The Link between Education and Health

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Abstract

This paper investigates the intergenerational effects of maternal education on child health in 68 developing countries across five continents over nearly three decades. Exploiting the between-sisters variation in the educational attainment of the mothers, we find that mother's education is positively associated with child health measured by the three most commonly used indices, namely height-for-age, weight-for-height, and weight-for-age. Our mechanism analyses further show that these favorable effects could be, at least in part, attributed to fertility behavior, assortative matching, health care utilization, access to information, health knowledge, and labor market outcome. Given the long-lasting impacts of early-life health over the life cycle, our findings underline the importance of maternal education in improving economic and social conditions in developing countries.

Keywords: Maternal Education, Child Health, Anthropometry

Introduction

Among under-five children worldwide in 2018, the proportion of stunted children (those too short for their age) was 22% while the fraction suffering from wasting (children too thin for their height) was 7% (Unicef, World Health Organization, and World Bank, 2019). These statistics indicate a widespread presence of undernutrition which accounts for approximately half of all deaths among children under five (Unicef, 2019). Besides, poor early-life health, in the form of childhood undernutrition, has a long-lasting effect over the life cycle such as cognitive impairment, lower educational attainment, higher vulnerability to chronic diseases, and declining productivity as well as earnings (Martorell, 1999; Alderman et al., 2006; Briend and Berkley, 2016). Given these detrimental private and social costs, considerable attention has been drawn to the improvement of child health where maternal education is regarded as one of the key solutions. According to Grossman (1972, 2006), not only are the more educated mothers capable of \producing" better child health with a given set of health inputs (i.e. productive efficiency), but they are also able to allocate health inputs more efficiently compared to women who are less educated (i.e. allocative efficiency). Nevertheless, there is conflicting empirical evidence on the relationship between maternal education and child health (e.g., Currie and Moretti, 2003; Lindeboom et al., 2009; Chou et al., 2010; McCrary and Royer, 2011; Keats, 2018; among others). In addition, as pointed out in Grossman (2006, 2015), the establishment of the causal relationship between maternal education and child health is plagued with the problem of endogeneity. Specifically, the existence of \third omitted" variables which jointly determine maternal education and child quality, such as genetics and family endowments, complicates the identification of the causal impacts. Multiple studies address this endogeneity problem by relying on the exogenous changes in education induced by multiple government programs within the instrumental-variable framework (Breierova and Duflo, 2004; Chou et al., 2010; Aslam and Kingdon, 2012; Grepin and Bharadwaj, 2015; Keats, 2018), or by the age-at-school-entry policies using the regression discontinuity design approach (McCrary and Royer, 2011). However, these studies tend to quantify the effects of interest for a subgroup of population within a context of one individual country. In exploring the relationship between the intergenerational transmission of education and child health, the contribution of our study is three folds. First, instead of focusing on just one country, our sample covers 68 developing countries across five continents over nearly three 1decades. This wide coverage across time and space makes it possible to interpret our results as externally valid. Second, to ensure the internal validity of our estimates, we exploit the between-sisters variation in educational attainment among the mothers in a sister fixed effects framework. In other words, our identification comes from the comparison of health outcomes among children born to mothers who are biological sisters. Finally, we contribute to the literature by exploring a variety of pathways through which mother's education improves child health. Policywise, understanding the underlying mechanisms can be helpful in designing targeted programs to magnify the beneficial effects of maternal education. We utilize the Demographic and Health Surveys which provide rich information on demographics, health, and nutrition among women and children. Child health is captured by the three most commonly used anthropometric measures, namely, height-for-age, weight-for-height, and weight-for-age z-scores. In addition, we also examine three child nutrition indicators derived from these z-scores: stunting (a low height-for-age), wasting (a low weight-for-height), and underweight (a low weight-for-age). Under-nutrition, which includes stunting, wasting, and underweight, strongly precipitates mortality among children under five years old (WHO and Unicef, 2009). Exploiting the between-sisters variation in the educational attainment of the mothers, our paper reaches the following findings. First, we uncover favorable effects of maternal education on child health. Specifically, a one-year increase in mother’s education raises child’s weightfor-height z-score by 0.02 standard deviations, and increases child’s height-for-age as well as weight-for-age z-scores by 0.04 standard deviations. Furthermore, an additional year of education accumulated by the mother decreases the probability of the child being wasted by 0.2 percentage points, and reduces the incidence of stunting as well as underweight by 1 percentage point. Second, we analyze multiple channels through which maternal education affects child health. We find that these favorable intergenerational impacts could be, at least in part, attributed to five main groups of mechanisms: (i) mother’s fertility behavior (proxied by the number of children and mother’s age at first birth), (ii) assortative matching (proxied by husband’s education), (iii) mother’s health care utilization (proxied by the number of prenatal visits, and whether mother sought prenatal care from formal sources, delivered the birth at a health facility, as well as received delivery assistance from professionals), (iv) access to information and health knowledge (proxied by whether mother watches television, reads newspapers, knows about ovulation cycle, utilizes contraception), and (v) labor market 2outcome (proxied by different measures of her labor force participation status and labor earnings). Particularly, the more educated mothers are more liable to reduce the number of births, increase the age at first birth, and marry higher-educated husbands. Moreover, there is a tendency among the more educated women to increase the number of prenatal care visits, to obtain prenatal care from formal sources, to deliver the birth at a formal medical institution, as well as to receive delivery assistance from health professionals. Education further induces mothers to acquire information through television and newspapers, to have knowledge of the ovulation cycle, to adopt contraceptive methods, as well as to be engaged in and earn more from market work. Finally, we detect heterogeneity in the impacts of mother’s education on child health by continent and income group. The effects tend to be larger in magnitude for Latin American and middle-income countries.

