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Maternal Education and the Multidimensionality of Child Health Outcomes in India

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Abstract

Maternal education plays a central role in children's health, but little research compares the role of maternal education across health outcomes. It is important to distinguish child health outcomes from medical care outcomes. Health outcomes such as short-term morbidity or stunting are multifactorial in origin and determined by a range of factors not necessarily under a mother's control. A mother's education, given the requisite structural factors, is more likely to lead to increased access and uptake of medical services. Using the India Human Development Survey (2004–05), eight separate logistic regressions show that maternal education linkages are strongest for medical care, immunizations (except polio), and iron supplementation for pregnant mothers, moderate for underweight, and weakest for short-term diseases and stunting. Additionally, the paper investigates if maternal education impacts health through the intervening roles of empowerment and human, social, and cultural capital. These intervening linkages are missing for short-term diseases and stunting bolstering the argument that the influence of maternal education is limited for these outcomes.

Keywords

Child Health and Nutrition; Education; Demography

Introduction

Maternal education is often considered one of the most important factors explaining child health outcomes (e.g., Caldwell, 1979; Bicego and Boerma, 1993; Fuchs et al., 2010). A large body of literature already links a mother's education to her child's immunizations, nutrition, morbidity, medical care, and survival. Not all results are conclusive, however, and there is little agreement on the linkages between a mother's education and her child's health.

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Ethical Approval

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Conflicts of interest

The authors have no conflicts of interest to declare

Resolving these inconsistencies may require closer attention to variability across health outcomes as these outcomes are not interchangeable measures of children's health.

However, there has been little conceptual work in the social sciences that might suggest which child outcomes might be especially sensitive to maternal education. This paper tests the multidimensionality among child health outcomes by comparing the maternal education relationship across eight measures of child health and medical care using data from the India Human Development Survey (IHDS). It posits that medical care access is more likely to be within the control of maternal effort when the necessary health facilities are within reach of the mother, and hence demonstrate a more robust relationship with maternal education. Other health outcomes, such as stunting and child morbidity that are multifactorial in origin may not demonstrate this strong link. Even the most conscientious maternal care cannot eliminate contagion from a neighbourhood or provide all the socioeconomic and institutional resources needed to ensure good health for children.

Desai and Alva (1998) argue that a critical distinction in assessing the maternal education effect on child health is the amount of control exercised by the household in determining an outcome versus the influence of external factors (e.g., neighbourhoods, contagion, availability of medical care) beyond a household's control. Their research is widely cited as a caution about the size of the maternal education effect, but their distinctions among the types of child health outcomes are relatively (and unfortunately) neglected. Instead, a strong "*maternal perspective"* guides research and practice, whereby the focus on the mother relegates the importance of other critical factors (Subramanian and Corsi, 2016). This viewpoint is partly due to the lack of attention given to other proximate and contextual determinants of health. Subramanian et al. (2016) highlight the need to adopt a multifactorial framework to understand the causes of undernutrition in India and underscore the importance of the socioeconomic context of the household and the community, something established theoretically (e.g., UNICEF 2013) but frequently ignored in research.

This paper assesses the maternal education and child health relationship by comparing a range of child health and medical care outcomes. Since the overview by Cleland and van Ginneken (1988), much effort has focused on identifying these linkages (see the discussion below). In this paper, four social and cognitive pathways are investigated that may mediate the relationship: human capital, social capital, cultural capital, and women's empowerment. Results show that human and cultural capitals are especially important, but only for medical care, not for other child health outcomes, such as stunting and child morbidity.

Multidimensionality of health outcomes

In the social science literature, there is surprisingly little theorization about the multidimensionality of child health. A search on "child health" will find studies with a wide range of outcomes, including child weight and height, health service utilization measures such as immunization and post-natal care, morbidities such as diarrhoea and fever, and even mortality. Sometimes only one of these is studied as the index of child health; more often, two or more similar measures (e.g., stunting and wasting) are analysed; occasionally a broad range of measures are combined in a single study.

The implicit interchangeability of all child health outcomes is exemplified by articles reporting "child health" results without identifying either in the title or the abstract which health outcome has been studied (e.g., Chen and Li, 2009; Glewwe, 1999; Sujarwoto and Tampubolon, 2013). This ambiguity discourages conceptual thinking about the multidimensionality inherent in child health outcomes. The treatment of different child health outcomes as interchangeable indicators of health ignores the differences across health outcomes as these are caused by a variety of factors, both social and biological. Some of the determinants are common across these outcomes, and others are not. Not all of the determinants may be under a mother's control, especially for indicators that are multifactorial in origin. Hence, it should not be expected that maternal education would be of similar importance for all the outcomes. To highlight that maternal education might be more salient for some child health outcomes rather than others; one has to begin by acknowledging that the strength of the relationship does, in fact, vary across child health outcomes.

Desai and Alva (1998) are a notable exception, perhaps driven by the need to interpret their positive findings for immunization but weaker and mostly non-significant results for height-for-age and child mortality. They argue that:

> "Educated mothers are more likely to engage in health-seeking behaviour, but its impact on actual health outcomes seems to be rather weak, possibly because the impact of environmental conditions supersedes the impact of parental behaviour in shaping child health (1998:71)."

Other studies with divergent results for different child health outcomes have rarely taken up the challenge of developing a broader theory to explain those differences. When multiple health outcomes are analysed, the maternal education coefficients often vary considerably, but unless some relationships are not statistically significant, little note is taken of the observed variation. For instance, Pebley et al. (1996) find maternal education associations for prenatal care among Guatemalan women, but not for immunizations, treatment of illnesses (Goldman et al., 2002) or trained delivery and suggest little explanation for the differences among the various practices.

That this is a missed opportunity is shown by the few studies that do use differential relationships to suggest broader ideas of how maternal education might exert its influence. Cleland (2010), for instance, uses the stronger education associations with child mortality than with neonatal mortality to infer that the education relationship owes more to her parental care than to her own better health. Miller and Rodgers (2009) found a maternal education relationship with stunting but not wasting in Cambodia and speculated that the weaker relationship with wasting might be because "mother's education is of limited effectiveness in preventing illness such as diarrhoea when there are widespread sources of infection (2009:157)." Environmental factors such as infections circumscribe the influence of mother's education. This is a useful starting point for theorizing which child health outcomes are most responsive to maternal education. What constitutes "household control" may need more specification, but the focus on *control* is central.

