Women's Education, Health and Fertility: Examining Three States in India: Bihar, Rajasthan and Tamil Nadu

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Abstract

Understanding the linkages between women's health and education are relevant to policy issues in developing countries like India. Education is understood to have a positive link with a woman's health and a negative correlation with fertility. At the same time, a woman's education level also impacts her socioeconomic status and geographical location, both factors that may also significantly impact health. This study uses data from the second round of the National Family Health Survey (1998-99) to analyze these linkages in three Indian states: Bihar, Rajasthan and Tamil Nadu. Results indicate that all fertility related variables are strongly linked in the poorer states. Association between education and two variables - contraceptive usage and disease prevalence- show different trends in the developed and less developed states. Nutritional status, on the other hand, is not associated with education in any of the three states.

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List of Acronyms

NFHS: National Family Health Survey
SES: Socio-economic Status
MDG: Millennium Development Goals
GDP: Gross Domestic Product
TB: Tuberculosis
PSU: Primary Sampling Unit
OLS: Ordinary Least Square

Introduction

Women's access to education in developing countries like India is increasingly being recognized as a fundamental right by international and national bodies. Enhancing this access is an important goal for most developing nation states. The benefits of educating women are manifold, ranging from increased productivity, economic development, and increased female autonomy. One significant benefit of educational attainment is understood to be better health and reduced fertility. Better-educated women experience lower levels of morbidity, mortality and disability and have fewer children (Ross & Mirowsky, 1999, Doornbous & Kramhout, 1990). However, there is mixed evidence on whether the linkage is direct or impacted by intervening pathways. One body of evidence suggests that the relationship is causal: that schooling teaches people cognitive skills that help them learn throughout their lives, which in turn helps them adopt healthier practices (Ross& Mirowsky, 2003). Another set of literature describes that education is merely a proxy for socioeconomic status of the household and the observed correlations between health/ fertility and education are, at best no more than links (Desai & Alva, 1998).

Assessing the impact of a woman's education on her health and that of the family can have important policy implications. If better education contributes to better health, these externalities embody important private benefits to education. In the developing as well as the developed world, public subsidies are provided for health, nutrition and family planning programs. Understanding this linkage is therefore important for policymakers and program planners, as it would demonstrate the potential role of women's education in improving maternal health and reducing fertility. Currently, however there is a lack of clarity on what aspects of women's health are linked to her education. Women's health is a diverse outcome variable that includes general

health behavior, nutrition as well as reproductive health. It is important to establish whether these different health determinants are equally associated with her education status.

Another important aspect of the health-education link is whether this linkage is similar or different at during various stages of a country's development. India is a nation of striking interregional diversity. Regions differ not only in culture but also socioeconomic development. Women in states like Kerala, Tamil Nadu and Andhra Pradesh enjoy higher education status and autonomy. On the other hand, northern states are strongly subject to traditional conservatism and women are predominantly less educated and less likely to work outside their homes.

The following research examines how women's education is associated with different aspects of health and fertility. This study focuses on three states in India: the eastern state of Bihar, the western state of Rajasthan and the southern state of Tamil Nadu. While Bihar and Rajasthan are two of the poorest performers in India in terms of gender equality, Tamil Nadu captures the other end of the spectrum with the state making significant strides in women's education and health (National Family Health Survey, 1999; Census, 2001). We use the second round of National Family Health Survey (NFHS, 1998-1999) for analysis. NFHS is a large-scale multi-round survey conducted in representative households in India. It provides state-wise information on women's education, health, fertility, family planning, child mortality etc.

This study is divided into the following sections: the background section provides details on the development status of India and for the three states being studied. The literature review analyses past literature on determinates of women's health, the relationship between health and education and the association between health and different extraneous variables that may impact women's well-being. This section is followed by the research questions that guide this study. The

conceptual framework section establishes the relationships between health, education and other variables that form the basis of this study. The section on data and methods describes the variables and the regression methodology in detail, followed by descriptive statistics and results of regression analysis. The discussion and conclusion section highlights the significance of the results and various policy implications of the findings.

Background

Overall, India's performance on most gender development indicators remains dismal. With a gender development indicator of 0.591, India ranks 96 among the 137 countries for which the Gender Development Indicator has been constructed (Human Development Report, 2004).[1] The Human Development Report also indicates that there are only five countries in the world that have higher education gender gaps than India: Bhutan, Syria, Togo, Malawi and Mozambique. The Education For All Global Monitoring report puts India in the "at risk" category of not achieving gender parity in education by 2015 (UNESCO, 2004). In the 6-14 age group, about 25 percent of girls are not in school (Census, 2001). At the same time, the regional disparities within India are also alarmingly high. While in some regions, women's literacy levels are comparable to the developed world, other regions continue to lag behind with more than half of the women unable to read and write (ibid).

In the recent past, with globalization and the development of the technological industry, India's economic growth has been phenomenal. It has translated, at least partly, into a reduction in poverty levels in the country. All parts of India however, have not benefited equally from this growth (Planning Commission of India, 2006). Disparities in the economic and social spheres are

[1] Gender related development indicator introduced in Human Development report 1995, measures gender inequalities in achievement in the following dimensions: living a long and healthy life, being educated and having a decent standard of living.

stark. A detailed study by the Indian Planning Commission examined the level of development in the fifteen major states that are home to more than 96 percent of the population. They concluded that Indian states could be divided into two groups: the 'forward states' and the 'backward states'. The forward states group comprises Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab and Tamil Nadu. The backward group comprises Assam, Bihar, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh and West Bengal. While the forward group of states account for about 40.4 per cent of the national population, the backward group accounts for as much as 55.1 per cent of the population of the country according to 2001 census (ibid).

For the purpose of this study, three states have been selected: two from the less-developed group: Bihar and Rajasthan and one from the developed group: Tamil Nadu. Even though Kerala is the best performing Indian state in terms of gender equality, much research has already been done comparing Kerala to the rest of the country. At the same time, various researchers have also pointed out that Kerala's socialist heritage and matrilineal traditions make it very dissimilar from the rest of the country and therefore comparisons are difficult. It is for this reason that Tamil Nadu is being analyzed as a representative of the developed states. Among the other group, Rajasthan and Bihar are chosen since both states are the least developed in the country and yet are very different from each other in culture and traditions.