Previous literature documents that poor childhood health diminishes health outcomes, reduces educational attainment, and potential earnings in adulthood (Martorell, 1999; Almond et al., 2005; Currie, 2009; Dewey and Begum, 2011). Furthermore, the cumulative consequences of poor health in early life could potentially be more adverse and long-lasting for children in developing countries than those in developed countries (Currie and Vogl, 2013). Therefore, our findings underline the importance of maternal education in enhancing economic and social conditions in developing countries. Our results also suggest that improving access to education for women could help achieve the Millennium Development Goals 4 (reduce child mortality) and 5 (improve maternal health).

Literature Review

Our study can be related to the literature that evaluates the intergenerational impacts of parental education on infant and child health. Among developed countries, Currie and Moretti (2003), Grytten et al. (2014), and Lundborg et al. (2014) find that children born to better-educated mothers tend to be healthier. In the context of the U.S., using the availability of colleges in the woman's county at age 17 as an instrument for education, Currie and Moretti (2003) document that more educated mothers have more favorable birth outcomes indicated 3by higher birth weight and longer gestational age. The authors attribute this relationship to the increased likelihood of mothers being married and the utilization of prenatal care, as well as the reduction in smoking. Also employing the instrumental variable (IV) method, Grytten et al. (2014) and Lundborg et al. (2014) present evidence that mother's education generates positive impacts on infant-child health in Norway and Sweden, respectively. Lundborg et al. (2014) further show that assortative matching, the reduction in fertility, and the increase in income contribute to the observed effects in Sweden. However, several studies show no evidence on the relationship of interest. For instance, within the regression discontinuity design (RDD) framework, McCrary and Royer (2011) show that women born just after the school entry date accumulate fewer educational years than those born just before the school entry dates. By comparing children born to women from both sides of the cutoff dates, the authors find virtually no difference in birth weight and gestational age. Lindeboom et al. (2009) also reach a similar conclusion when exploiting the increase in the minimum school-leaving age in the UK as a quasi-experiment. Within the context of developing countries, numerous attempts have been made to establish the causal link between parental education and child health. These studies rely on the exogenous variation in educational attainment induced by the exposure to certain government programs (e.g. school construction, the elimination of primary school fees, or compulsory schooling law) within an IV regression framework. Specifically, by exploiting the school construction program in Indonesia, Breierova and Duflo (2004) uncover the reduction in mortality rate among children born to higher educated parents. Grepin and Bharadwaj (2015) come to a similar conclusion as they instrument female education with exposure to the secondary school expansion in Zimbabwe. Employing the elimination of primary school fees in Uganda, Keats (2018) shows an increase in child health investment and a decline in child malnutrition as returns to increased maternal education. Chou et al. (2010) document the reduction in the incidence of low birth weight and mortality among infants born to parents who accumulated more education induced by the extended compulsory education in Taiwan. Utilizing the compulsory schooling reform in Turkey as an IV for education, Gunes (2015) detects favorable health outcomes among children born to higher educated mothers while Dincer et al. (2014) only uncover weak evidence on child mortality. A few studies attempt to explore the pathways for the effects of maternal education on child health. In particular, Grepin and Bharadwaj (2015) and Gunes (2015) regard the increased age at first birth and decreased demand for children as important mechanisms behind the favorable impact 4of maternal education in Zimbabwe and Turkey, respectively. Keats (2018) attributes the impacts of maternal education to increased contraception use and employment opportunities. Outside the economics literature, a variety of development studies seek to explore and explain the link between parental schooling and child nutrition. For example, in a cross-sectional study, Semba et al. (2008) show that maternal education is a strong determinant of child stunting in Indonesia and Bangladesh. Aslam and Kingdon (2012), employing an IV framework, find that maternal schooling improves child health measured by anthropometric measures, in the context of Pakistan. Alderman and Headey (2017) point out the child health returns to parental education are larger for mothers than for fathers in 56 developing countries. The above-mentioned studies, however, only consider individual countries separately. Moreover, as discussed in Grossman (2006, 2015), there exist two important issues. The first issue is the conflicting findings in empirical studies. While several studies detect the positive impacts of maternal education on child health (e.g., Currie and Moretti, 2003; Chou et al., 2010; Keats, 2018; among others), others point to the nonexistence of such relationship (e.g., Lindeboom et al., 2009; McCrary and Royer, 2011; among others). The second issue is the problem of endogeneity, which refers to unobservable factors that jointly determine maternal education and child quality, such as genetics and family endowments. These \third omitted" variables make it challenging to identify the causal impacts of interest. Therefore, Grossman (2006; 2015) suggests that there should be more research on the link between mother's education and child health. Our paper aims to address these concerns and contribute to the literature in three aspects. First, instead of focusing on just one country, our sample covers 68 developing countries across five continents from 1990 to 2018. This wide coverage across time and space lends support to the external validity of our estimates, i.e. our results could be generalized to out-of-sample countries.1 Second, we explore the link between maternal education and child health using a different empirical approach compared to the studies mentioned previously. In particular, we exploit the between-sisters variation in the number of educational years accumulated by the mothers while prior studies adopt either the IV or the RDD method as the identification strategy. The richness of our data allows us to match mothers with 1 In this respect, the closest work to ours is Desai and Alva (1998) who also examine the impacts of maternal education on child health in a context of 22 developing countries. Not only does our paper cover a broader context (68 developing countries), but we also attempt to address the problem of endogeneity. 5their biological sisters who also have children. Therefore, our identification comes from the comparison of health outcomes among children born to mothers who are biological sisters.2 Finally, we contribute to the literature by exploring a variety of channels through which mother's education improves child health.