A number of household-level factors have an impact on a variety of child health outcomes. For example, paternal education and household socioeconomic resources influence child health, nutrition and medical care outcomes (Aslam and Kingdon, 2012; Semba et al., 2008; Subramanian et al., 2016). Moestue and Huttly (2008) highlight the importance of the father's and the grandmother's education on child nutritional status in India, independent of maternal education. They argue for the need to move beyond a mother-child dyad to one encompassing the family and the community more broadly.

It is also important to recognize the intergenerational aspect of child health. Evidence points to the role of maternal resources such as her stature and weight on birth weight and nutritional status of children (e.g. Corsi et al., 2016; Subramanian et al., 2016). These are representative of the economic, social and cultural (dis)advantages women face over their life course. In the absence of adequate nutrition and health care, children become malnourished women, who, in turn, are more likely to deliver low birth weight infants due to intrauterine growth retardation (WHO, 1995). This cycle is expected to be strongly correlated with the socioeconomic status of the mother's family.

Considerable evidence links environmental forces beyond the household with child health. Access to clean and potable water and improved sanitation sharply reduce overall morbidity, stunting, and child mortality (Prüss-Üstün and WHO, 2008; Fink et al., 2011).Contagion is important, as infections easily spread among children (Calder and Jackson, 2000). The education of the mother or the socioeconomic status of the household cannot fully protect children from an environment beset with infections.

Economic status of the neighbourhood influences children's health beyond the household's socio-economic status (Montgomery and Hewett, 2005). Moreover, Shin (2007) finds that community-level wealth reduces the estimates for maternal education-child anthropometric indicators suggesting the importance of these factors in reducing the influence of maternal education.

Healthcare supply is another community level determinant of child health beyond household control (Sunil et al., 2006). Even though maternal education can improve the uptake of health services (Babalola and Fatusi, 2009), the absence of quality health services may impede educated and illiterate women alike. Distance to the health facility, quality of health care, topography and travel time have a significant impact on health service utilization (Acharya and Cleland, 2000; Perry and Gesler, 2000). Educational differentials are found to be stronger in rural and poor areas where health services are scarce but tend to narrow in urban areas where health services are readily accessible (Raghupathy, 1996; Sastry, 1996). Therefore, good-quality universal services may substitute the influence of maternal education.

In short, a variety of factors influencing health outcomes are not necessarily under the mother's (or the household's) control. Additionally, no child health outcome is entirely outside some degree of household effort to mitigate adverse consequences. Conversely, all outcomes under the control of household decisions are also affected by the surrounding context, such as the lack of medical services or its opposite, universal access.

The causality debate

Maternal education is usually understood to have a causal impact on child health (Bicego and Boerma, 1993; Caldwell, 1979; Cleland and van Ginneken, 1988; Wang et al., 2014). Early studies found a strong statistical association but often had to resort to weaker background controls because the early World Fertility Surveys had limited information about the socioeconomic status of the child's family. More recent studies include controls for mother's employment, past fertility (e.g., parity, spacing), father's education, and household wealth, with some including all four types of controls (e.g., Cassell et al., 2006; Frost et al., 2005; Shin, 2007). With these controls, the strength of the maternal education relationship declines substantially, suggesting the mother's education may, in part, be a proxy for other household factors.

Controls for contextual factors associated with maternal education may be especially important. Well-educated mothers tend to live in villages or urban neighbourhoods with other well-educated mothers, have better access to medical care, and water and sanitation services. Steele, Diamond and Amin (1996), for instance, find the effect of mother's education on immunization in Bangladesh is reduced to being not statistically significant if village-level variables are held constant (see also Aslam and Kingdon, 2012; for Pakistan and Babalola, 2009, for Nigeria). Kravdal (2004) documents the positive externalities produced by other local women's education on childhood mortality and several other child health outcomes. Similarly, Parashar (2005) notes the importance of average female literacy in a district for childhood immunizations in rural India.

Desai and Alva (1998) control for contextual effects in their Demographic and Health Survey data from 22 countries by using a village/neighbourhood fixed effect design. These more extensive controls eliminate most statistically significant effects of maternal education on stunting and mortality in many countries. The remaining individual-level effects of maternal education in the literature may well be reduced or even eliminated with more extensive contextual controls that include these unmeasured community differences.

However, recent work has used quasi-experimental approaches to assess the impact of mother's education on child health. For example, some papers use changes in education reform as natural experiments to control for potential endogeneity of education by exploiting age-specific exposure to these reforms (E.g., Chou et al., 2010; Güneş, 2015; Grépin and Bharadwaj, 2015). These papers find a significant influence of maternal education on child health and mortality.

Pathways

Education confers cognitive and social advantages on a mother and her household. If a mother's education has a genuinely causal impact on her children's health, one should be able to identify what is it about her education that improves child health. This paper suggests four possible pathways and contends that the strength of each will vary depending on the extent to which health outcomes are under maternal influence.

Human capital: Education leads to more accurate knowledge about health and greater receptivity to health messages (Glewwe, 1999; LeVine, 1987; Rowe et al., 2005; Streatfield et al., 1990; Smith-Greenaway et al., 2012; Levine et al. 2011). Academic skills, especially literacy, not only make women more receptive to health information but also improves their ability to understand health messages in the print and broadcast media (Handa, 1999; LeVine et al., 2001; Rowe et al., 2005; Levine et al. 2011). Additionally, schooling enhances their problem-solving capability (LeVine, 1987).