Tamil Nadu, located at the southern tip of India ranks high for most human development indicators in India. It is bounded by the states of Puducherry, Kerala and Andhra Pradesh. Tamil Nadu has the fifth largest economy in the country and the second highest per capita income. Chennai, its capital, is the fourth largest city in the country. It has the second lowest population growth rate in India after the state of Kerala. Tamil Nadu's literacy growth in the past decade has been phenomenal. The literacy rate grew from 65 percent in 1991 to 73 percent in 2001, which

was well over the national average (Census, 2001). The female literacy rate of 65 percent was also much above the national average of 53 percent. Tamil Nadu is also understood to have one of the most efficient governance structures in India and the least corrupt state bureaucracy (India Knowledge, Wharton School, 2007).

Bihar, on the other hand has the poorest development indicators in India. It is in the east of India surrounded by the state of Uttar Pradesh in the west, Jharkhand in the south and West Bengal in the east. Until recently, Bihar and Jharkhand were a single state (also called Bihar). For political reasons, Jharkhand was carved out of Bihar in the year 2000. In ancient times, Bihar was an important center of power, culture and education. However, currently its performance is much lower than the national average on almost all indicators. The per capita income is $86 as compared to the national average of $285 (Indiastat, 2004-05). 42.6 percent of the people live below the poverty line against India's 26.1 percent (Tewary, 2005). Bihar is an agrarian economy with a vast swath of fertile land that makes it ideal for agriculture. Despite that advantage, Bihar does not contribute significantly to the agricultural economy of the state. Popularly, Bihar's poor performance is blamed on its misrule, caste dominated politics and rampant corruption in bureaucracy and politics. According to the World Bank (2005), Bihar is the only state in India where the level of poverty is expected to rise. By current trends, Bihar is projected to fall well behind on all Millennium Development Goals (MDG) targets by 2015.

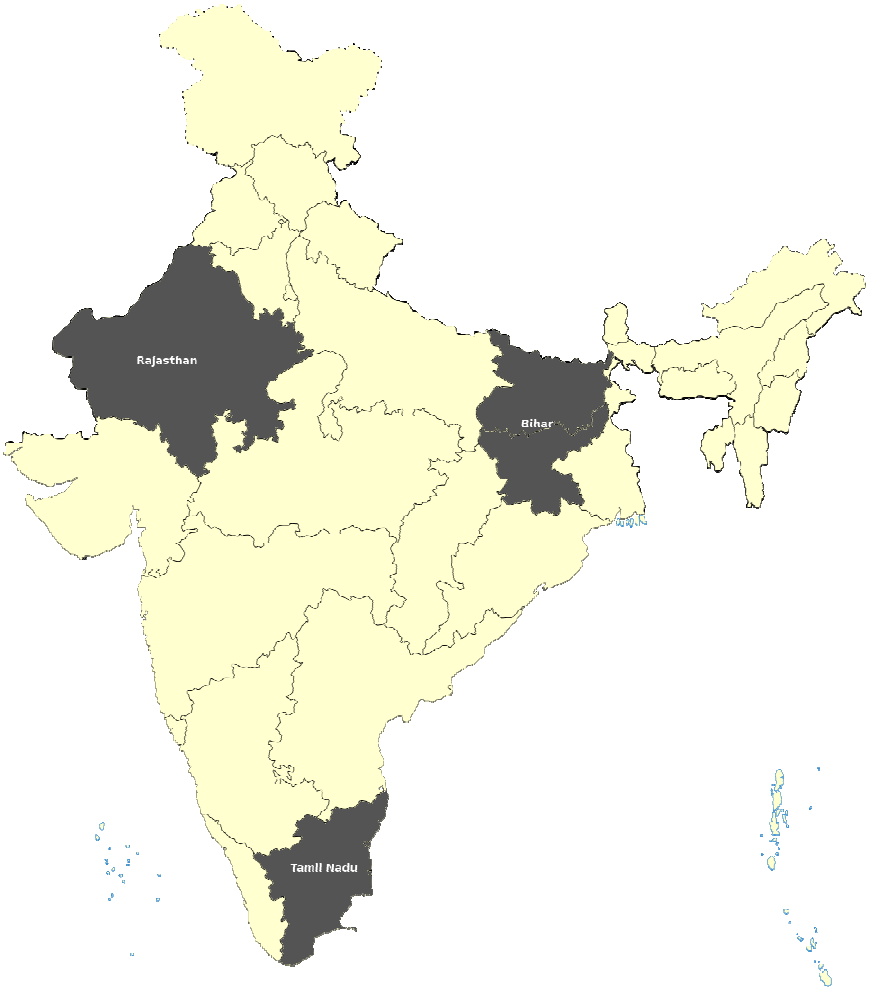

Figure 1: Map of India (the three states of study are shaded)[2]

Due to its rich cultural heritage and ancient architecture, Rajasthan is arguably one of the most popular tourist destinations in the country. It is also a state of striking gender disparities and rigid patriarchal traditions. Rajasthan has the highest incidence of female infanticide, female feticide and child marriage. Parts of Rajasthan have reported a sex ratio[3] of less than 850 as a result of female feticide and infanticide (Census, 2001). Rajasthan's per-capita GDP is $208 (Indiastat, 2004-05). However, governance in Rajasthan is considered more efficient than states like Bihar

[2] The Bihar region on the map indicates undivided Bihar prior to 2000
[3] Number of females per 1000 males.

and in the recent past Rajasthan has seen many new welfare programs. Rajasthan has been the pioneer in implementing the mid-day meal program in schools and other welfare programs including incentives for parents for sending daughters to schools. In the recent state budget, the Chief Minister of Rajasthan announced a considerable sum of the funds for women-focused development programs (Chandrashekhar & Ghosh, 2006).[4]

Research Questions and Arguments

Greater educational attainment is linked to better health status for women and decrease in fertility. Both health status and education are also correlated with a better quality of life and higher socio-economic status. We propose to study this link between education and health/ fertility in three states of India: Bihar, Rajasthan and Tamil Nadu. The monograph will aim to address whether this link is direct or whether there are other intervening variables that affect this linkage. If the linkage is not direct, education could be a proxy for variables like socioeconomic status or geographical location. At the same time, this study asks whether these relationships are similar in the developed and the underdeveloped regions within India. Health and fertility indicators will not be measured as one single outcome. For health related variables, we will analyze the relationship of women's education with disease incidence and nutritional status. For fertility related variables, the indicators will be contraceptive usage, number of children born and the age at the time of first childbirth. The objective is to examine if these different aspects of health are related to education in a similar manner.

