (2015) uses variation from age-specific exposure to a series of reforms in Zimbabwe (Used as an IV) that increased access to education for females to identify effect of maternal secondary education on child survival in Zimbabwe. They find that an extra year of maternal education was associated with a 1.7 percentage point decrease in the probability that a child was reported to have died prior to the survey. They also attempt to identify channels through which years of mothers schooling affect child survival by using the same IV and determine delay in cohabitation, decreased number of kids born, and increased age at first birth to be some of the possible channels.

There have been studies investigating the causal effect mother's education on child health in developed countries as well. Currie and Moretti (2003) Examine the relationship between maternal education and birthweight among US white women with data from individual birth certificates from the Vital Statistics Natality files for 1970 to 2000. They used information on college openings between 1940 and 1990 to construct an availability measure of college in a woman's seventeenth year as an instrument for schooling. McCrary and Royer (2006) uses a combination of school entry policies and compulsory years of schooling laws as IV for mother's education to identify the effect of mother's education on the probability of low birthweight and infant mortality in Texas and California in the US. They do not find any effect of years of mother's education on child birth outcome.

Most of these studies look at the relationship between parent's (in some cases only mother's) education and child survival. This surely is the first and one of the most immediate inter-generational effect of mother's education to look at, but survival is a narrow definition of health. To my knowledge, Currie and Moretti (2003) and McCrary and Royer (2006) are the only papers that look at health of the children who do survive, specifically incidence of low birthweight. This paper takes the next step by estimating the effect of mother's education on stunting, wasting and and incidence of being underweight of under 5 children.

There have been a few studies evaluating the impact of the Female Secondary School Stipend Program (FSSSP) in Bangladesh and another similar program in Pakistan. Most of these papers look at the short run goals of the programs, i.e. school enrollment of females while some look at fertility and age at marriage outcomes. A number of studies find a positive effect of FSSSP on female secondary schooling (Fuwa, 2001; Khandker, Pitt and Fuwa, 2003; Schurmann, 2009; Hong and Sarr, 2013) increased age of marriage (Hong and Sarr, 2013; Hahn, Islam, Nuzhat, Smyth, & Yang, 2015) and labor force participation in the formal sector (Hahn, Islam, Nuzhat, Smyth, & Yang, 2015). In Pakistan, a similar CCT program shows increased female enrollment (Chaudhury & Parajuli, 2006) delayed marriage, fewer birth and higher matriculation rates (Alam, Baez, & Carpio, 2011)

3. Institutional Background: Female Secondary School Stipend Program (FSSSP) in Bangladesh

Primary school in Bangladesh is grades 1 through 5 and secondary school is 6 through 10. In the 1990s there was a large disparity between schooling of men and women in Bangladesh. In 1991, 75 percent of girls between 6 and 10 years old were enrolled in schools while 85 percent of boys of the same age were enrolled in primary school. The disparity continued in secondary school where 14 percent of girls between the age of 11 and 16 were in secondary school while for boys it was 25 percent (World Bank, 2003). To address the inequality in secondary education in Bangladesh, the FSSSP started in Bangladesh in 1994 with three stated goals: to increase female enrollment and retention rates in secondary school, to increase age at marriage for girls and to enhance female employment opportunities. It was targeted to girls from rural schools only.

The eligibility criteria for receiving the stipend are that the girl has to (a) have a minimum of 75 precent attendance rate at school, (b) have at least 45 percent score in annual exam and (c) remain unmarried. The program was rolled out in all rural schools at the same time. The annual stipends were equivalent to US$12 in Grade 6, US$13.50 in Grade 7, US$15 in Grade 8, US$30.25 in Grade 9 and US$36.25 in Grade 10.[3] In addition, a book allowance in grade 9 and examination fee in grade 10 were available. Tuition fees were covered as well, which were directly paid to the school. The cash stipend was paid directly to the girls in two annual instalments in the form of deposits into savings accounts in the nearest bank branch. Not all grades received stipend from 1994. In 1994 grades 7 and 9 received stipends, in 1995 grades 6,7,9 and 10 received stipends and from 1996 onwards, all grades from 6 to 10 received stipends. Table 1 shows the years of eligibility for different cohorts of mother.

