

RESEARCH ARTICLE

Maternal education and the multidimensionality of child health outcomes in India

Kriti Vikram^{1,*} and Reeve Vanneman²

¹Department of Sociology, National University of Singapore, Singapore and ²Department of Sociology, University of Maryland, College Park, USA

*Corresponding author. Email: socvk@nus.edu.sg

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Abstract

Maternal education plays a central role in children's health, but there has been little research comparing 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 and stunting are multifactorial in origin and determined by a range of factors not necessarily under a mother's control. Mother's education, given the necessary structural factors such as medical centres, is likely to lead to increased access to, and uptake of, medical services. Using data from the 2004–05 India Human Development Survey, eight separate logistic regressions were carried out on 11,026 women of reproductive age and their last-born child under five years of age. The results showed that maternal education had the strongest association with medical care, immunization (except polio) and iron supplementation for pregnant mothers, moderate association with underweight and weak association with short-term diseases and stunting. In addition, the study investigated whether maternal education impacts child health and medical care outcomes through the intervening roles of empowerment and human, social and cultural capital. These intervening linkages were found to be 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 influencing child health outcomes (e.g. Caldwell, 1979; Bicego & Boerma, 1993; Fuchs *et al.*, 2010). A large body of literature links mother's education to child immunization, nutrition, morbidity, medical care and survival. Not all studies have been conclusive, however, and there has been little agreement on the linkages between mother's education and child health. Resolving these inconsistencies may require closer attention to variability across health outcomes as these are not interchangeable measures of children's health.

There has been little conceptual work on which child outcomes might be especially sensitive to maternal education. This study aimed to test the multidimensionality of 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). The study 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, which 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) argued 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 between the different types of child health outcomes have (unfortunately) been relatively neglected. Instead, a strong 'maternal perspective' guides research and practice, whereby the focus on the mother relegates the importance of other critical factors (Subramanian & 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) highlighted the need to adopt a multifactorial framework to understand the causes of undernutrition in India and underscored 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 study assessed the maternal education–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 Discussion). Four social and cognitive pathways were 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 child 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 postnatal 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 & Li, 2009; Glewwe, 1999; Sujarwoto & 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 than for others, one has to begin by acknowledging that the strength of the relationship does, in fact, vary across child health outcomes.

The study of Desai and Alva (1998) is a notable exception, perhaps driven by the authors' need to interpret their positive findings for immunization but weaker and mostly non-significant results for height-for-age and child mortality. They argued 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' (Desai & Alva, 1998, p. 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) found maternal education associations for prenatal care among Guatemalan women, but not for immunization, treatment of illnesses (Goldman *et al.*, 2002) or trained delivery and offered 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, used the stronger education associations with child mortality than with neonatal mortality to infer that the education relationship owes more to the mother's 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' (Miller & Rodgers, 2009, p. 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 (Semba *et al.*, 2008; Aslam & Kingdon, 2012; Subramanian *et al.*, 2016). Moestue and Huttly (2008) highlighted the importance of the father's and grandmother's education on child nutritional status in India, independent of maternal education. They argued 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 inter-generational aspect of child health. Evidence points to the role of maternal resources such as her stature and weight on the 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, female 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 *et al.*, 2008; Fink *et al.*, 2011). Contagion is important, as infections easily spread among children (Calder & 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 socioeconomic status (Montgomery & Hewett, 2005). Moreover, Shin (2007) found that community-level wealth reduced the estimates for maternal education-child anthropometric indicators, suggesting the importance of these factors in reducing the influence of maternal education.

Health care 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 & 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 all have a significant impact on health service utilization (Acharya & Cleland, 2000; Perry & 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 for the influence of maternal education.

In short, a variety of factors influencing child 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 (Caldwell, 1979; Cleland & van Ginneken, 1988; Bicego & Boerma, 1993; 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. Frost *et al.*, 2005; Cassell *et al.*, 2006; Shin, 2007). With these controls, the strength of the maternal education relationship declines substantially, suggesting that 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, and have better access to medical care, and water and sanitation services. Steele *et al.* (1996), for instance, found the effect of mother's education on immunization in Bangladesh was reduced to being statistically insignificant if village-level variables were held constant (see also Aslam & Kingdon, 2012, for Pakistan; and Babalola, 2009, for Nigeria). Kravdal (2004) documented the positive externalities produced by other local women's education on childhood mortality and several other child health outcomes. Similarly, Parashar (2005) noted the importance of average female literacy in a district for childhood immunization coverage in rural India.