A mother with incomplete knowledge about dosage and timing may be less likely to complete her child's immunization (Jamil et al., 1999). Streatfield et al. (1990) find the effect of formal education on vaccinations is entirely mediated through correct knowledge about vaccine functions in Indonesia. Similar results have been replicated in Nepal and Northern Nigeria where health knowledge mediates the impact of mothers' schooling on their use of medical and preventive health care (Rowe et al., 2005; Babalola, 2009). Block (2007) finds that nutrition information explains some of the maternal education effect on anaemia in Central Java, and Frost et al. (2005) find that the knowledge pathway explains 15% of the education effect on children's stunting in Bolivia. Finally, although we previously pointed to community level amenities as beyond household control, an understanding of sanitation may prevent illnesses even when toilet facilities are not readily available (Handa, 1999). Greater health knowledge is therefore hypothesized to improve child health.

Social capital: Schools teach social skills in addition to facts and mental skills. Educated women may have broader social networks that provide knowledge of good health behaviours or where to find quality medical care. They may be more likely to participate in local organizations that broaden their social contacts and make medical services more accessible. Cassell et al. (2006) find mothers in the rural Gambia are influenced by their peer networks and organizations like village music groups to attend clinic days as a group. Mothers' participation in women's saving groups in Bangladesh (e.g., Grameen Bank) or even their residence in NGO program areas increases their children's probability of being immunized (Amin and Li, 1997; Steele et al., 1996). Andrzejewski et al. (2009) discover members of community organizations in coastal Ghana have better knowledge of disease causes, thus linking social and human capital. Studies confirm relationships between social capital and child survival in Mali (Adams et al., 2002), Ethiopia (Fantahun et al., 2007), and The Gambia (Rutherford et al., 2009). Nutritional outcomes have been linked to social capital as well, but the evidence is more mixed than for mortality: Sujarwoto and Tampubolon (2013) for higher height-for-age and weight-for-age in Indonesia; Harpham, De Silva, and Tuan (2006) for weight-for-age but not height-for-age in Vietnam; and De Silva and Harpham (2007) find no relationships between organizational memberships and nutritional outcomes in Peru, Ethiopia, or the Indian state of Andhra Pradesh.

The *kind* of social capital may define how networks affect access to medical care, child immunization and undernutrition (Vikram et al., 2012; Story, 2014; Vikram, 2015, Story and Carpiano, 2017, Vikram, 2018). Bonding social capital, from religious or caste organizations, may reinforce traditional attitudes and beliefs regarding modern medicine or discourage mothers' physical mobility. In contrast, association with development

organizations may encourage more bridging ties to people with new modes of thought, increasing information about the benefits of medical care and hygiene.

Cultural capital: Well-educated mothers are likely to have a position of privilege that commands respect from health care providers (Gittelsohn et al., 1994) and enables a self-confident interpersonal style that smoothens interactions with the medical system. These traits can be considered cultural capital, defined by Bourdieu (1977) as institutionalized, widely shared, high-status cultural signals used for social exclusion (Lamont and Lareau, 1988). This paper adopts a broader interpretation of cultural capital, which is not defined by aesthetic preferences or tastes but by verbal facility and communication styles that have been shown to be important components of cultural capital (Lareau, 2003). Bourdieu (1986) argues that embodied cultural capital may be reflected in long-lasting dispositions of the mind and body. Therefore, it can be revealed in women's behaviour, demeanour, knowledge and communication styles.

Schools socialize students into the dominant bureaucratic culture (LeVine et al., 2001; LeVine et al., 2011), giving them "more social confidence at handling officials and perhaps an enhanced ability and willingness to travel outside the home community in search of services" (Cleland and van Ginneken, 1988: 1363). In particular, LeVine et al. (2011) underscore the importance of oral skills developed through scripted activities in the classroom that bestows, for instance, the ability to produce an organized narrative concerning an episode of illness. They argue that girls learn *communicative effectiveness* in schools, which enables them to successfully navigate bureaucratic settings like clinics to seek adequate medical treatment. Cultural capital of better-educated mothers is hypothesized to be associated with favourable health outcomes, especially access to medical care.

Empowerment: Household decisions in many societies, particularly in South Asia, are dominated by hierarchies based on gender and generation. Constraints on women's physical mobility outside the home further restrict their ability to act on independent decisions about medical care (Jefferey et al., 1989; Mandelbaum, 1986). Limits on their direct contact with unrelated males or on their movements outside the home, such as going to a pharmacy, may be relaxed with greater exposure to modern institutions such as schools (Jejeebhoy,1995).

Studies in India have long emphasized the relationship between maternal education, decision-making autonomy, and greater utilization of health services (e.g., Basu, 1992; Das Gupta, 1990). Surveys show educated women have higher autonomy in decision-making and mobility, facilitating their use of antenatal care (Bloom et al., 2001; Jejeebhoy and Sathar, 2001). Education is hypothesized to raise mothers' decision-making ability and enhance their mobility, which in turn, will enhance child health.

The Indian context

As the above argumentation suggests, child health outcomes are multidimensional, with some aspects of child health more responsive to maternal control than others. Certain factors such as the child's diet and breastfeeding are under greater maternal control as compared to illnesses, where contagion, water, and sanitation facilities have a stronger influence. This is not to say that a mother's education and associated control has no role to play in a child's

sickness, but her input is likely to matters less in an unfavourable environment. This paper uses the case of India to demonstrate the multidimensionality of child health outcomes through its relationship with maternal education.

India faces severe infrastructural deficits. Even though 90% of the Indian population now have access to drinking water (UNDP, 2011), the quality of water remains suspect (Bain et al., 2012), and sanitation facilities are available to only 50% of the population (UNDP, 2011). A significant percentage of global diarrheal deaths are attributable to unsafe water, inadequate sanitation, and poor hygiene (Black et al., 2003; WHO, 2014). It is no surprise; therefore, that diarrhoea is among the leading causes of child death in India, claiming more than two million lives (Liu et al., 2012). Kumar and Vollmer (2013) find that improved sanitation reduces the likelihood of contracting diarrhoea among Indian children by 17%. Jalan and Ravallion (2003) say access to piped water can reduce the prevalence of diarrhoea among Indian children by 17.4%. Similarly, Nandi et al. (2017) argue that improvements in piped water and sanitation would considerably reduce the burden of diarrhoea and diarrhoea deaths in India.