FSSSP supports over 2 million girls each year and consists of 60 percent of the secondary school development budget and 13% of total education budget of Bangladesh (WB 1997). This makes the stipend program a major undertaking for the country. Just above half of the program cost is born by the g7overnment of Bangladesh (GOB) and the rest by a number of donor organizations. Even though the program has seen a lot of success in increasing female schooling and reducing child marriage, there is a push from the donors to change the program and make it more targeted by restricting the stipend to only girls whose family is below an income threshold. Government of Bangladesh has historically been very much opposed to this idea.

[3] All allowance are simple conversions and not PPP.

4. Data

The data source for this study is 3 rounds of Bangladesh Demographic Health Survey (BDHS) collected in 2007, 2011 and 2014. DHS is a nationally representative household survey that includes detailed health related variables for mother and child. It surveys information on women of age 15 to 49 and men of age 15 to 59. The surveys include individual and household level information. One unique feature of DHS survey is that the surveyor weights and measures all under 5 children in the household which are then used to calculate the weight for height (Wasting measure), height for age (Stunting measure) and weight for height (Measure of being underweight) deviation from reference median measures.

Table 2 shows the means of the variables of interest for rural and urban areas of Bangladesh for pre and post 1979 birth-year cohort of mothers. The outcome variables of particular interest are stunting, underweight and wasting. The literature on under 5 child health uses WHO approved z-scores for height for age (HAZ), weight for age (WAZ) and weight for height z scores (WHZ). These scores are comparable across age and sex. The scores are calculated using the following equation:

$$HAZ_i = (h_{ij}-h_j)/\ \sigma_j$$

where h_{ij} is the observed height of child i in group j, where a group is defined according to child sex and the birth month. h_j and σ_j are the median and standard deviation of the height in group j, using American children as the reference population. HAZ_i is child i's height for age standard deviation from a reference median. Similarly, WAZ_i and WHZ_i are weight for age and weight for height standard deviation from a reference median for child i. Figure 1 shows the distribution of

HAZ, WAZ and WHZ in the DHS survey sample. All three have a bell-shaped distribution with mean smaller than zero.

According to WHO, moderate to severe stunting, underweight and wasting is defined as height for age, weight for age and weight for height being 2 standard deviations below the median of reference population, i.e. HAZ, WAZ and WHZ being less than -2 respectively. In this paper the binary variables for stunting, wasting and underweight have been constructed using this definition. According to table 2, 47.2 percent of under 5 rural children in the pre-1979 cohort of mothers are stunted, while 43.9 percent are underweight and 17.7 pervent are wasted. Prevalence of stunting, wasting and underweight among under 5 children is higher in rural area compared to urban area for the

pre-1979 mother cohort. This trend persists in the post 1979 mother cohort as well. All three under 5 child health risk measures are higher in rural areas compared to urban areas in the post period, but the gap has shrunk for the post 1979 mother cohort. Figure 2 shows the shrinking gap in stunting following the shrinking gap in mother's years of education between rural and urban areas.

There is one shortcoming of the DHS dataset used in this study. Mother's childhood place of residence is not available in the data. Due to the lack of availability of this variable in the survey data, I will use the urban/ rural classification of current area of residence instead. Justification of this decision is that migration in Bangladesh is overwhelmingly from rural to urban areas (Richard Marshall & Rahman, 2013) and consequently most mothers who currently live in rural areas grew up in rural areas as well. Given that the stipend program is implemented in rural areas only, the migration from rural to urban area will underestimate any positive effect of the program on mother's years of education and child health.

5. Methodology

This paper identifis the effect of the secondary school stipend program in Bangladesh on children's health, specifically, stunting, underweight, wasting as well as the height for age, weight for age and weight for height standard deviations from reference median (z scores) of under 5 children. The determinants of mother's education may be correlated with unobservable ability which also affect mother's nurturing of children and child health. This gives rise to an endogeneity problem in estimating the effect of mother's education on child health. This study will use years of eligibility in a female secondary school stipend program (FSSSP) as an instrument for mother's years of schooling to address this endogeneity problem. It will also examine the reduced form relationship between mother's years of eligibility for stipend program and child health using a difference in difference method.