Desai and Alva (1998) controlled 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 eliminated 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 used 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 & Bharadwaj, 2015). These studies found a significant influence of maternal education on child health and mortality.

Pathways linking maternal education with health and medical care outcomes

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 it is about her education that improves child health. This study 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 (LeVine, 1987; Streatfield *et al.*, 1990; Glewwe, 1999; Rowe *et al.*, 2005; LeVine *et al.*, 2011; Smith-Greenaway *et al.*, 2012). Academic skills, especially literacy, not only make women

more receptive to health information but also improve their ability to understand health messages in 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) found that the effect of formal education on vaccinations was entirely mediated through correct knowledge about vaccine functions in Indonesia. Similar results have been replicated in Nepal and northern Nigeria, where health knowledge was found to mediate the impact of mothers' schooling on their use of medical and preventive health care (Rowe *et al.*, 2005; Babalola, 2009). Block (2007) found that nutrition information explained some of the maternal education effect on anaemia in central Java, and Frost *et al.* (2005) found that the knowledge pathway explained 15% of the education effect on children's stunting in Bolivia. Finally, although it has been previously stated that community-level amenities are 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) found that mothers in rural Gambia were 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. the Grameen Bank), or even their residence in NGO programme areas, have been found to increase their children's probability of being immunized (Steele *et al.*, 1996; Amin & Li, 1997). Andrzejewski *et al.* (2009) discovered that members of community organizations in coastal Ghana had better knowledge of disease causes, thus linking social and human capital. Other studies have confirmed the 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 *et al.* (2006) for weight-for-age but not height-for-age in Vietnam; and De Silva and Harpham (2007) found 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, 2018; Story & Carpiano, 2017). 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 smooths 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 & Lareau, 1988). This study adopted 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) argued 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, 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 & van Ginneken, 1988, p. 1363). In particular, LeVine *et al.* (2011) underscored the importance of oral skills developed through scripted activities in the classroom, which bestow, for instance, the ability to produce an organized narrative concerning an episode of illness. They argued 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 child 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 (Mandelbaum, 1986; Jefferey *et al.*, 1989). 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. Das Gupta, 1990; Basu, 1992). Surveys show that educated women have higher autonomy in decision-making and mobility, facilitating their use of antenatal care (Bloom *et al.*, 2001; Jejeebhoy & Sathar, 2001). Education is hypothesized to raise mothers' decision-making ability and enhance their mobility, which in turn enhances child health.

The Indian context

Child health outcomes are multidimensional, with some aspects of child health being more responsive to maternal control than others. Certain factors, such as the child's diet and breast-feeding, are under greater maternal control compared with 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 matter less in an unfavourable environment. This study used 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 population now have access to drinking water (Government of India, 2011), the quality of the water remains suspect (Bain *et al.*, 2012), and sanitation facilities are available to only 50% of the population (Government of India, 2011). A significant percentage of global diarrhoeal 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 300,000 deaths annually (Million Death Study Collaborators, 2010). Kumar and Vollmer (2013) found that improved sanitation reduced the likelihood of contracting diarrhoea among Indian children by 17%. Jalan and Ravallion (2003) reported that access to piped water can reduce the prevalence of diarrhoea among Indian children by 17.4%. Similarly, Nandi *et al.* (2017) argued that improvements in piped water and sanitation would considerably reduce the burden of diarrhoea and diarrhoea-related deaths in India.

Public health programmes 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 & Peters, 2012). Educational gains for the mother, thus, do not necessarily translate into economic benefits for herself or her 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. It cannot be assumed that the results in one context will be replicated across all contexts (Navaneetham & Dharmalingam, 2002). The extent of maternal control is the crucial conceptual distinction that would influence how a mother's education influences her children's health.

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 thirteen Indian languages and was 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, pp. 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 aged 15–49 years asked about her health, medical care utilization and knowledge of health issues, and the gender relations in the household. The survey also collected health histories for the last-born child of each eligible woman. The interviewer, usually a female, also assessed her communication abilities and interaction style.

Dependent variables

Medical care of mothers and last-born child

A dichotomous variable *Antenatal care (ANC)* was created to indicate whether a woman received at least four ANC visits from a health professional. The Government of India recommends iron and folic acid (IFA) supplements for pregnant women for at least 90 days during pregnancy. A dichotomous variable *IFA consumption* was created to indicate whether a woman received this. The sample size for the IFA consumption and Antenatal care variables was 11,026 women.