The following research questions will guide the study:

[4] The section on descriptive statistics presents more details on women's health and education status in the three states.

Research Questions:

1. **Is women's education associated with fertility and fertility-related behavior? More specifically, is education linked with contraceptive usage, the number of children born, and a woman's age at the time of first childbirth?**

2. **Is women's education associated with different health outcomes? The two health variables being analyzed are incidence of diseases and nutritional status.**

3. **Is the relationship direct? If not, what are the intervening variables that impact the relationship? The intervening variables being tested in the study are socioeconomic status, geographical location, husband's education level, religion, employment status and caste. Are education and the health of the woman linked even after controlling for other variables?**

4. **Are the associations similar or different in different regions within India? Considering that states in India are at very different stages of development, are the trends in the education-health and education-fertility link different from each other?**

It is important to keep in mind that health is a multidimensional phenomenon and it is impossible to cover all its characteristics in one study. For example, this research does not touch upon any aspects of mental health, which is increasingly understood to be an important determinant of a

person's well-being. Nevertheless, this analysis is an attempt to capture a few major facets of health that are considered vital in the context of developing countries.

While analyzing the relationship of health and fertility with women's education, we focus on the effect of formal schooling rather than non-formal education. Researchers often speculate that non-formal education- ranging from adult education to skill development- information about maternal and child health, and family planning can have consequences for health. Unfortunately, because of the limited scope of the data upon which this study is based, non-formal education is not taken into account.

Critical Literature Review

The review of past literature is divided into three sections. The first section reviews literature on different aspects of health that play a significant role in determining the overall health status of women. This section establishes the determinants of women's health in the context of developing countries. The second section explores empirical research on the association between women's health and fertility and education level. The final section describes literature relating to other extraneous variables (such as husband's education, autonomy level, caste etc.) that impact women's health.

Determinants of Women's Health

This section provides an overview of research on different aspects of health and fertility outcomes that we analyze in this study. We begin with literature on diseases and malnutrition followed by significance of fertility indicators as determinants of health.

Disease Prevalence

Four major diseases- malaria, jaundice, tuberculosis and asthma- have been found to be a major public health burden in India and are a major cause of morbidity and mortality, especially among women.

Malaria: India reports 2.5 to 3 million cases of malaria that result in 1,000 deaths annually (Sharma, 1999). It has been found to be particularly harmful for women since it can create complications during pregnancy resulting in abortion, premature and low birth weight and maternal mortality (Singh, Shukla & Sharma, 1999).

Tuberculosis (TB): Tuberculosis is an infectious disease that mostly affects the productive age group. Studies have indicated that the direct and indirect costs for TB are enormous for women. Around the world, TB kills more women each year than any other infectious disease (Rajeshwari et al, 1999). It is the third most significant cause of mortality among women of reproductive age group in developing countries (Connolly & Nunn, 1996). In India, TB results in 1000 deaths everyday (MoHFW, 2007)[5].

Jaundice: Jaundice/hepatitis is a serious morbid disease that results in high mortality among women. In many states in India, jaundice is responsible for more than 15 percent of deaths annually (Aparajita & RamanaKumar, 2005).

Asthma: Asthma has a high prevalence among the female population in India. This high incidence among women is the effect of indoor pollution due to domestic cooking with biomass fuel and liquefied petroleum gas. Indoor pollution induces asthma, which further results in more complications and leads to two million deaths in developing countries. No reliable estimates of

[5] Ministry of Health and Family Welfare

female mortality due to asthma are available for India. However, the Indian Government now considers asthma to be a major public health burden (Smith, 2000).

Malnutritition

Malnutrition has been found to be a significant cause of maternal mortality in India. South Asia has the highest rate of malnutrition among women, which leads to severe and moderate anemia. The prevalence of anemia among women in India is as high as 52 percent (NFHS, 1998-99). The consequences of anemia for women include increased risk of low birth weight or prematurity, perinatal and neonatal mortality, inadequate iron stores for the newborn, increased risk of maternal morbidity and mortality, and lowered physical activity, mental concentration and productivity (Gillespie& Johnston, 1998; Stoltzfus 1997; Allen 1997). Women with even mild anemia may experience fatigue and have reduced work capacity (Gillespie 1998). Qualitative studies conducted on women's illness and health-seeking behavior in diverse socio-cultural settings across India report 'weakness' as one of the most common symptoms of ill health that they experience. Weakness due to inadequate nutrition is often ranked at the top of illnesses that cause concern (Patel, 1994; Kilemann, 2000; Amin, 2000).

Fertility and Family Planning

While a high fertility rate is no longer considered undesirable in the developed world where the total fertility rates are below replacement levels (Bongaarts, 2002), developing countries like India and China continue to have a growing population with inadequate resources. It is estimated that at any time, one woman in six between the ages 15 and 49 is pregnant in developing countries, compared with one woman in seventeen in developed countries. At the same time, in a developing country, a high level of fertility has a negative impact on a woman's own well-being. Repeated childbearing, short birth intervals and pregnancy at an early age all pose high risks to

health of women. (Dyson & Crook,1984; Acsadi & Johnson-Acsadi,1986). Mothers of less than 18 years of age run a high risk of complications and/or death in pregnancy and childbirth and of giving birth to premature babies.

Association between Women's Education and her Health/ Fertility

Existing literature on the links between health and education is conflicting. While some researchers claim that women's education is positively linked to their health and negatively linked to fertility in most developing countries, other studies present evidence that once socio-economic status and geographical location are taken into account, the linkages disappear. These studies assert that a woman's education level is merely a proxy for better socioeconomic status and higher autonomy for her within the family. If family background and other demographic variables are taken into account, a woman's education is not linked to her health status and fertility. The following section provides an overview of macro and household level literature on the education-health/ fertility link for women in developing countries.