The female secondary school stipend program in Bangladesh started in 1994 with girls from grades 7 and 9, and by 1996 it included all the girls in grades 6 to 10. The program was rolled out in all rural schools at the same time. The geographically non-staggered nature of implementation within rural areas is problematic for identification. There are, however, some variations that can be exploited such as (i) rural girls born in or after 1979 received stipend for at least a year (ever stipend) and those who were born before 1979 were in 10th grade or higher and did not receive any stipend and (ii) the stipend program was rolled out only in rural schools. This paper will exploit these two variations in an IV design to estimate the effect of mother's years of schooling on child health. It will also use a difference in difference design to estimate the reduced form effect of the stipend program eligibility on child health.

5.1. Difference in Difference Analysis

A girl's eligibility to the stipend program depends on two factors, being born after 1978 and living in a rural area. This gives rise to a difference in difference identification strategy where the treatment group are the rural mothers, and the control group are the urban mothers while the pre-period is the mother's birth cohort before 1979 and post period is the birth cohort of 1979 and after 1979. Equation (i) lays out the DID specification for reduced form relationship.

$$\text{DID RF: } Y_i = \beta_0 + \beta_2 rural_i + \beta_3\, MyobFE_i + \beta_4\, rural_i * elig\_years_i + \beta_5 Mage\_childbirthFE_i + \beta_6 districtFE_i * CyobFE_i + \beta_7 bord_i + \varepsilon_i \qquad \text{(i)}$$

Here, Y_i is a health outcome for child i (Stunting, wasting, underweight and HAZ, WAZ and WHZ), $rural_i$ is a dummy variable that takes the value 1 if the mother of child i lives in rural area, $MyobFE_i$ is mother's birth year fixed effect and $Mage\_childbirthFE_i$ is mother's age at childbirth. $district_i$ and $Cyob_i$ are dummy variables for district of mother of child i, and year of birth of child i. Bangladesh is divided into 64 districts where each district has both urban and rural areas in it. $elig\_years_i$ is the years of eligibility to the stipend program of mother of child i. $elig\_years_i$ will be determined by mother's birth cohorts. Mothers born before 1979 were in grade 10 or higher in 1994 when the program was introduced, so they did not receive stipend under FSSSP[4]. Due to the staggered nature of the implementation of the stipend program, girls born in or after 1983 received all 5 years of stipend. Girls born between 1982 and 1979 (Inclusive) receive varying durations of stipend ranging from 2 to 4 years. See table 1 for a breakdown of mother's exposure to stipend by year of birth. The variable $eligibility_i$ will take the value 0 if mother was born in or before 1978, 5 if mother was born in or after 1983 and 2 to 4 for mothers born between 1979 and 1984 (inclusive).

[4] In 1994 girls from only grades 7 and 9 received stipend.

The identifying assumption in this reduced form analysis is that the pre-1979 cohorts in rural and urban areas have a parallel trend in the outcome variables of interest. The pre-trend in outcome variables percentage stunting, percentage wasting and percentage underweight as well as HAZ, WAZ and WHZ in rural and urban areas in Bangladesh can be seen in figure 2. The coefficient of interest in equation (i) is β_4. While the reduced form analysis requires a lower number of identifying assumptions, this can only let us know the effect of the stipend program on child health and not the effect of mother's education on child health.

5.2. Two Stage Least Square

A more general and arguably more interesting question would be what the effect of mother's education on child health is. Equation (ii) shows the relationship of interest. But due to the possibility of an omitted variable induced endogeneity in the relationship between mother's education and child health I use an IV method. Equations (iii) and (iv) are the first and second stages of an IV design where mother's years of schooling is instrumented by her years of eligibility for the stipend program. For the exclusion restriction to hold, eligibility, which is an interaction between the dummy variable $rural_i$ and the continuous variable years of eligibility ($elig\_years_i$), should influence child health only through mother's education. But it can be argued that the mother being in a rural area may affect child health due to inferior medical service availability compared to urban area which in turn affects child health. This problem is ameliorated by the fact that a rural control is included as covariate which will absorb the effect of a rural vs urban address of the child-mother pair. I will include the number of health-care facilities in each area to control for this factor in future. Despite this caveat, this DID+IV method enables the use of a control group in estimating the effect of mother' education on child health.