A variable *Postnatal care of child*, indicating whether a child received a postnatal check-up within 2 months of birth by a medical practitioner, was created ($N=10,870$). A dichotomous

Table 1. Description of medical care and child health outcome variables

Variable	Mean	SD	Age range	N
Medical care				
Full immunization (except polio)	0.492	0.492	1–5 years	8579
Full polio	0.728	0.445	1–5 years	8778
Antenatal care (ANC)	0.363	0.481	For children <5	11,026
Iron folic acid (IFA) consumption	0.337	0.473	For children <5	11,026
Postnatal care of child	0.315	0.464	For children <5	10,870
Child health outcomes				
No short-term morbidity (cold/diarrhoea)	0.890	0.313	0–5 years	10,872
Not underweight	0.546	0.498	0–5 years	9720
Not stunted	0.416	0.493	0–5 years	8115

variable *Full immunization (except polio)* indicated 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 dose 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 was used as a control variable. The immunization sample included 8579 children aged 12 months to 5 years.

Polio was modelled separately from other recommended immunizations because an extensive national campaign has 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 included 8778 children under five and the variable *Full polio* indicated whether the child received all three polio immunization doses by 12 months of age.

Child health outcomes

No short-term morbidity was a dichotomous variable indicating whether the mother reported that a child did not experience diarrhoea, cough or fever in the last month. The sample included 10,872 children under the age of five.

An *underweight* child has a ‘weight-for-age’ z-score that is at least two standard deviations (SDs) 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 *Not underweight* was created to indicate if a child was not underweight. The sample included 9720 children under the age of five who had complete and valid data on underweight status.

A *stunted* child has a height-for-age z-score that is at least two SDs 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 *Not stunted* was created to indicate a child who was not stunted. The sample included 8115 children under the age of five who had complete and valid data on stunting. Table 1 summarizes all the dependent variables included in the analyses.

Independent and control variables

Maternal education and its pathways

Mother's 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 was used.

To assess Human Capital, the mothers were asked five questions about reproductive and child health to assess *Health knowledge*: (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 water to drink than usual during diarrhoea. The responses were coded as dichotomous to indicate correct versus incorrect and 'don't know' answers. Correlations among the five items were low (ranging from 0.08 to 0.13); therefore, the use of single items as well as a summary scale was explored. Different knowledge items proved statistically significant for different outcomes with no detectable meaningful patterns, so results for the summary scale were reported (*Health knowledge*).

To assess 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 of any religious, caste or festival organization (*Religious/caste organization*) was interpreted as a measure of bonding social capital and membership of any other association (*Development organization* – 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) was a measure of bridging social capital. Both indices had moderate Cronbach's alpha estimates of reliability: 0.59 for religious and caste groups and 0.56 for development organizations.

Cultural Capital (the communication ability of the woman) was 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; and 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 (*Communication skills*) is indicative of her ease of communicating with trained medical personnel.

Women's empowerment was measured using two dichotomous variables: if she was the main decision-maker when the child was ill (*Decision on treating a sick child*) and if she could go to the local health centre without seeking permission (*Can visit clinic without permission*).

Control variables

Educated women tend to live in educated communities with better access to resources, so part of the maternal education effect would be a proxy for those *contextual effects*. Fixed effects were 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. The study's approach was equivalent to adding dummies for each cluster to the equation. With cluster fixed effects, it was possible to test whether educated mothers were 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. However, they require some variation on the outcome variable within the PSU. Because the outcome variables were dichotomous, many PSUs were homogeneous on some outcomes; these cases had 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.

As the father's education is an important determinant of child health (Pebley *et al.*, 1996), a control for this was included. However, 3.2% of the cases were missing, possibly indicating migrants or separated/divorced spouses. Mean imputations were carried out for the missing

values, and the missing cases were 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 & Pritchett, 2001).

Caste had 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 (*Joint family*). *Birth order* of the child had three categories: first child (reference group); second child; and third or higher birth order child. Lastly, *Maternal work status* (none; part-time or seasonal work – fewer than 2000 hours per year; full time – 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 of the child, child's age (at the time of interview) and sex were controlled for. For immunization variables, control for the source of immunization data, i.e. government card or mother's report, was also included (*Immunization card*). Table 2 provides the descriptive statistics for the independent and control variables included in the analyses.