Data

To uncover the effects of maternal education on child health, we employ the data from the Demographic and Health Surveys (DHS). Conducted by the Inner City Fund (ICF) International, the DHS program is jointly funded by the United States Agency for International Development (USAID) and other parties, such as the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), the World Health Organization (WHO), and the Joint United Nations Program on HIV and AIDS (UNAIDS). The DHS are administered in over 90 developing countries across five continents and cover a wide range of topics including population, health, and nutrition. There are four types of questionnaires in the DHS: Household, Woman, Man, and Biomarker. The Household Questionnaire is intended to gather general demographic information on all household members (for example, age, sex, education, etc.), the relationship with household head, characteristics of the residence such as the ownership of various assets and utility usage, among others. From the Household Questionnaire, eligible members are selected for individual interviews which are based on Woman's or Man's Questionnaire. The Man's Questionnaire gathers background information, reproduction, and health knowledge among eligible men. The Woman's Questionnaire targets women in reproductive age (15-49) and collects information on woman's background characteristics, health knowledge and health behaviors, fertility patterns, child's health/nutrition status, as well as husband's background. Finally, the Biomarker Questionnaire provides details on child's anthropometry (height and weight), hemoglobin level in the blood, along with HIV test results.3 The DHS child file contains detailed information, both demographic and anthropometric, on children aged zero to four. We concentrate on women aged 18 and older since this is 2 In terms of identification strategy, the closest work to ours is Wolfe and Behrman (1987). The authors use the between-siblings comparison in the context of Nicaragua and find that mother's schooling does not seem to affect the health outcome of their children. The sibling fixed effects method is also utilized in various studies for different research objectives (see, for example, Altonji and Dunn, 1996a; Altonji and Dunn, 1996b; Aaronson, 1997; Currie and Stabile, 2006; Fletcher and Wolfe, 2008; Fletcher, 2010). 3 See https://dhsprogram.com for more details. 6the age threshold for adulthood recognized in most countries. The focus on women aged 18 and older enables us to isolate the impacts of education at completed schooling (McCrary and Royer, 2011). Since our identification strategy hinges upon the between-sisters variation in completed years of education (details are provided in Section 4), we need to construct a sample made up of sister groups. Groups of sisters are identified as follows. First, the mothers who are biological daughters of the household head form a group of sisters. Second, the mothers who are biological sisters of the household head (and the head herself if she's also a mother in our sample) are considered a group of sisters as well. Hence, our sample consists of children under five born to women who are at least 18 years old and can be matched to their biological sisters.