Public health programs can reduce the advantage associated with personal resources, such as maternal education (Raghupathy, 1996). India is illustrative; its aggressive vertical polio campaigns have been so intense that individual variation is swamped by near universal acceptance in areas where the campaigns are conducted. The campaign, begun in 1995 a decade before the first IHDS was administered, was declared successful in eliminating polio in India in 2014. Other immunizations are still delivered via general health facilities, and greater maternal effort would be required to attain them. Therefore, maternal education would still be significant for vaccinations besides polio. However, public health campaigns directed at increasing knowledge and behaviour change (without making supply-side changes) may influence educated women more strongly than uneducated ones.

In India, the relationship between female education and labour force participation is weak (Klasen and Peters, 2012). Educational gains for the mother, thus, do not necessarily translate into economic benefits for herself or the child. In other contexts, where the link between maternal education and employment is stronger, the maternal education-child health relationship may be more robust because gains in her education are likely to improve the economic condition of the household.

While generalizing this to other contexts, it is imperative to recognize that some aspects of child health may be more responsive to maternal education than others and these are likely to vary across regions and cultural contexts. We cannot assume results in one context will be replicated across all contexts (Navaneetham and Dharmalingam, 2002). The extent of maternal control is the crucial conceptual distinction that would influence how a mother’s education would influence her children’s health.

Data and Methods

The India Human Development Survey (IHDS) is a nationally representative face-to-face survey of 41,554 households across all Indian states and union territories (minor exceptions

are the Andaman and Nicobar Islands and Lakshadweep), 384 districts, 1503 villages, and 971 urban blocks. The survey was translated into 13 Indian languages and administered by pairs of local interviewers; women respondents were interviewed by women interviewers whenever possible. The fieldwork was carried out from September 2004 to August 2005 under the supervision of the National Council of Applied Economic Research, New Delhi (for detailed information on sampling, see Desai et al., 2010: 214–216).

The IHDS survey asked a knowledgeable informant, typically the male head of the household, about the socioeconomic condition of the household, its level of social capital as measured by social networks and association memberships, and about employment and education of all household members. An interview with an ever-married woman, 15–49 years, asked about her health, medical care utilization, and knowledge of health issues, and the gender relations in the household. The interviewer, usually a female, also assessed her communication abilities and interaction style.

Dependent variables

Medical care

Antenatal care (ANC).: The survey collected health histories for the last-born child of each eligible woman and for the medical care she received during pregnancy. From this information, a dichotomous variable was created to indicate whether the woman received at least four ANC visits from a health professional.

Iron and folic acid (IFA) consumption during pregnancy: The Government of India recommends IFA consumption for at least 90 days during pregnancy. A dichotomous variable was created to indicate whether the woman consumed IFA for at least three full months during pregnancy. The sample for IFA consumption and ANC has 11,026 women.

Postnatal check-up: Postnatal check-ups soon after delivery safeguard the health of mother and baby, particularly for births outside health care facilities. A variable indicating whether the child received a postnatal check-up within two months of birth by a medical practitioner is used. The postnatal care sample has 10,870 cases.

Full immunization (except polio): This dichotomous dependent variable indicates whether the child received all five recommended immunizations by 12 months of age: three doses of DPT vaccine (diphtheria-pertussis-tetanus), one dose of BCG (Bacillus Calmette-Guerin) against tuberculosis, and one of measles vaccine. Immunization histories came from the government-issued vaccination card if available or from the mother’s recollection if not. A variable indicating whether data were obtained from the card or through recall is also used as a control variable. The immunization sample includes 8,579 children, 12 months to five years of age.

Full polio: Polio is modelled separately from other recommended immunizations because an extensive national campaign increased polio immunizations well above other vaccinations (72% versus 49%). As access to medical care becomes more widespread, the role of maternal education may be less critical in determining who has access. Hence, polio

vaccinations were analysed separately. There were fewer missing data on polio vaccines, probably due to increased familiarity with the vaccine. The sample for polio includes 8,778 children under five and the variable indicates whether the child received all three polio immunization doses by 12 months of age.

Child outcomes

Short-term morbidity: A dichotomous variable indicating whether the mother reported that a child did not experience diarrhoea, cough, or fever in the last one month was created. The sample includes 10,872 children under the age of five.

Not underweight: An underweight child has a "weight-for-age" z-score that is at least two standard deviations (SD) below the median for WHO child growth standards. Underweight or weight-for-age is considered a comprehensive indicator of malnutrition, capturing stunting (an indicator of long-term nutritional deprivation) and wasting (an indicator of short-term nutritional status): both stunted and wasted children are likely to be underweight. A dichotomous variable was created to indicate a child who is not underweight. The sample includes 9,720 children under the age of five who have complete and valid data on underweight.

Not stunted: A stunted child has a height-for-age z-score that is at least two standard deviations (SD) below the median for WHO child growth standards. Stunting reflects chronic malnutrition and linear growth retardation resulting from lack of adequate nutrition over a long period which may be exacerbated by recurrent and chronic illness (Gross et al., 2000). A dichotomous variable was created to indicate a child who is not stunted. The sample includes 8,115 children under the age of five who have complete and valid data on stunting. Table 1 summarizes all the dependent variables included in the analyses.

Maternal education and its pathways

Education: Maternal education was measured as the highest number of years of education completed as reported by the woman herself. For missing cases (less than 2% of the sample), the information provided by the household head is used.

Human capital: The mothers were asked five questions about reproductive and child health: (1) if it is harmful to drink one or two glasses of milk daily during pregnancy; (2) if men become physically weak after sterilization; (3) if colostrum is beneficial for the child; (4) if smoke is harmful to a child; (5) if a child needs to be given more than usual water to drink during diarrhoea. The responses were coded as dichotomous to indicate correct versus incorrect and "don't know" answers. Correlations among the five items are low (ranging from .08 to .13); therefore, the use of single items as well as a summary scale was explored. Different knowledge items prove statistically significant for different outcomes with no detectable meaningful patterns, so we reported the results for the summary scale.