Education and Fertility

The education-fertility linkage is not the same across the world. Studies point out that the link is weak in poor illiterate societies and improves as societies enhance their overall education level. Once the desired fertility level has been reached, the link becomes weak yet again (Martin, 1995). A study in 26 low and low-middle income countries suggests that education and fertility have a strong negative relationship whereas health outcomes and education have a positive link (Subbarao & Raney, 1995). Subbarao and Raney claim that education is the single most important determinant of fertility, even more important than the provision of services. Another study using district level census data in India (from 1981 and 1991) demonstrates that the relationship is strong for India (Dreze and Murthi, 2001). Other studies claim that the lack of

education among women in itself is not a cause of high fertility. A recent study by McNay et al. (2003) describes that there is an emerging trend of more and more uneducated women using contraception. They attribute this change to what they call 'diffusion of knowledge' from the women who use contraception to those who previously did not. This knowledge diffusion, they say, increases contraceptive usage among the uneducated therefore indicating the significance of non-formal learning in reproductive health behavior. Another study that reports primary evidence from India, Pakistan and Sri Lanka by Jefferey and Basu (1993) also describes that a causal link between fertility and education has been assumed by policymakers but has a weak theoretical and empirical basis. They report that the linkage of female schooling and fertility is a part of much wider change in the position of a woman and her family within the society. The only state level study in India found that in the state of West Bengal (in East India), education had a limited impact on contraceptive usage (Pal & Makepeace, 2003). The study found that less educated women are more likely to use irreversible methods of family planning compared to more educated women who prefer reversible methods. This indicates that affordability of contraception may be a more important factor than knowledge. Reversible family planning methods like tubal ligation are heavily subsidized under the National Population Control Program in India which make them much more affordable for women across economic groups.

Education and Health

Literature on the education-health linkage is equally conflicting. Macro-level studies have found that education level in states is positively related to life expectancy, which is an important indicator of health status. In India, Kerala, the state with the highest female literacy rate of 87 percent, also has the highest life expectancy of 71.5 years. On the other hand, Rajasthan with

female literacy rate of 28 percent[6] has a life expectancy of no more than 53.3 years (Abbasi, 1999). Desai and Alva (1998) used Demographic Health Surveys in 22 developing countries to examine the effect of maternal education and health. They describe that education acts as a proxy for socioeconomic status and geographical location and therefore no causal links can be established. Another research by Elo (1992) studies the influence of woman's formal education on the use of reproductive health services in Peru. Upon controlling for family background, she finds that education does not seem to be linked to women's use of services. In this case, therefore, education becomes a proxy for other background factors. In a case study of Bangladesh, Mayuzumi (2004) argues that literacy and health need to be reconsidered from a standpoint of a local woman, her worldviews, indigenous knowledge and oral traditions. She asserts that western influence is a major contributor to the popular perception that women's lack of formal education is responsible for their poor health. She claims that 'euro-centric' policymakers have assumed that women's poor health in developing countries is a direct result of their lack of education without much empirical evidence.

Other Variables that Impact Women's Health

Research also points towards the significance of men's education for woman's health and fertility. In a country like India, underlying structures such as kinship and marriage allocate power and authority primarily to men. Research in this area describes men's role to be vital in women's well being (Singh, Bloom and Tsui,1998). Women's health is also significantly associated with her position within the family. Studies that use women's employment status as a proxy for her independence have found that employment and economic independence is positively linked with health status and negatively linked to fertility (Chen, Haq and Dsouza,

[6] Figures from 1991 census

1981). Other studies have found women's position in the family to be important even independent of her employment and education status. In India, diverse marriage and kinship patterns lead to very different levels of autonomy for females that result in regional differences in health status (Dyson & Moore, 1983).

Cultural differences across regions also impact women's health. One study found that even when comparing women in the same socioeconomic status with similar access to health services, women in south India had better health and fertility indicators than women in the northern parts (Malhotra et al., 1995). Apart from the traditional culture, studies have found radical or democratic tradition of the society as a whole as being vital in making health services work more effectively for women (Nag, 1982). Nag compared rural Kerala and West Bengal showing that attitude towards fighting for one's rights was much more deeply entrenched in Kerala that led to more efficient healthcare services and therefore lower mortality.

Missing Literature

Classic literature indicates that women's education and fertility have a negative association in a developing society. At the same time, the limited literature available on health indicators suggests that education has a positive relationship with health status. There is mixed evidence on whether these relationships are direct or impacted by intervening variables like husband's education, socioeconomic status, and geographical location. Nevertheless, these intervening variables are themselves crucial determinants of women's health. There are two aspects in the education-health and education-fertility relationship where the literature available is extremely scarce. First, no empirical research has studied this relationship at a regional level in India. There are some parts of India that have development indicators that are comparable with the developed world while other Indian regions continue to be plagued with very high levels of illiteracy, poor

health, and gender disparities. It is important to analyze how women's education is associated with her health in the context of the development level of the state she lives in. Secondly, there is a dearth of literature on how specific aspects of women's health and fertility relate to her education. Research studying the education-health linkage mostly uses life expectancy or usage of health services as an indicator of health status. No studies have examined how education specifically impacts incidence of disease and malnutrition in India.

In the following analysis, we address these two critical aspects. This research investigates the education-health/fertility linkage among women in the context of three Indian states, one of which has among the best development indicators in the country (Tamil Nadu) and two others that are on the other end of the spectrum, having the poorest human development indices (Bihar and Rajasthan). Also, apart from assessing the fertility- education linkage, this research will analyze the health-education linkage as measured by two key variables that have not been studied in previous literature in this area: prevalence of major diseases and malnutrition. The education- fertility association analyzes three variables: contraceptive use, number of children/ fertility rate and woman's age at the time of first childbirth.

Conceptual Framework

It is a complex process to assess all factors that impact women's health and fertility. Research on education-health/fertility builds two distinct hypotheses: First, that women's education is directly linked to her health status and fertility rate. Other set of hypotheses claim that the relationship is impacted heavily by intervening variables like SES and employment status. At the same time, economic status and education have a direct link. Studies also show that religion and ethnicity impact family's health status. In India, Muslim religious beliefs contribute to non-usage of

contraception among Muslim women. At the same time Muslim women, on an average have fewer years of education as compared to the majority Hindu women (Census, 2001). Caste factors also influence both education and health. Some studies claim that caste is the single most important determinant of woman's health and education (Deshpande, 2000). Other research describes that the association is not upheld when socio economic factors are accounted for (Subramaniam et al., 2006).