We use data from 1990 and onward because the information on the relationship with the head of the household is not available in the DHS data prior to 1990. Since we measure child health with child's anthropometric indices, we can only make use of countries and data waves which contain details on child's anthropometry. These restrictions leave us with 23,958 children across 68 countries in Africa, Latin America, and Eurasia with data covering from 1990 to 2018.5 The list of countries along with the information on geographic area and income 4 Biological sisters also include half sisters. However, the data does not allow us to distinguish half siblings from full siblings. 5 In our sample, there are four countries that can be classified as European countries, namely, Albania, Armenia, Azerbaijan, and Moldova. We group these countries with other 14 Asian countries and refer to this set of countries as Eurasia. Besides, there are four North American and six South American nations. They are also grouped together and referred to as Latin America. 7group classification is provided in Table B1 in the Appendix. In addition, the black regions in Figure 1 illustrate the geographic coverage of our sample. 3.1 Mother Characteristics The DHS Women file provides us with a wide variety of mother characteristics. The main explanatory variable is mother's education, which is the total number of educational years completed by the mother. The age and birth order of the mother are also available. Our main empirical model controls for mother's education, age differentials between the mother and her sister, and mother's birth order (summary statistics in Table 1). As we explore mechanisms behind our estimated effects, we draw on the information about mother's fertility behavior, husband characteristics, utilization of health care service, access to information, health knowledge, and engagement in market work. Descriptive statistics of these variables are provided in Table A1.

Panel A of Table 1 reports the mean value of maternal education for women in the full sample and in each continent. The average years of education completed by all women are approximately 6.11 years. On average, women in Latin America attain the highest number of educational years (7.28 years), followed by women in Eurasia (6.84 years), and African women (5.34 years). The mean age of mothers is roughly 26.12 in the Africa sample, 25.96 in the Eurasia sample, and 25.83 in the Latin America sample. 3.2 Child Health We measure child health with child's anthropometry, including height-for-age, weight-forheight, and weight-for-age. Anthropometric measures are calculated for children under five by their age and sex, based on the Centers for Disease Control and Prevention (CDC) Standard Deviation-derived Growth Reference Curves which are derived from the National Center for Health Statistics (NCHS)/CDC Reference Population. Measuring child health based on the international reference population is justified since the height and weight of well-fed healthy children follow a similar growth path across countries (Martorell and Habicht, 1986; Grantham-McGregor et al., 2007). Child's anthropometric measures reflect the nutrition and growth status of children in both the long run and the short run. Given gender, height-for-age reflects long-run health status and weight-for-height indicates current health status (Thomas et al., 1991; WHO, 2008). Particularly, a low height-for-age (stunting) is perceived as the prolonged lack of nutrients that support normal growth or repeated illness suffering. A low weight-for-height (wasting), on the other hand, is caused by recent adverse circumstances such as a significant decrease in food consumption or serious illness. In addition, weight-for-age is an indicator of body mass relative to age and is influenced by both height-for-age and weight-for-height. In the DHS data, height-for-age, weight-for-height, and weight-for-age are expressed by the z-score classification system. In other words, these anthropometric measures are described as the number of standard deviations below or above the median of the international reference population. Z-score, as pointed out in WHO (1997), is the best system for analysis and demonstration of anthropometric data. We further measure child health with different nutritional statuses. Specifically, Stunting, Wasting, and Underweight are three indicators constructed based on height-for-age, weightfor-height, and weight-for-age z-scores, respectively (WHO, 1997). Stunting is a dummy 9variable that takes the value of one if height-for-age z-score is below -2, and zero otherwise. Wasting is a dichotomous variable which takes the value of one if weight-for-height z-score is lower than -2, and zero otherwise. Similarly, Underweight is an indicator taking the value of one if weight-for-age z-score is less than -2, and zero otherwise. The threshold value of -2 is established by WHO (1997). Panel B of Table 1 provides the descriptive statistics of anthropometric measures of all children aged 0-4 in our sample, disaggregated by continent. Overall, the average of child health in our sample is below the world average which also includes children from developed countries. The raw means of all three anthropometric measures are the highest in Latin America and lowest in Eurasia. On average, child's height-for-age z-score lies at -1.17 standard deviations. The mean values of height-for-age z-score in Africa, Eurasia, and Latin America are -1.21, -1.29, and -0.98 standard deviations, respectively. Moving to weight-for-height z-score, the mean of this measure is the highest in Latin America (0.04 standard deviations), then in Africa (-0.34 standard deviations), and lowest in Eurasia (-0.79 standard deviations). The mean weight-for-age z-score is -0.99 standard deviations for the full sample, -1.03 standard deviations for the Africa sample, -1.42 standard deviations for the Eurasia sample, and -0.60 standard deviations for the Latin America sample. The fractions of children categorized as stunted, wasted, and underweight are provided in the lower half of Panel B of Table 1. 3.3 Sample Representativeness Since our identification of the effects of maternal education on child health hinges upon the between-sisters variation in educational attainment (more details in Section 4), our sample consists of children of sisters who live together. There could be a concern that this living arrangement might engender a selected sample, despite the wide coverage across time and space of our sample (68 countries, over three decades). To shed some light on this potential issue, we proceed to test if the mothers in our estimating sample (who live with their sisters) are different from those outside of our sample (who do not live with their sisters). To do so, we separately regress each of the mother characteristics on the dummy Sister Group, conditional on statistical area-by-wave-by-birth year fixed effects. Sister Group is a categorical variable which takes the value of one if the mother can be matched with her sisters and zero otherwise. Coefficients on Sister Group are reported in 10Table 2.6 Mother characteristics include mother's education, age, birth order, an indicator for whether mother belongs to the major religious group in her country, husband education, and current place of residence (indicator for rural area). The estimating results in Table 2 are statistically and economically insignificant. Therefore, women in our estimating sample are mostly similar to those in the remaining DHS sample, lending suggestive evidence for the external validity of our estimates.