$$\text{Relationship of interest: } Y_i = \beta_0 + \beta_1 rural_i + \beta_2 Myoe_i + \beta_3 Mage\_childbirthFE_i + \beta_4 MyobFE_i + \beta_5 districtFE_i * CyobFE_i + \beta_6 bordFE_i + \varepsilon_i \qquad \text{(ii)}$$

$$\text{First Stage: } Myoe_i = \beta_0 + \beta_1 rural_i + \beta_2\, rural_i * elig\_years_i + \beta_3 MyobFE_i + \beta_4 Mage\_childbirthFE_i + \beta_5 districtFE_i * CyobFE_i + \beta_6 bordFE_i + \varepsilon_i \qquad \text{(iii)}$$

$$\text{Second Stage: } Y_i = \beta_0 + \beta_1 rural_i + \beta_2 MyoeHat_i + \beta_3 MyobFE_i + \beta_4\, Mage\_childbirthFE_i + \beta_5 districtFE_i * CyobFE_i + \beta_6 bordFE_i + \varepsilon_i \qquad \text{(iv)}$$

Here, Y_i is the child health outcome, $Myoe_i$ is the years of education of the mother of child i, $elig\_years_i$ is the years of eligibility of mother for stipend program which ranges from 0 to 5. Eligibility is an interaction of the binary variable rural and the continuous variable "elig_years" which depends on mother's birth year. The years of eligibility for various birth cohorts can be seen in table 1.

Similar to Currie & Moretti (2003), the identifying variation comes from the fact that each district has rural and urban areas in it and the model compares birth's in a district that occur in the same year but to mothers of different ages some of whom live in rural and others in urban areas. The interaction of district and child year or birth fixed effects ensures that the model controls for any between-district and between-year differences in medical technology, family planning programs etc.

6. Results

Table 3 shows the reduced form DID model specified in equation (i). Elig_years is an interaction of a binary variable rural and a continuous variable years of stipend eligibility of the mother according to her birth cohort. One extra year of eligibility for stipend program for mother decreases the probability of being wasted by 1 percentage point (5.9 percent decrease in incidence of wasting compared the mean for rural, pre-intervention mother cohort as stated in Table 1). It also increases weight for age and weight for height z score by 2 percent and 3 percent respectively.

Table 4 shows the result of naïve OLS regression of child health outcomes (stunting, underweight, wasting and the z scores) on mother's years of education, controlling for indicator for mother living in a rural or urban area, mother's age at child birth, mother's year of birth and child birth order. All the models include interaction of child's year of birth and district fixed effects. The naïve OLS shows a positive and significant relationship between mother's years of education and probability of being stunted and underweight. Increase in mother's schooling by one-year decreases probability of being stunted and underweight by 2 percentage points. Mother's years of schooling also has a positive and significant effect on all three z scores. A one-year increase in mother's schooling increases height for age, weight for age and weight for height z scores of the child by 6, 5, and 3 percent respectively. These relationship, however may not be causal. An omitted third variable like mother's ability may affect both mother's years of education and child health. This endogeneity problem will render these estimates biased. To solve the endogeneity problem I instrument mother's years of schooling with mother's years of eligibility for the stipend program.

The validity of IV depends on strength of the first stage and exclusion restriction. The strong positive and significant relationship between years of mother's education and years of eligibility conditional on other covariates specified in equation (iii) can be seen in table A1 in appendix. Table 5 shows the result of 2SLS IV design. One extra year of schooling leads to a 2-percentage point decrease in the probability of wasting (11.3% decrease compared the mean for rural, pre-intervention mother cohort) and no significant effect on probability of children being underweight or stunted. An extra year of mother's schooling also leads to a 9 percent increase in WAZ (Weight for age z score) and 11 percent increase in WHZ (Weight for height z score). The fact that mother's years of schooling leads to an increase in WAZ but does not decrease the probability of being underweight shows that mother's schooling influenced child's weight for age at a margin that does not push underweight children above the threshold. More investigation is required to check if mother's years of schooling increases weight for age of children who are not underweight or increases weight for age for underweight children but does not push them above the threshold.