Statistical models

Logistic regressions were 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 was on the change in the maternal education coefficients (log-odds) with the introduction first of background controls and then of the hypothesized pathways. It was expected that maternal education coefficients would 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, the focus first is on the maternal education relationships across all eight outcomes, and this will be repeated for the pathways linking maternal education to child health. The consistent pattern observed was for maternal education to have stronger associations with outcomes where the mother had greater control compared with external forces (Table 3). Antenatal care, postnatal care, immunization (except polio) and IFA consumption demonstrated strong maternal education associations, even after adding 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 care, 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

Educated mothers were far more likely to have had four or more ANC check-ups. Model 2 in 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

Table 2. Descriptive statistics for independent and control variables

	Mean	SD	Range
Mother's education (years)	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 caste	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 religion	0.055	0.228	0–1
Sex of child (girl=1)	0.465	0.499	0–1
Maternal age (years)	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 higher child	0.463	0.499	0–1
Standard of living	10.382	5.866	0–30
Father's education (years)	6.563	4.751	0–15
Dummy for mean imputation for father's education	0.032	0.175	0–1
Joint family	0.539	0.499	0–1
Maternal work status: not working	0.484	0.500	0–1
Full time employment	0.050	0.218	0–1
Part time employment	0.460	0.498	0–1
Missing on employment	0.006	0.077	0–1
Health knowledge	3.136	1.176	0–5
Development organization	0.327	0.782	0–7
Religious/caste organization	0.280	0.584	0–2
Communication skills	1.638	0.378	0–2
Decision on treating a sick child	0.851	0.357	0–1
Can visit clinic without permission	0.802	0.399	0–1

Source: India Human Development Survey 2004–05.

households, have fewer children and live in areas where antenatal check-ups are more common. Nevertheless, the relationship with maternal education remained strong ($\beta = 0.062$) after controls.

Maternal education showed 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 consumption relationship remained strong, albeit reduced ($\beta = 0.041$). More-educated women are wealthier and more likely

Table 3. Relationship between mothers' education and child health and medical care outcomes

	Model 1	Model 2
Antenatal care		
Mother's education	0.189 (0.005)***	0.062 (0.010)***
Household assets		0.067 (0.010)***
Father's education		0.022 (0.010)*
2nd child		-0.452 (0.090)***
3rd child		-0.845 (0.105)***
IFA consumption		
Mother's education	0.112 (0.006)***	0.041 (0.009)***
Household assets		0.032 (0.009)***
Father's education		0.021 (0.008)*
2nd child		-0.178 (0.078)*
3rd child		-0.372 (0.090)***
Postnatal care of child		
Mother's education	0.115 (0.004)***	0.041 (0.010)***
Household assets		0.055 (0.010)***
Father's education		0.009 (0.009)
2nd child		-0.189 (0.085)*
3rd child		-0.475 (0.099)***
Full immunization (except polio)		
Mother's education	0.122 (0.007)***	0.058 (0.011)***
Household assets		0.062 (0.011)***
Father's education		0.026 (0.010)**
2nd child		-0.109 (0.101)
3rd child		-0.043 (0.113)
Full polio		
Mother's education	0.076 (0.006)***	0.020 (0.012)
Household assets		0.073 (0.012)***
Father's education		0.015 (0.011)
2nd child		-0.154 (0.112)
3rd child		-0.112 (0.126)
No short-term morbidity		
Mother's education	0.034 (0.009)***	-0.008 (0.012)
Household assets		0.021 (0.012)
Father's education		0.005 (0.011)
2nd child		0.205 (0.112)
3rd child		0.254* (0.125)

Table 3. (Continued)

	Model 1	Model 2
Not underweight		
Mother's education	0.103 (0.005)***	0.034 (0.009)***
Household assets		0.062 (0.009)***
Father's education		0.020 (0.008)**
2nd child		-0.126 (0.077)
3rd child		-0.159 (0.088)
Not stunted		
Mother's education	0.081 (0.005)***	0.017 (0.009)
Household assets		0.048 (0.009)***
Father's education		0.011 (0.008)
2nd child		-0.063 (0.083)
3rd child		-0.164 (0.095)
PSU control	Not included	Included
All other controls	Not included	Included

Model 1 adjusted for child's age and age squared for all child health and health care outcomes. For immunization outcomes, presence of immunization cards was also included. For antenatal care and IFA consumption, child's age was not included. Model 2 introduces father's education, child's sex, household assets, maternal employment, maternal age fixed effects, caste, religion and cluster fixed effects. Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

to reside in localities with better services. These results suggest that maternal education translates into better health practices.

The picture for postnatal care was similar to that of 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 were held constant ($\beta = 0.041$).

In Model 2, the children of more-educated mothers were still more likely to be immunized (except polio) ($\beta = 0.058$), although their advantages were substantially attenuated with controls. The effect of household economic standing on immunizations was especially important. Polio vaccination, unlike other immunizations, did not have a statistically significant association with maternal education once neighbourhood and other household factors were held constant ($\beta = 0.020$). It appears the national Pulse Polio Campaign has rendered parental education less critical for household access to polio than to other immunizations. However, standard of living remains important.