Social capital: The head of the household was asked whether the family participated in nine types of social organizations. From the responses, two measures were created: bridging and bonding social capital. Membership in any religious, caste, or festival organization is

interpreted as a measure of bonding social capital and membership in any other association (women's groups; youth clubs, sports groups, reading rooms; trade unions, business or professional groups; self-help groups; credit or savings groups; development NGOs, agricultural co-operatives) is a measure of bridging social capital. Both indices have moderate Cronbach's alpha estimates of reliability: 0.59 for religious and caste groups and 0.56 for development organizations.

Cultural capital: Cultural capital scale measures the communication ability of the woman as rated by the interviewer (usually female) on a scale with five items: whether she understood the purpose of the interview; whether she had any difficulty understanding questions; whether she looked directly at the interviewer; whether she was knowledgeable about health and education expenditure; whether she appeared confident (Cronbach's alpha of 0.74). A woman's confidence in interacting with an educated interviewer is indicative of her ease of communicating with trained medical personnel.

Empowerment: Women's empowerment is measured with two dichotomous variables: if she was the main decision maker when the child was ill and if she could go to the local health centre without seeking permission.

Control variables

Contextual factors: Educated women tend to live in educated communities with better access to resources, so part of the maternal education effect would be proxies for those contextual effects. Fixed effects are used to control for village and urban neighbourhood characteristics. The villages and urban blocks forming the primary sampling units (PSUs) were used as the clusters. Our approach is equivalent to adding dummies for each cluster to the equation. With cluster fixed effects, it is possible to test whether educated mothers are more likely to have healthier children than less educated mothers within the same PSU. Fixed effects models have the advantage of controlling both for measured and unmeasured local characteristics.

Fixed effects models require some variation on the outcome variable within the PSU. Because the outcome variables are dichotomous, many PSUs are homogeneous on some outcomes; these cases have to be deleted from the analysis because it is not possible to compare educated and less educated mothers on an outcome that does not vary. Table 5 records this attenuation of the sample for all outcomes.

Household characteristics: As the father's education is an important determinant of child health (Pebley et al., 1996), a control for his education is included. However, 3.2% of the cases are missing, possibly indicating migrants or separated/divorced spouses. Mean imputations were carried out for the missing values, and the missing cases are marked using a dichotomous variable. Assets reflect the long-term economic status of the household, so a summative measure of *standard of living* by counting 30 housing goods and amenities was also included (Filmer and Pritchett, 2001).

***Caste* was controlled in five broad categories:** Brahmins, other forward castes, other backward classes, scheduled castes, and scheduled tribes. Religion was divided into Hindus,

Muslims, and other religions. *Family structure* was controlled with a dummy variable for a joint versus a nuclear family. *Birth order* of the child was included in three categories - first child (reference group), the second child, third or higher birth order. Lastly, *maternal work status* (none; part-time or seasonal work – less than 2000 hours per year; fulltime – 2000 or more hours a year) and *maternal age* fixed effects were included as controls.

Method controls were included where appropriate. For stunting, underweight, immunization, short-term morbidity and postnatal care for the child, child's age (at the time of interview) and gender was controlled for. For immunization variables, control for the source of immunization data, i.e., government card or mother's report was also included. Table 2 provides the descriptive statistics for the independent and control variables included in the analyses.

Statistical models

Logistic regressions are carried out in three steps: first, using maternal education and controls for children's age (Model 1); second, adding PSU fixed effects and background controls to Model 1 (Model 2); third, adding the hypothesized pathways to Model 2 with maternal education, PSU fixed effects and background controls (Model 3). The focus is on the change in the maternal education coefficients (log-odds) with the introduction first of background controls and then of the hypothesized pathways. It is expected that maternal education coefficients will be larger and statistically significant for medical care access and outcomes under the control of the mother and weaker for child health outcomes with multifactorial causation.

Results

Rather than discussing the models for each outcome separately, we focus first on the maternal education relationships across all eight outcomes and repeat this for the pathways linking maternal education to child health. The consistent pattern is for maternal education to have stronger associations with outcomes where the mother has greater control vis-à-vis external forces (Table 3). Ante-natal and post-natal care, immunizations (except polio), and iron tablet consumption demonstrated strong maternal education associations even after controls whereas stunting and short-term morbidities showed weaker effects. The coefficient was not significantly different from zero for these upon the addition of controls. Maternal education was not statistically significant for full polio vaccination and the effect size was weak, an anomaly discussed in the following section.

Table 4 reports the hypothesized pathways for all the dependent variables from Model 3 with PSU fixed effects and controls. Consistent with expectations, the pathways appear more important for medical care outcomes: full immunization, antenatal and postnatal care, and IFA consumption. This further underscores the importance of distinguishing among child health outcomes when investigating maternal effects. The only outcome that strays is polio: maternal education is not a significant determinant, but certain pathways remain important.

Maternal education

ANC: Educated mothers were far more likely to have had four or more ANC check-ups. Model II of Table 3 includes background controls and cluster-level fixed effects. Two-thirds of the maternal education advantage in antenatal care is explained by the fact that educated mothers live in more affluent households, have fewer children and live in areas where antenatal check-ups are more common. Nevertheless, the relationship with maternal education remains strong (β = 0.062) after controls.

IFA consumption: Maternal education has a strong and statistically significant association with IFA consumption during pregnancy. The more educated the mother, the more likely she was to have consumed IFA for at least three months. With controls, the education-IFA relationship remained strong, albeit reduced (β = 0.041). More educated women are wealthier and more likely to reside in localities with better services. These results suggest that maternal education translates into better health practices.

Postnatal care: The picture is similar to antenatal care, in that socioeconomic status, area of residence, and birth order reduced the maternal education effect by 64%, but it remained significantly correlated with postnatal care even after confounding factors are held constant (β = 0.041).

Immunization (except polio): In model 2, children of the more educated mothers were still more likely to be immunized (β = 0.058), although their advantages were substantially attenuated with controls. The effect of household economic standing on immunizations is especially important.