7. Conclusion

Child malnutrition and subsequent irreversible effects on cognition, low performance at school and low wage in the labor market is a cycle that may lead to inter-generational poverty. Countries have been designing various supply side (Better health care facilities, increasing the number of antenatal care facilities, increasing the number of trained nurses for child birth, providing family planning services, etc.) and demand side (Information campaign for family planning, hygiene campaign, etc.) interventions to reduce child malnutrition. This paper finds that 1 more year of schooling for mother leads to 2 percentage point decrease in incidence of wasting or an 11.3 percent decrease in incidence of wasting compared the mean for rural, pre-intervention mother cohort. Furthermore, mother's education also increases weight for age and weight for height z scores by 9 percent and 11 percent respectively. The reduced form difference in difference estimates show that years of eligibility to the stipend program also leads to 1 percentage point decrease in the incidence of wasting (5.9 percent decrease in incidence of wasting compared the mean for rural, pre-intervention mother cohort) and 2 and 3 percent increase in weight for age and weight for height z scores. The first stage regression also shows a strong positive relationship between years of eligibility and years of schooling.

Given the effectiveness of mother's education in improving child health, the cost -benefit analysis of the FSSSP in specific and education related CCTs in general should include the long run inter-generational nutrition effect of the program. These results show that mother's education may be an integral part of reaching the WHO Global Targets 2025 that targets a childhood wasting incidence of 5 percent globally and UN Sustainable Development Goals (SDG) that includes low stunting and wasting incidence goals.

There are three planned additions to this study. First, I will include 5 more years of DHS survey from 1993 to 2003 to the study. Second, I will explore the possible mechanisms through which mother's education may affect child health. Possible pathways include age of marriage, number of children the mother has by a certain age, and income of household. Third, I will investigate the heterogenous treatment effect by estimating the effect of mother's education on different sub-groups of income, and education.

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Tables and Figures

Table 1

Grade in 1994	Age in 1994	Year of birth for each age in 1994	Years for which rural girl received stipend if at school	Treatment status
1	7	1987	5	Treated
2	8	1986	5	
3	9	1985	5	
4	10	1984	5	
5	11	1983	5	
6	12	1982	4	Partially Treated
7	13	1981	3	
8	14	1980	2	
9	15	1979	2	
10	16	1978	0	Control
11	17	1977	0	
12	18	1976	0	
13	19	1975	0	
14	20	1974	0	

Table 2: Summary Statistics

Variable	Rural (Treatment) Pre-1979 mother cohort	Urban (Control) Pre-1979 mother cohort	Rural (Treatment) Post 1979 mother cohort	Urban (Control) Post 1979 mother cohort
Outcomes				
HAZ: Height for age SD	-1.869	-1.428	-1.671	-1.392
WAZ: Weight for age SD	-1.822	-1.355	-1.631	-1.313
WHZ: Weight for height SD	-1.071	-0.783	-0.973	-0.758
Stunted[5]	0.472	0.358	0.406	0.333
Underweight [6]	0.439	0.326	0.372	0.275
Wasted[7]	0.177	0.138	0.163	0.132
Covariates				
Mother's years of education	2.907	6.2	5.401	6.781
Mother's current age	35.17	34.99	24.36	24.77
Total number of children of the mother	4.717	3.661	2.321	2.026
Mother's age at first child birth	18.82	20.62	17.71	18.57
Mother's age at child birth	31.73	31.5	21.58	21.98
Marriage to first birth interval	38.95	36.25	23.79	25.34
Birth order number	4.522	3.514	2.110	1.871
N	2242	1100	10619	5005

[5] Equals 1 if HAZ<-2 i.e. height is 2 SD lower than standard set by WHO
[6] Equals 1 if WAZ<-2 i.e. weight is 2 SD lower than standard set by WHO
[7] Equals 1 if WHZ<-2 i.e. weight is 2 SD lower than standard set by WHO

Table 3: Reduce Form DID
continuous eligibility

VARIABLES	(1) Dep_var: Stunting	(2) Dep_var: Underweight	(3) Dep_var: Wasting	(4) Dep_var: HAZ	(5) Dep_var: WAZ	(6) Dep_var: WHZ
elig_years	0.00	-0.00	-0.01*	0.01	0.02*	0.03**
	(0.005)	(0.005)	(0.004)	(0.015)	(0.014)	(0.013)
Rural	0.04*	0.06**	0.05***	-0.20***	-0.30***	-0.26***
	(0.023)	(0.024)	(0.015)	(0.065)	(0.063)	(0.058)
Constant	0.87**	0.84*	0.21	-3.43***	-3.37***	-1.93**
	(0.412)	(0.439)	(0.266)	(1.104)	(0.872)	(0.927)
Observations	19,904	19,904	19,904	19,904	19,904	19,904
R-squared	0.134	0.122	0.078	0.161	0.149	0.097
CyobFE*district FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by district in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Naive OLS