Woman's position within the family and the society is another important determinant of her health (Chen, Haq & D'souza, 1981). Woman's autonomy is heavily impacted by her educational status. Another important pathway between woman's own education and health is the education level of her husband. Educated women are more likely to have better educated partners and in a patriarchal society like India, men play a vital role in women's well being. Other factors like women's age and the geographical location (urban/ rural) are also significant mediating factors.

The diagram below shows that these different intervening variables influence health and fertility status of the woman but are themselves impacted by education level. It is important to keep in mind that their relationship with education is two-way. The intervening variables (shaded light gray in the diagram) are not only impacted by women's education but also impact education. At the same time, all of them influence women's health and fertility even independent of education. Apart from these linkages, women's health is influenced by existing healthcare systems in the region she lives. Regional differences in the availability of public healthcare could make access to healthcare completely independent of her individual or familial socio-economic status. Health is also influenced by community level variables like cultural practices and behavior. Such cultural practices could also vary by region. In our study, Tamil Nadu is understood to have a

more effective public healthcare system in comparison to Bihar and Rajasthan. As a state, Tamil Nadu makes more investments in public healthcare. Anecdotal evidence also suggests that people in Indian Southern states follow healthier practices in comparison to population in Northern states.

At the same time, education can potentially have a direct link with health and family related variables by changing women's attitudes and beliefs (represented by bold arrows). In our study, we aim to examine the relationship between education-health/fertility while accounting for the intervening pathways (shaded variables) described earlier. Due to lack of empirical data, variables like healthcare systems and cultural beliefs are not controlled for in this study.

While this diagram builds a near comprehensive picture of the different factors that influence women's health and how education potentially plays a role in health, it is impossible to capture all extraneous variables that relate to women's well being. Five major outcome variables are included in this research that are represented in the diagram: incidence of disease, incidence of malnutrition, contraceptive usage, fertility rate, age at first childbirth (represented by circles shaded darker gray). Many other aspects of health are being left out due to the limited scope of this study.

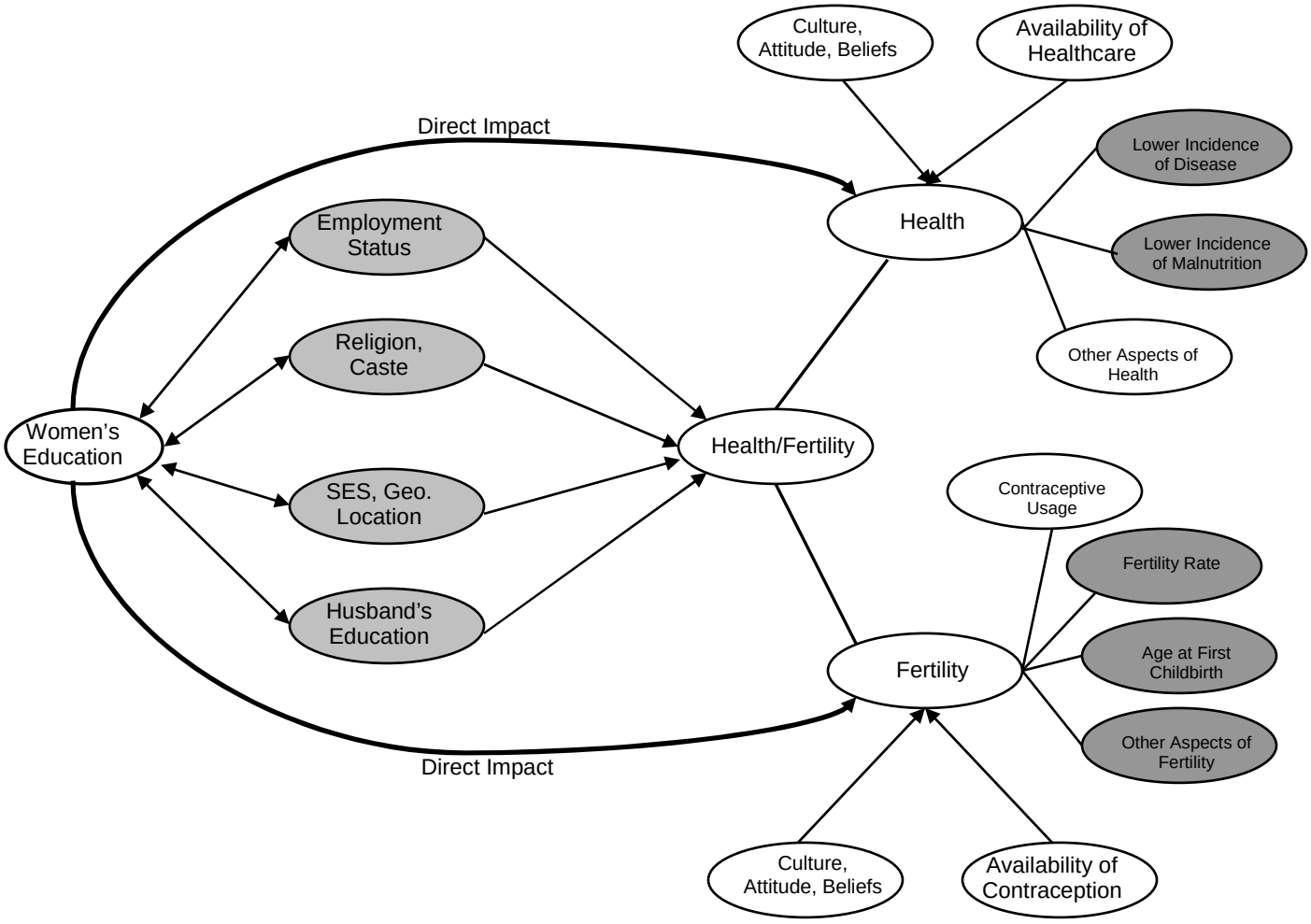

Figure 2: Association between women's education and her health and fertility indicators: *Linkages and Pathways*