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 ($\beta = 0.034$) remained statistically significant and only slightly smaller than for the health care variables discussed previously.

For stunting, the coefficient for maternal education attenuated considerably, barely remaining statistically significant after the household and local controls ($\beta = 0.017$). The weaker relationship with stunting rather than underweight was 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.

Maternal education appeared 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

Table 4. Pathways linking maternal education with child health and medical care outcomes

	Model 3							
	Antenatal care	IFA consumption	Postnatal care of child	Full immunization	Full polio	Not underweight	Not stunted	No short-term morbidity
Maternal education	0.055*** (0.010)	0.027** (0.009)	0.034*** (0.010)	0.046*** (0.011)	0.008 (0.012)	0.032*** (0.009)	0.015 (0.009)	-0.008 (0.013)
Health knowledge	0.103** (0.035)	0.104 *** (0.031)	0.180*** (0.033)	0.189*** (0.037)	0.174*** (0.038)	0.029 (0.028)	-0.001 (0.032)	-0.025 (0.041)
Development organization	-0.018 (0.077)	0.017 (0.044)	0.026 (0.048)	0.130* (0.058)	0.164* (0.066)	0.085 (0.045)	0.021 (0.048)	-0.051 (0.062)
Caste/religious organization	-0.001 (0.050)	-0.114 (0.066)	0.172* (0.073)	-0.031 (0.088)	-0.124 (0.093)	0.051 (0.066)	0.136 (0.073)	-0.037 (0.093)
Communication skills	0.106 (0.114)	0.818*** (0.101)	0.022 (0.105)	0.330* (0.120)	0.513*** (0.125)	0.073 (0.091)	0.193 (0.103)	0.022 (0.131)
Can visit clinic without permission	-0.071 (0.096)	0.015 (0.083)	0.207* (0.089)	-0.159 (0.103)	-0.113 (0.109)	0.068 (0.078)	0.066 (0.086)	-0.073 (0.115)
Decision on treating a sick child	0.112 (0.109)	-0.096 (0.098)	-0.063 (0.105)	0.195 (0.124)	0.087 (0.120)	-0.055 (0.090)	-0.059 (0.098)	0.044 (0.127)

This analysis (Model 3) also included 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 was included for immunization outcomes. For antenatal care and IFA consumption, child’s age and sex were not included. Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

thus more likely to report them. Therefore, a gradient for maternal education could not be observed here. Additionally, the proportion of children with short-term morbidities was quite low, so these finding must be interpreted with caution.

Pathways linking maternal education with child health and medical care outcomes

Health knowledge (human capital) was the most consistent pathway mediating maternal education effects on medical care outcomes. All five outcomes (IFA consumption, antenatal and postnatal check-ups and 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.

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 of development organizations had a significant positive relationship with both immunization variables, but with

Table 5. Maternal education coefficients across models

	Before controls		After controls		After inclusion of 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)		

Antenatal care sample: $N=11,026$, FE sample: $N=6025$.

IFA consumption sample: $N=11,026$, FE sample: $N=7335$.

Postnatal care sample: $10,870$, FE sample: $N=6219$.

Immunization sample: $N=8579$, FE sample: $N=5151$.

Full polio sample: $N=8778$, FE sample: $N=4518$.

Underweight sample: $N=9720$, FE sample: $N=7817$.

Stunting sample: $N=8115$, FE sample: $N=6323$.

No short-term morbidity: $N=10,870$, FE sample: $N=4957$.

Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

no other outcome. Development organizations may support or even host vaccination campaigns, so the positive effects on children's vaccinations is not surprising. Membership of 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 did not explain why well-educated mothers get better health care for their children. However, the model included 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 that models contextual factors (Vikram, 2015, 2018; Story & Carpiano, 2017).

A mother's communication ability (cultural capital) demonstrated a strong association with both immunization measures and IFA 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 – were unrelated to the cultural capital scale.

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 has also noted the importance of factors beyond the control of the mother. For example, Kim *et al.* (2017) highlighted 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 immunization 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 study included a whole range of medical care and child health outcomes, it did not include infant or child survival. It used 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 present sample, the use of 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 study has demonstrated 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 and 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 study has emphasized 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 is 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, it would still be expected 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 the study's 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. The authors 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) demonstrated for Nigeria that maternal literacy is significant for child survival only when the mother has decision-making power. Hatt and Waters (2006) found a positive interaction of maternal education with household wealth across twelve 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.

Kravalda (2004) argued 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 study 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, the 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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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.

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