VARIABLES	(1) Dep_var: Stunting	(2) Dep_var: Underweight	(3) Dep_var: Wasting	(4) Dep_var: HAZ	(5) Dep_var: WAZ	(6) Dep_var: WHZ
education in single years	-0.02***	-0.02***	-0.00***	0.06***	0.05***	0.03***
	(0.001)	(0.001)	(0.001)	(0.004)	(0.003)	(0.003)
rural	0.03***	0.05***	0.02***	-0.13***	-0.17***	-0.13***
	(0.012)	(0.012)	(0.007)	(0.032)	(0.028)	(0.026)
Constant	0.97**	0.93**	0.25	-3.77***	-3.74***	-2.17**
	(0.406)	(0.436)	(0.266)	(1.054)	(0.849)	(0.934)
Observations	19,884	19,884	19,884	19,884	19,884	19,884
R-squared	0.147	0.134	0.079	0.179	0.170	0.102
CyobFE*district FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by district in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: 2SLS_cont_elig

VARIABLES	(1) Dep_var: Stunting	(2) Dep_var: Underweight	(3) Dep_var: Wasting	(4) Dep_var: HAZ	(5) Dep_var: WAZ	(6) Dep_var: WHZ
education in single years	0.00	-0.00	-0.02*	0.03	0.09*	0.11**
	(0.019)	(0.020)	(0.013)	(0.055)	(0.050)	(0.050)
rural	0.05**	0.06***	0.00	-0.15***	-0.14***	-0.07
	(0.019)	(0.019)	(0.013)	(0.054)	(0.045)	(0.045)
Constant	0.17	0.18	0.66**	-1.55	-4.44***	-5.14***
	(0.468)	(0.445)	(0.332)	(1.050)	(1.188)	(1.230)
Observations	19,884	19,884	19,884	19,884	19,884	19,884
R-squared	0.131	0.124	0.045	0.175	0.155	0.043
CyobFE*district FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by district in parentheses
*** p<0.01, ** p<0.05, * p<0.1