Data and Methods

About 90,000 ever-married women[7] aged 15-49 were interviewed in the National Family Health Survey-2 (NFHS-2) of 1998-99 that is used in the analysis. The survey uses clustered sampling technique and covers all twenty-six[8] states in India. Within each state, a number of census

[7] This included women who were currently married and those who had ever been married in the past.
[8] At the time of survey, India had 26 states. Three states (Bihar, Madhya Pradesh and Uttar Pradesh) were divided in the year 2000.

enumeration areas ("primary sampling units"- PSUs) had been selected. In total, 3215 such areas were covered by the survey, each typically spanning a village, or part of town or city. On average, around 30 households in each area (referred to as NFHS cluster) were randomly selected for interview. To make the survey representative, weights specific to a small group of PSUs were assigned. The total number respondents in Bihar were 7024, 6813 in Rajasthan, and 4676 in Tamil Nadu.

Description of Key Variables

The study analyzes key variables which past literature identifies as determinants of woman's health status. The dependent variables can broadly be classified into two categories: fertility and health variables. Fertility outcomes include number of births, age of woman at the time of first birth, usage of family planning methods. General health is defined as: whether the woman suffered from malnutrition/anemia[9] or other morbid diseases like asthma, TB, malaria, jaundice.

Dependent Variables

Contraception: Ever-married women were asked about their usage of contraception methods. The variable was measured as 1: Never used contraception, 2: Used traditional methods 3: Used modern methods. Traditional contraception included calendar method whereas modern methods included condoms, oral pills, intra-uterine devices and sterilization. We created a dummy variable combining the groups of women who used traditional forms with those using modern forms. The reason for including all types of contraception is that traditional methods may also be very effective if used appropriately (Johnson-Hank, 2002).

[9] Since malnutrition leads to anemia, these terms are used interchangeably in the study.

Fertility Rate/ Number of Children: In the survey, women were asked about how many births they had ever had, including the number of children living and children who may have died. For this study, this variable is used as continuous.

Age at the time of first childbirth: Women's age at the time of their first birth is also an important determinant of their health. In all developing countries age at first pregnancy is negatively linked to maternal mortality (Bhatia, 1993) and therefore becomes an important health determinant. This dependent variable is used as continuous.

Disease prevalence: Women were asked whether they were currently suffering from the following diseases: jaundice, tuberculosis, malaria and asthma. The interviewers used common native language terms for the disease. For the analysis, we create a combined dummy variable where women who had suffered from at least one of these diseases are classified together vs. women who are not suffering from any of these ailments. There are two significant limitations of measuring the incidence of diseases through this survey: first, the reporting was by the women themselves and not confirmed by a physician's diagnosis. Second, it excluded women who might have suffered from the disease in the past and cured.

Malnutrition: Hemoglobin levels were tested for 6223 respondents in Bihar, 6069 in Rajasthan and 4591 in Tamil Nadu. Literature on women's malnutrition levels categorizes women with a blood hemoglobin level of less than 110g/l as moderately anemic and those with level less than 70g/l as severely anemic (Bentley and Griffiths, 2003). For the purpose of this study, we create a dummy variable where women having moderate to severe anemia (hemoglobin level less than 110g/l) are classified as anemic or malnourished and women with higher hemoglobin level

categorized as non-anemic. The hemoglobin level is an important determinant of woman's health since it indicates whether a woman is getting sufficient iron though proper nutrition.

However, hemoglobin testing was only conducted in areas where the interviewers were trained to draw and preserve the blood sample. This limitation could result in potential selection bias with women from higher socioeconomic regions constituting majority of the sample. It is therefore possible that the incidence of malnutrition/anemia was higher than that reported in the survey.

Primary Independent Variable: Women's Level of Education

The key independent variable is the education level of respondents. Education level is a continuous variable ranging from 0-22, with 0 representing no education at all, 1 representing school attendance for one year and so on. Since the mean education level in all three states is no more than primary schooling[10], we do not create categorical variables corresponding to school levels (e.g., primary, secondary, college etc.).

Control Variables

Socio-Economic Status (SES)

For our analysis, we create an index for SES. In absence of data on family income, we use the following measures to create the index:

1) Electricity in the household
2) Access to any kind of toilet facility
3) Radio in the household
4) Any private means of transportation in the household (bicycle/ motorcycle/car)
5) Telephone in the household

[10] For more details see section on descriptive statistics.

6) Television (only for Tamil Nadu)[11]

Each of the above measure is assigned a weight of 1. Therefore the total range of the SES index is from 0-6[12]. Further, we categorize SES into three dummy variables

- Low SES: Households in the SES index range of 0-1
- Mid SES: Households in the SES index range of 2-3
- High SES: Households in the SES index range of 4-6.

Low SES is taken as the reference category

Other background variables that are controlled for:

1) Husband's Education (continuous variable)
2) Employment status (Dummy variable with 1 representing women who were currently working or had worked in the past 12 months).
3) Place of residence: Urban/Rural (Dummy)
4) Religion: Separate dummy variables created for Hindu, Muslim and other religions, with Hindu as the reference category.
5) Caste: We create a dummy variable with women belonging to lower castes categorized as 0 and all other women categorized as 1. The category of lower castes includes the Scheduled Castes (categorized under the Indian Constitution as belonging to marginalized castes), Scheduled Tribes (categorized under the Indian Constitution as Adivasis, meaning aboriginals, who are not part of the caste system) and Other Backward Castes (intermediate castes but still quite low in the hierarchy of castes).
6) Age: A continuous variable.

[11] Since majority of households in Bihar and Rajasthan did not have electricity, television was not included as a socio economic variable for these states

[12] The range was 0-5 in the case of Bihar and Rajasthan since television was not included in the index.