Full polio: Unlike other immunizations, polio vaccination did not have a statistically significant association with maternal education once neighbourhood and other household factors were held constant (β = 0.020). It appears the national “Pulse Polio Campaign” has rendered parental education less critical for household access to polio than to other immunizations. However, the standard of living remains important.

Not underweight: Children born to more educated mothers were less likely to be underweight. More than half of this could be attributed to other characteristics of educated mothers, but even holding those factors constant, the estimated coefficient for maternal education (β = 0.034) remained statistically significant and only slightly smaller than for the health care variables discussed previously.

Not stunted: The coefficient for maternal education attenuated considerably, barely remaining statistically significant after the household and local controls (β = 0.017). The weaker relationship with stunting rather than underweight is consistent with the usual interpretation of stunting as a long-term measure of child nutrition affected not only by diet and disease but also by maternal stature, factors less under the control of the mother in the Indian context.

Short term morbidity: Maternal education appears to be a weak determinant of a child experiencing fever, diarrhoea, or a cough after the addition of background controls and cluster level fixed effects ($\beta = -0.008$). It is likely that educated mothers are more sensitive to minor symptoms than less educated ones and thus more likely to report them. Therefore, a gradient for maternal education cannot be observed here. Additionally, the proportion of children with short-term morbidities was quite low, so these finding must be interpreted with caution.

Pathways

Human capital: Health knowledge was the most consistent pathway mediating maternal education effects on medical care outcomes. All five outcomes (iron-folic acid consumption, ante- and postnatal check-ups, immunization measures [including polio]) had significant associations with a mother's correct answers on the five health questions. In contrast, none of the child health outcomes with multifactorial causation showed a significant relationship with health knowledge. Even though maternal education was not a significant factor in determining polio uptake, higher health knowledge influenced polio independent of education.

Social capital: The addition of social capital variables to the base model showed few changes in the maternal education coefficient (or any other coefficient). A household's membership in development organizations had a significant positive relationship with both immunization variables, but no other outcome. Development organizations may support or even host vaccination campaigns, so the positive effects on children's vaccinations is not surprising. Membership in religious and caste-based organizations (bonding capital) did not inhibit health care as suggested above, as children in such households were actually *more* likely to have received adequate postnatal care. In short, these two measures of social capital had non-significant relationships with most child health outcomes and do not explain why well-educated mothers get better health care for their children.

However, our model includes fixed effects for communities. These controls may wash away the influence of social capital indicators that have been shown to be of relevance for undernutrition using a multilevel design which models contextual factors (Vikram, 2015, 2018; Story and Carpiano, 2017).

Cultural capital: A mother's communication ability demonstrated a strong association with both immunization measures and iron-folic tablet consumption. Arguably, greater communication abilities are a pathway through which education leads to better health care. Nevertheless, prenatal and postnatal visits to a medical facility – interpersonal encounters for which communication skills should be relevant – are unrelated to the cultural capital scale.

Empowerment: The addition of the two empowerment variables had little effect on the maternal education coefficients. A woman's ability to go to a clinic without asking permission was associated with her child receiving more postnatal care.

Discussion

As predicted, maternal education is generally more important for children's health when the outcome is directly under her or her family's control. This is especially true for obtaining health care such as antenatal and postnatal care or having a child fully immunized. But when a child's health is measured by health outcomes with multifactorial causation such as stunting or by common illnesses resulting from contagion, such as fevers and diarrhoea, many other factors may come into play, some haphazard, such as exposure to a sick playmate, and others more socially structured, such as poor sanitation in neighbourhoods. As these other factors may be less under a family's purview, well-educated mothers, even those who might be aware of the dangers, may have less power to protect their children. Other research in the region also notes the importance of factors beyond the control of the mother. For example, Kim et al. (2017) highlight the importance of household wealth and maternal factors such as maternal height, BMI and age at marriage in predicting child undernutrition.

The results demonstrate that our markers of human and cultural capital are relevant pathways for explaining the effect of maternal education on health care utilization measures but weaker for explaining multifactorial health outcomes such as child stunting. Educated mothers are likely to use their education to improve health behaviours by having their children immunized and by consuming IFA, but better health knowledge may be insufficient to help them control the contextual or socioeconomic factors associated with child health. Similarly, cultural capital, as measured by an ability to communicate with an educated interviewer, appears to be important in explaining improved medical care but not for morbidity and stunting. The Indian medical system is a high-status, largely Western institution that may deter easy access because of the social and cultural gap between most mothers and medical personnel. Being skilled in social interactions helps educated women achieve improved access to modern health institutions.

Is it possible to reconcile these divergent findings? This paper argues that the key is the differential role of behavioural and contextual factors. Medical care and immunizations are more likely to be under the purview of parental influence when a basic supply of these services is available. But it is still up to the parents' initiative to bring the child to a health care centre. In contrast, child morbidity and stunting are affected by a host of factors over which parents may have limited control.

Even though this paper includes a whole range of medical care and child health outcomes, it does not include infant or child survival. This paper uses fixed effects at the PSU level to control for village and urban neighbourhood characteristics. Comparing child health and medical care outcomes within a single design is advantageous because it allows for the comparison of the size of the maternal education coefficient within the same study and context using the same statistical design. Given the small number of deaths in the sample, cluster-level fixed effects was not a strategy that could be employed because of the limited variability of the dependent variable within each PSU. However, the paper demonstrates that maternal education is associated with positive health behaviours and improved access to services. Therefore, it is expected that maternal education will lead to improved survival due to the aforementioned factors. However, as argued earlier, certain environmental factors such

as the lack of sanitation, clean drinking water or contagion may undermine maternal effort to protect children.

More broadly, the results demonstrate that child health is inherently multidimensional. Because of the breadth of DHS and other surveys such as IHDS, it is now common to include multiple child health outcomes in empirical studies. But even when multiple child health measures are tested, interpretations rarely focus on differences across outcomes. Even in cases when differences are noted, few take the opportunity to theorize about the nature of the maternal education-child health relationship.