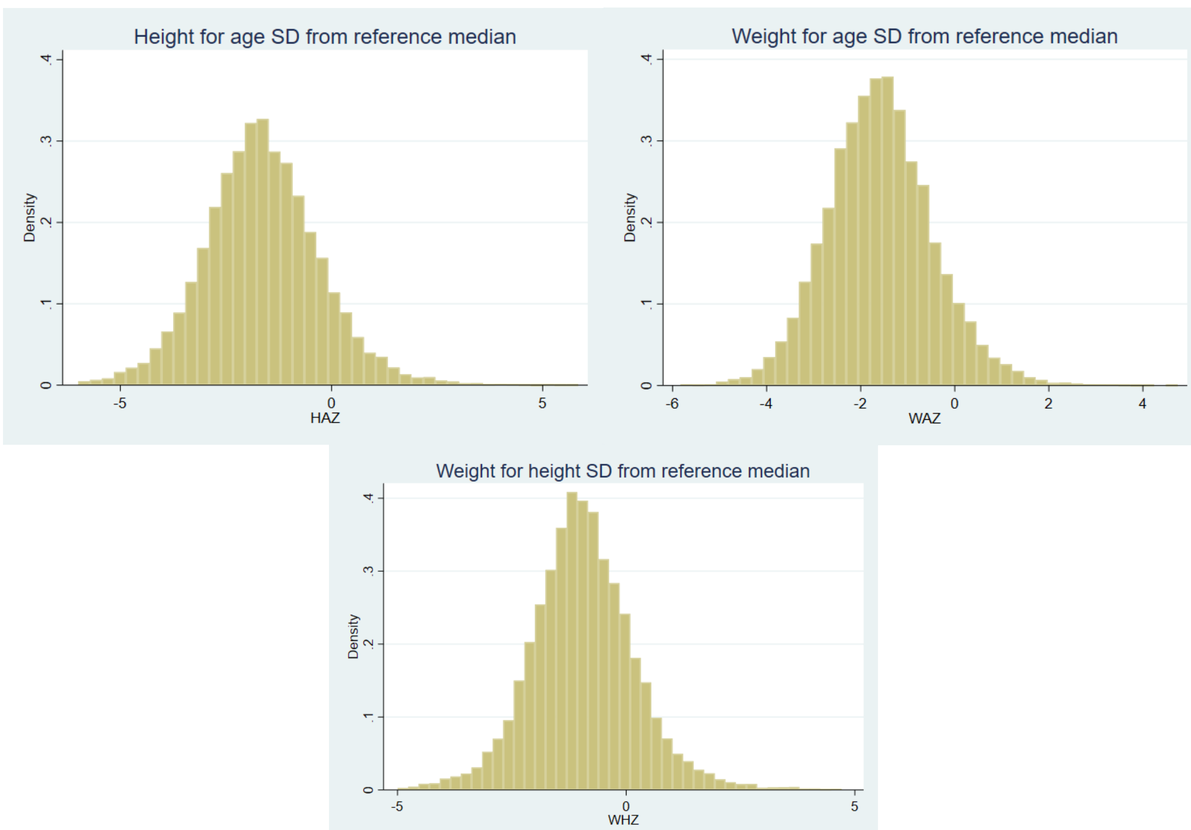

Figure 1: Height for age, weight for age and weight for height deviation from median of reference population