Methodology

Logistic and Ordinary Least Square (OLS) regression are used to analyze the relationship between health outcomes and education. The following models are used:

For OLS

$(Y_{\text{(fertility rate, childbirth age)}} = F(\beta_0 + \beta_{pi}(ED)_{pi} + \beta q_i(SES)_{qi} + \beta_{ri}(HE)_{ri} + \beta_{si}(EMP)_{si} + \beta_{ti}(REL)_{ti} + \beta_{ui}(CAS)_{ui} + + \beta_{vi}(PR)_{vi} + \text{Error})$

The dependent variables for the OLS models are: number of children and age at the time of first birth. The independent and control variables are: Education (ED), socioeconomic status variables (SES), Husband's education (HE), employment status (EMP), caste (CAS), Religion (REL) and Place of Residence (PR).

For Logistic

For the four categorical outcome variables, logistic analysis is used:

$(Y_{\text{(contraceptive, disease, malnutrition)}} = F(\beta_0 + \beta_{pi}(ED)_{pi} + \beta q_i(SES)_{qi} + \beta_{ri}(HE)_{ri} + \beta_{si}(EMP)_{si} + \beta_{ti}(REL)_{ti} + \beta_{ui}(CAS)_{ui} + \beta_{wi}(PR)_{wi} + \text{Error})$

The dependent variables for the logistic models are contraceptive usage, prevalence of morbid diseases, and incidence of malnutrition.

Descriptive Statistics

This section provides detailed descriptive statistics for the three states of study.

Education

Table 1 provides information on means and standard deviations for the number of years of education for women in each of the three states. Average number of years of education for

women in Tamil Nadu is approximately five years whereas for Bihar and Rajasthan, the average years of education is less than two years.

Women's Education Level (in years)			
	Bihar	**Rajasthan**	**Tamil Nadu**
Mean	1.89	1.95	5.03
St. Deviation	3.70	3.77	4.56

Table 1: Women's Education level in single years in Bihar, Rajasthan and Tamil Nadu

Continuous Health Variables: Fertility levels and age at first childbirth

Table 2 and 3 provide information on women's fertility level and their average age at the time of first childbirth

Women's Fertility Rate			
	Bihar	**Rajasthan**	**Tamil Nadu**
Mean	3.28	3.32	2.37
St. Deviation	2.36	2.33	1.61

Table 2: Average number of children per woman in three states

Age (in years) at the time of first childbirth			
	Bihar	**Rajasthan**	**Tamil Nadu**
Mean	18.35	18.79	19.93
St. Deviation	3.07	2.33	3.62

Table 3: Average age at the time of first childbirth

For both Bihar and Rajasthan, the mean age at which the women have their first child is approximately a year and a half less then the mean age for women in Tamil Nadu (18.35,18.79

and 19.93 years respectively). Fertility rate for Bihar and Rajasthan is over three children per woman. Desired fertility rate for population stabilization is 2.1 and Tamil Nadu is much closer to that level.

Categorical Health Variables: Contraceptive Usage, Disease Prevalence, Malnourishment

For all the following health determinants, women in Tamil Nadu fare better than women in Bihar and Rajasthan. A higher percentage of women use contraception in Tamil Nadu as compared to the other two states. The incidence of diseases like jaundice, TB, malaria and asthma is much lower in Tamil Nadu. At the same time, women in Tamil Nadu are also much better nourished, which has a positive impact on their hemoglobin levels.

In Percentage	**Bihar**	**Rajasthan**	**Tamil Nadu**
Cont. Usage	27%	36.27%	56.92%
Disease Prevalence	8.89%	8.47%	2.89%
Malnourishment	54.43%	46%	18.66%

Table 4: Percentage of women in three states using contraception, suffering from morbid diseases and malnourishment

Control Variables

Socioeconomic Status			
In Percentage	**Bihar**	**Rajasthan**	**Tamil Nadu**
Low SES	63.97%	44.41%	23.49%
Mid SES	28.84%	41.60%	37.04%
High SES	7.19%	13.99%	39.37%

Table 5: Socio Economic Status in three states

The majority of households in Bihar fall in the low socioeconomic strata. The percentage is lower for Rajasthan and Tamil Nadu. It is important to note that the socioeconomic index is a relative index and the households falling in the high SES category are not comparable to households in more developed countries.

Husband's Education Level (in Years)			
	Bihar	**Rajasthan**	**Tamil Nadu**
Mean	5.32	5.87	6.70
St. Deviation	5.31	5.13	4.63

Table 6: Husband's education level in single years in three states

Husbands' mean education level was significantly higher in Tamil Nadu as compared to Bihar and Rajasthan.

Other Variables of Interest			
In Percentage	**Bihar**	**Rajasthan**	**Tamil Nadu**
Rural	90.22%	76.63%	54.81%
Hindu	83.61%	89.28%	87.81%
Muslim	14.86%	8.86%	6.44%
Upper Castes	19.22%	45.62%	2.69%
Women Employed	26.29%	45.07%	49.55%

Table 7: Other Variables of interest

The table above shows the percentage of women based on their place of residence, religion, caste and employment status. Interestingly, even though Tamil Nadu is the most developed of the three

states, majority of the households in Tamil Nadu belong to lower castes with a very small minority (less than 3 percent) in the upper castes.

Surveyed Women's Age (in Years)			
	Bihar	**Rajasthan**	**Tamil Nadu**
Mean	30.24	30.28	32.28
Standard deviation	8.99	8.73	8.57

Table 8: Women's average age in three states

The table above depicts, in years, the mean age (with standard deviation) of surveyed women in all three states of study.

(For detailed correlation tables for the data from the three states, refer to appendix.)

Regression Results

We ran three different models for each of the dependent variables to analyze their relationship with women's education level. The first set of models includes univariate regression that estimated the association between health determinants and education. The second set of models controlled for socioeconomic status. The third set of models controlled for all SES and background variables (place of residence, partner's education, religion, caste, employment status).

Dependent Variable: Contraception Usage

The following table (page 30) shows logistic regression models for the dependent variable 'contraceptive usage'. In the two poor states, Bihar and Rajasthan, education is positively associated with women's contraceptive usage at the 1 percent significance level even after socioeconomic status and other background variables are accounted for. However, trends in

Tamil Nadu are not the same. Education and contraception are not associated in models 2 and 3, indicating that education does not predict contraceptive usage in regions where the usage is high (In Tamil Nadu 57 percent of women use contraception whereas in Bihar and Rajasthan the percentage is 27 and 36 respectively). Both socioeconomic status and husband's education are strongly associated with family planning in all three states. Rural women are less likely to use contraception as compared to women in urban areas. Religion is a significant predictor of contraceptive usage in Bihar and Rajasthan. Muslim women are less likely to use contraception as compared to majority Hindu women. Also, women from upper castes are more likely to use contraception. Religion and caste, however, are not associated with family planning in Tamil Nadu. Both employment status and age have a positive link with contraception in all three states.