This paper emphasizes the importance of *control* as a key distinguishing factor; however, the emphasis on the role of control requires some caveats. First, a substantial portion of all relationships with both medical care and children's health outcomes are not causal. Educated mothers come from better-off families and live in areas with better health infrastructure. These advantages combine to improve nutrition and facilitate health service utilization. Adding controls for these background characteristics reduces the association of maternal education with child health indicators by 55–75% and reduces its association with short term morbidity and stunting to statistical non-significance (Table 5).

Second, it is the relative pattern of the differences in relationships with these outcomes that matters, not necessarily the statistical significance of the relationships. It is not suggested that maternal education is not relevant for outcomes with multifactorial causation. The sample sizes differ across outcomes and some outcomes have low variation; therefore, we hesitate to rely on statistical significance alone. Other measures, larger samples, more refined research designs, more sensitive statistical analyses or different institutional contexts may reveal a more causal role. However, we would still expect that *while comparing child health outcomes* the associations with child stunting and morbidity should be weaker than with medical care.

The importance of the pattern of relationships rather than the absolute size may be especially relevant for understanding our weak findings on pathways. In the best case – iron supplements – all the pathways together explain only about a third of the maternal education effect on child health. Some pathways, notably empowerment, hardly explain any of the relationships at all. Errors in measuring the intervening variables may explain some of the weak results. We are in the early stages of developing these measures, and better measures may yield better explanations. Moreover, the four proposed pathways do not exhaust the ways more maternal education leads to better outcomes. For example, the IHDS does not measure, nor is it easy for any survey to measure, the role of others' expectations from educated mothers (Ewbank 1994). Health care is a *social* interaction, and how medical care systems treat mothers may be important, but surveys focus only on the mother's side of that interaction. Other, perhaps more qualitative or observational methods may be better at determining why educated mothers have better medical care and healthier children.

Third, it is possible that maternal education by itself is not a sufficient condition for determining maternal control in some contexts. Smith-Greenaway (2013) demonstrates for Nigeria that maternal literacy is significant for child survival only when the mother has

decision-making power. Hatt and Waters (2006) find a positive interaction of maternal education with household wealth across 12 Latin American countries: educated mothers can protect their children from infection better when they have adequate resources to enact their preferences.

Finally, results suggest the importance of institutional contexts for determining the strength of various maternal education-child health relationships. In particular, the lack of a maternal education association with polio vaccinations suggests that sufficiently robust public health campaigns targeted towards a specific goal might negate the role of family advantages in accessing child health care.

Moreover, the argument that mothers have more control over medical care, such as immunizations and prenatal care, assumes those services are readily available. A severe lack of medical care availability could diminish the influence of maternal education on medical care. Only when medical care is available locally does it become a matter of choice.

Unfortunately, these analyses have not gone very far in capturing which contextual influences are important for moderating the maternal education-child health relationships. The controls used for local conditions are crude – sweeping all those effects away in a PSU-level fixed effects analysis. While the use of PSU-fixed effects does help control for unobserved characteristics in the community, it does not help control for unobserved characteristics of mothers, their families, or their households. Such characteristics may bias the observed relationships by simultaneously affecting maternal education and child health.

Kravdal (2004) argues persuasively that those contextual influences of well-educated villages are an important part of the maternal education effect and show similar multidimensional patterns with child health outcomes. The contextual education effects are stronger for mothers' antenatal care than for children's preventive care and stronger for both of these medical care outcomes than for short-term morbidity, much as this paper reports for the direct effect of a mother's education.

While it is important to clarify how external situations affect the maternal education-child health relationship, results reported here suggest it is especially important to study how child health outcomes differ. When the responsibility of child health is viewed to rest primarily on the mother's shoulders, it makes the state and health systems less accountable for children's health. Using maternal education as a policy tool to improve child health is therefore problematic. Education of women is an essential directive in its own right; however, it cannot be seen as a solution to a problem that is inherently more complex and entails multiple stakeholders besides the mother.

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Table 1.

Description of medical care and health outcomes under study

Medical care	Mean	SD	Age range	Observations
Full immunization except polio	0.492	0.492	1–5 years	8579
Full Polio	0.728	0.445	1–5 years	8778
Antenatal care for the mother	0.363	0.481	For children <5	11026
Iron folic acid consumption	0.337	0.473	For children <5	11026
Postnatal care for the child	0.315	0.464	For children <5	10870
Child health outcomes				
No short-term morbidity (cold/diarrhoea)	0.890	0.313	0–5 years	10872
Not underweight	0.546	0.498	0–5 years	9720
Not stunted	0.416	0.493	0–5 years	8115

Table 2.

Descriptive statistics for independent and control variables

	Mean	Standard Deviation	Range
Mother's education	4.309	4.77	0–15
Mother's education not self-reported	0.018	0.132	0–1
Immunization card	0.246	0.431	0–1
Brahmin	0.044	0.204	0–1
Forward castes	0.213	0.410	0–1
Scheduled tribe	0.082	0.275	0–1
Scheduled caste	0.236	0.425	0–1
Other backward classes	0.424	0.494	0–1
Hindu	0.805	0.397	0–1
Muslim	0.140	0.347	0–1
Other religions	0.055	0.228	0–1
Sex of the child (Girl =1)	0.465	0.499	0–1
Maternal age	27.398	5.679	15–49
Birth order: First child	0.247	0.431	0–1
Second child	0.290	0.454	0–1
Third or more child	0.463	0.499	0–1
Standard of living	10.382	5.866	0–30
Father's education	6.563	4.751	0–15
Dummy for mean imputation	0.032	0.175	0–1
Joint family	0.539	0.499	0–1
Health knowledge	3.136	1.176	0–5
Development social capital (SC)	0.327	0.782	0–7
Religious and caste based SC	0.280	0.584	0–2
Interviewers' rating	1.638	0.378	0–2
Decision on child health	0.851	0.357	0–1
Permission for health centre	0.802	0.399	0–1

Source: India Human Development Survey 2004–05

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Table 3

Relationship between mothers' education and children's health outcomes and health seeking behaviour