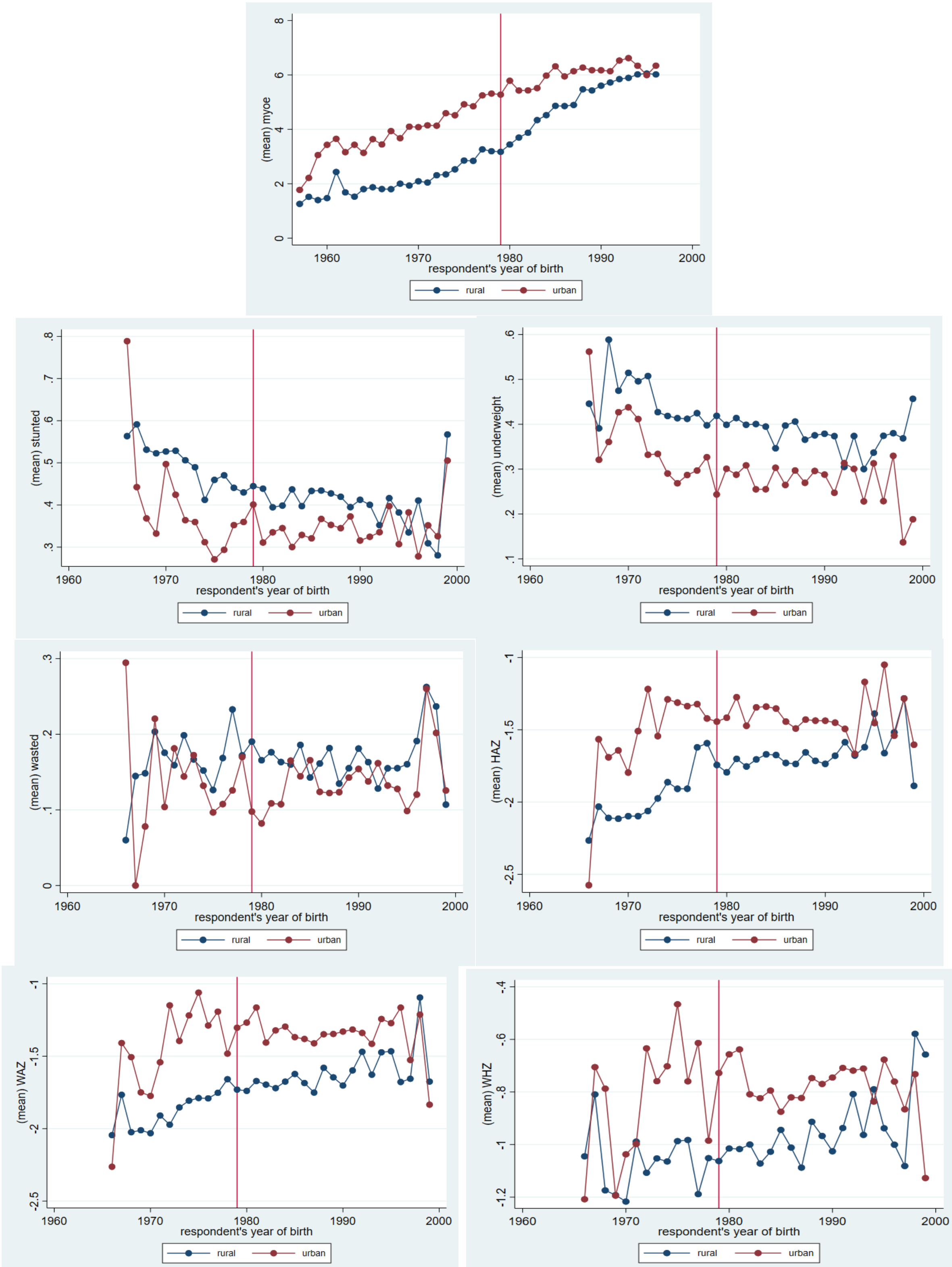

Figure 2: Mother's birth cohort trend of education and child health

Appendix:

Table A1: 1st Stage strength test

VARIABLES	(1) Dep_var: Mother's years of education All controls
elig_years	0.19***
	(0.025)
rural	-1.46***
	(0.122)
Constant	11.14***
	(2.294)
Observations	120,073
R-squared	0.289

Robust standard errors clustered by district in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3: 2SLS binary eligibility

VARIABLES	(1) Dep_var: Stunting	(2) Dep_var: Underweight	(3) Dep_var: Wasting	(4) Dep_var: WAZ	(5) Dep_var: HAZ	(6) Dep_var: WHZ
education in single years	-0.01	-0.00	-0.02	0.03	0.09*	0.11**
	(0.024)	(0.026)	(0.017)	(0.055)	(0.050)	(0.050)
rural	0.03	0.06**	0.01	-0.15***	-0.14***	-0.07
	(0.022)	(0.022)	(0.015)	(0.054)	(0.045)	(0.045)
Constant	0.36	0.20	0.56	-1.55	-4.44***	-5.14***
	(0.499)	(0.494)	(0.354)	(1.050)	(1.188)	(1.230)
Observations	19,884	19,884	19,884	19,884	19,884	19,884
R-squared	0.147	0.126	0.068	0.175	0.155	0.043
CyobFE*district FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by district in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A4: Reduce Form DID
binary eligibility

VARIABLES	(1) Dep_var: Stunting	(2) Dep_var: Underweight	(3) Dep_var: Wasting	(4) Dep_var: HAZ	(5) Dep_var: WAZ	(6) Dep_var: WHZ	(7) Dep_var: WHZ
elig	-0.01	-0.00	-0.01	0.07	0.11	0.11	0.11
	(0.026)	(0.027)	(0.018)	(0.077)	(0.070)	(0.069)	(0.069)
rural	0.06**	0.06**	0.03**	-0.23***	-0.30***	-0.24***	-0.24***
	(0.024)	(0.025)	(0.016)	(0.070)	(0.067)	(0.065)	(0.065)
Constant	0.86**	0.84*	0.22	-3.40***	-3.37***	-1.95**	-1.95**
	(0.412)	(0.439)	(0.266)	(1.101)	(0.871)	(0.930)	(0.930)
Observations	19,904	19,904	19,904	19,904	19,904	19,904	19,904
R-squared	0.134	0.122	0.078	0.161	0.149	0.097	0.097
CyobFE*district FE	Yes	Yes	Yes	Yes	Yes	Yes	

Robust standard errors clustered by district in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5: RF_RD_rural_only_cont_elig

VARIABLES	(1) Dep_var: Stunting	(2) Dep_var: Underweight	(3) Dep_var: Wasting	(4) Dep_var: HAZ	(5) Dep_var: WAZ	(6) Dep_var: WHZ
elig_years_norural	0.04	0.03	0.01	-0.05	0.04	0.07
	(0.050)	(0.054)	(0.041)	(0.151)	(0.113)	(0.096)
Constant	0.42	-0.08	0.06	-2.07	-1.44	-0.24
	(0.677)	(0.432)	(0.226)	(1.699)	(1.107)	(0.696)
Observations	758	758	758	758	758	758
R-squared	0.650	0.620	0.563	0.634	0.640	0.593
CyobFE*district FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by district in parentheses
*** p<0.01, ** p<0.05, * p<0.1