Our findings are in line with those in prior studies which report a larger return to maternal education in higher-income countries compared to lower-income countries. For example, an additional year of mother's education reduces the incidence of low birth weight by 10% and 20% in the US and in Norway, respectively (Currie and Moretti, 2003; Grytten et al., 2014). The corresponding effect is only 5.5% in Taiwan (Chou et al., 2010). Finally, we conduct a heterogeneity analysis along the line of time. Specifically, we attempt to examine how the relationship between maternal education and child health evolves over time. In our most extensive sister fixed effects model, we include the interaction between mother's education and indicators for survey waves. The coefficient on this interaction captures the differential effects of mother's educational attainment on child anthropometric measures by time. We report the results in Table A7. There is weak evidence this relationship diminishes over time as suggested in Karlsson et al. (2019).

Conclusion

By studying a broad context across time and space (68 countries over almost three decades), we investigate the intergenerational effects of maternal education on child health. Our identification strategy compares the average health outcomes of children born to women who are biological sisters and attain different levels of education. We uncover positive impacts of mother's education on child health measured by the three most commonly used indices, namely, height-for-age, weight-for-height, and weight-for-age. Specifically, an additional year of maternal education raises child's weight-for-height z-score by 0.02 standard deviations, and increases child's height-for-age as well as weight-for-age z-scores by 0.04 standard deviations. Mother's education also reduces the probability of the child being stunted, wasted, and underweight. Intuitively, investment in female education could engender beneficial gains for their offspring, in terms of supporting child's normal growth, and cushioning the negative health shocks, thus facilitating a healthy development in child's early life. We further examine multiple pathways for the effects on child health. We show that mother's education improves child health through fertility behavior, assortative matching, health care utilization, access to information, health knowledge, labor force participation, and labor earnings. Specifically, education enables women to reduce fertility, increase the age at first birth, and marry a well-educated husband. We provide strong evidence that higher educated mothers are more likely to increase both the quantity and quality of health care utilization, which ultimately affects child health. Particularly, women are more liable to increase the number of prenatal care visits, to obtain prenatal care from formal sources, to deliver the birth at a formal medical institution, as well as to receive delivery assistance from health professionals, as she accumulates more education. Moreover, education also enables mothers to acquire information through television and newspapers, to have knowledge of the ovulation cycle, as well as to adopt contraceptive methods. Finally, our results suggest that the increased tendency to participate in the labor market and higher earnings from work could partially explain the link between maternal education and child health. In addition, we present heterogeneous effects of mother's education by continent and income group. In addition, our estimating results indicate that the impacts of maternal education are larger in magnitude in middle-income countries than 29in low-income countries. Given the persistent effects of childhood health over the life-cycle (Martorell, 1999; Almond et al., 2005; Currie, 2009; Dewey and Begum, 2011), our estimating results highlight the importance of maternal education in enhancing economic and social conditions in developing countries. Therefore, government programs which aim to improve access to education for young women could potentially improve child health in the short run, as well as generate aggregate economic benefits in the long run since healthy children will eventually become educated and productive adults themselves. Our findings also suggest that improving access to education for women could help achieve the Millennium Development Goals 4 (reduce child mortality) and 5 (improve maternal health).

Appendix 1

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