	Antenatal care		IFA consumption		Postnatal care for the child	
	I	II	I	II	I	II
Mother's education	0.189(0.005)***	0.062(0.010)***	0.112(0.006)***	0.041(0.009)***	0.115(0.004)***	0.041(0.010)***
Household assets		0.067(0.010)***		0.032(0.009)***		0.055(0.010)***
Father's education		0.022(0.010)*		0.021(0.008)*		0.009(0.009)
Birth order: 2 child		−0.452 (0.090)***		−0.178 (0.078)*		−0.189 (0.085)*
Birth order: 3 child		−0.845(0.105)***		−0.372(0.090)***		−0.475(0.099)***
PSU fixed effects (FE)	N	Y	N	Y	N	Y
All other controls	N	Y	N	Y	N	Y

	Full immunization		Full Polio	
	I	II	I	II
Mother's education	0.122(0.007)***	0.058(0.011)***	0.076(0.006)***	0.020(0.012)
Household assets		0.062(0.011)***		0.073(0.012)***
Father's education		0.026(0.010)**		0.015(0.011)
Birth order: 2 child		−0.109(0.101)		−0.154(0.112)
Birth order: 3 child		−0.043(0.113)		−0.112(0.126)
PSU controls	N	Y	N	Y
All other controls	N	Y	N	Y

	No Short-Term Morbidity		Not underweight		Not stunted	
	I	II	I	II	I	II
Mother's education	0.034(0.009)***	−0.008(0.012)	0.103(0.005)***	0.034(0.009)***	0.081(0.005)***	0.017(0.009)
Household assets		0.021(0.012)		0.062(0.009)***		0.048(0.009)***
Father's education		0.005(0.011)		0.020(0.008)**		0.011(0.008)
Birth order: 2 child		0.205 (0.112)		−0.126(0.077)		−0.063(0.083)
Birth order: 3 child		0.254*(0.125)		−0.159(0.088)		−0.164(0.095)

	No Short-Term Morbidity		Not underweight		Not stunted	
	I	II	I	II	I	II
PSU controls	N	Y	N	Y	N	Y
All other controls	N	Y	N	Y	N	Y

Model 1 adjusts for child's age, age squared and child's gender for all child health and healthcare outcomes. For immunization outcomes, presence of immunization cards is also included. For antenatal care and IFA consumption, child's age and gender are not included. Model 2 introduces father's education, household assets, maternal employment, maternal age fixed effects, caste, religion and cluster fixed effects.

Table 4.

Pathways across child health outcomes

	Ante-natal care	IFA consumption	Postnatal care for child	Full immunization	Full Polio	Not underweight	Not stunted	No short term morbidity
Maternal Education	0.055***	0.027**	0.034***	0.046***	0.008	0.032***	0.015	−0.008
	(0.010)	(0.009)	(0.010)	(0.011)	(0.012)	(0.009)	(0.009)	(0.013)
Health knowledge scale	0.103**	0.104***	0.180***	0.189***	0.174***	0.029	−0.001	−0.025
	(0.035)	(0.031)	(0.033)	(0.037)	(0.038)	(0.028)	(0.032)	(0.041)
Development organization	−0.018	0.017	0.026	0.130*	0.164*	0.085	0.021	−0.051
	(0.077)	(0.044)	(0.048)	(0.058)	(0.066)	(0.045)	(0.048)	(0.062)
Caste/religious organization	−0.001	−0.114	0.172*	−0.031	−0.124	0.051	0.136	−0.037
	(0.050)	(0.066)	(0.073)	(0.088)	(0.093)	(0.066)	(0.073)	(0.093)
Communication skills	0.106	0.818***	0.022	0.330*	0.513***	0.073	0.193	0.022
	(0.114)	(0.101)	(0.105)	(0.120)	(0.125)	(0.091)	(0.103)	(0.131)
Can visit the clinic alone	−0.071	0.015	0.207*	−0.159	−0.113	0.068	0.066	−0.073
	(0.096)	(0.083)	(0.089)	(0.103)	(0.109)	(0.078)	(0.086)	(0.115)
Decision of treating a sick child	0.112	−0.096	−0.063	0.195	0.087	−0.055	−0.059	0.044
	(0.109)	(0.098)	(0.105)	(0.124)	(0.120)	(0.090)	(0.098)	(0.127)

Standard errors in parentheses

*** p<0.001

** p<0.01

* p<0.05

This analysis (Model 3) also includes father's education, household assets, maternal employment, child's sex, birth order, child age, age squared, maternal age fixed effects, caste, religion and cluster fixed effects. Presence of immunization cards with the mother is included for immunization outcomes. For antenatal care and IFA consumption, child's age and gender are not included.

Table 5:

Maternal education coefficients across models

	Before controls		After controls		Pathways		Reduction after controls
Antenatal care	0.189	***	0.062	***	0.055	***	67%
	(0.005)		(0.010)		(0.010)		
IFA consumption	0.112	***	0.041	***	0.027	**	63%
	(0.006)		(0.009)		(0.009)		
Postnatal care	0.115	***	0.041	***	0.034	***	64%
	(0.004)		(0.010)		(0.010)		
Full immunization	0.122	***	0.058	***	0.046	***	52%
	(0.007)		(0.011)		(0.011)		
Full polio	0.076	***	0.020		0.008		74%
	(0.006)		(0.012)		(0.012)		
Not underweight	0.103	***	0.034	***	0.032	***	67%
	(0.005)		(0.009)		(0.009)		
Not stunted	0.081	***	0.017		0.015		79%
	(0.005)		(0.009)		(0.009)		
No short-term morbidity	0.034	***	−0.008		−0.008		124%
	(0.009)		(0.012)		(0.013)		

Standard errors in parentheses

*** p<0.001

** p<0.01

* p<0.05.

Ante-natal care sample:11026, FE sample 6025; iron tablet consumption sample: 11026, FE sample: 7335; post-natal care sample: 10870, FE sample: 6219; immunization sample: 8579, FE sample: 5151; full polio sample: 8778, FE sample: 4518; underweight sample: 9720, FE sample: 7817; stunting sample: 8115, FE sample: 6323; no short-term morbidity: 10,872, FE sample: 4957.