Bihar	Model 1	Model 2	Model 3
Education	1.115***	1.067***	1.048***
	(0.007)	(.008)	(.010)
Mid SES		1.725***	1.418***
		(0.108)	(.100)
High SES		2.858***	1.725***
		(0.317)	(0.221)
Husband's Education			1.056***
			(0.008)
Rural			0.736***
			(0.074)
Muslim			0.309***
			(0.034)
Other Religion			0.640*
			(0.159)
Caste			1.266***
			(0.103)
Employment Status			1.237***
			-0.089
Age			1.079***
			(0.004)
Pseudo R^2	0.031	0.045	0.143
N	7024	7024	7015

Rajasthan	Model 1	Model 2	Model 3
Education	1.107***	1.053***	1.048***
	(0.008)	(.008)	(.010)
Mid SES		1.758***	1.564***
		(0.096)	(.096)
High SES		2.982***	1.89***
		(0.276)	(0.207)
Husband's Education			1.052***
			(0.007)
Rural			0.824**
			(0.064)
Muslim			0.54***
			(0.056)
Other Religion			1.031
			(0.222)
Caste			1.337***
			(0.076)
Employment Status			1.201***
			-0.068
Age			1.089***
			(0.068)
Pseudo R^2	0.025	0.044	0.137
N	6809	6809	6805

Tamil Nadu	Model 1	Model 2	Model 3
Education	1.026***	0.989	1.01
	(0.007)	(.008)	(.009)
Mid SES		1.380***	1.339***
		(0.108)	(.109)
High SES		2.336***	1.743***
		(0.206)	(0.172)
Husband's Education			1.002
			(0.009)
Rural			0.680***
			(0.049)
Muslim			0.877
			(0.112)
Other Religion			0.929
			(0.128)
Caste			0.78
			(0.156)
Employment Status			1.018
			(0.07)
Age			1.055***
			(0.068)
Pseudo R^2	0.026	0.181	0.055
N	4675	4675	4663

Table 9: Logistic Regression results: Dependent Variable- Contraceptive Usage[13]

[13] ***p<0.01%, ** p<0.05%, *p<0.1%, standard error in parentheses

Dependent Variable: Number of Children

Women's education is also strongly associated with another fertility related variable- the number of children that a woman has borne (table on page 32). In all three states, a higher level of education is associated with women having less number of children. This association is significant at 1 percent level even after controlling for socioeconomic status and other background variables. Other variables that are significant predictors of fertility rates are husband's education (negative association), religion (Muslim women on an average have more children) and age (older women on an average have more children). Trends for caste are different for Tamil Nadu as compared to the other two states. In Bihar and Rajasthan, higher caste women, on an average have more children than lower caste women. In Tamil Nadu, however, it is the lower caste women who have more children.

Bihar	Model 1	Model 2	Model 3
Education	-0.116***	-0.127***	-0.042***
	(0.007)	(.009)	(.008)
Mid SES		-0.059	-0.163***
		(0.066)	(0.052)
High SES		0.354***	-0.510***
		(0.125)	(0.101)
Husband's Education			-0.010**
			(.005)
Rural			-0.056
			(0.077)
Muslim			0.612***
			(0.062)
Other Religion			-0.418**
			(0.171)
Caste			0.145**
			(0.059)
Employment Status			0.120**
			(0.050)
Age			0.171***
			(0.002)
R^2	0.032	0.033	0.457
Const	3.501	3.481	-1.73
	(0.031)	(0.035)	(0.111)
N	7024	7024	7015

Rajasthan	Model 1	Model 2	Model 3
Education	-0.145***	-0.159***	-0.062***
	(0.007)	(.009)	(.007)
Mid SES		-0.078	-0.201
		(0.060)	(0.469)
High SES		0.289***	0.363***
		(0.276)	(0.083)
Husband's Education			-0.025***
			(.005)
Rural			0.092
			(0.059)
Muslim			0.696***
			(0.076)
Other Religion			0.491***
			(0.153)
Caste			0.163***
			(0.044)
Employment Status			0.058
			(0.043)
Age			0.177***
			(0.002)
R^2	0.0549	0.056	0.494
Const	3.611	3.63	-1.65
	-0.031	(0.041)	-0.104
N	6809	6809	6805

Tamil Nadu	Model 1	Model 2	Model 3
Education	-0.104***	-0.116***	-0.051***
	(0.005)	(.006)	(.006)
Mid SES		0.092	0.120**
		(0.060)	(0.052)
High SES		0.282***	0.032
		(0.663)	(0.062)
Husband's Education			-0.025***
			(.006)
Rural			0.160***
			(0.045)
Muslim			0.421***
			(0.081)
Other Religion			0.143*
			(0.085)
Caste			-0.377***
			(0.123)
Employment Status			-0.139***
			(0.043)
Age			0.096***
			(0.002)
R^2	0.086	0.089	0.336
Const	2.894	2.811	-0.431
	(0.034)	(0.048)	(0.101)
N	4675	4675	4663

Table 10: OLS Regression Results- Dependent Variable: Number of Children

Dependent Variable: Age at the Time of First Childbirth

In all three states of study, a higher level of education is associated with women bearing their first child at an older age (table on page 34). The association is significant at the 1 percent level after accounting for economic status and other background variables. A one-year difference in education is positively associated with a 0.13-year delay in childbearing in Bihar, 0.18 year in Rajasthan and 0.25 year in Tamil Nadu. Like other fertility variables, husband's education is a strong predictor of childbearing age. In Tamil Nadu, being Muslim is associated with having a child at an earlier age. Belonging to upper caste is associated with childbirth delays in Tamil Nadu but not in Bihar and Rajasthan. In all three states, employed women, on an average have children at a younger age as compared to non-working women.

Bihar	Model 1	Model 2	Model 3
Education	0.162***	0.138***	0.130***
	(0.010)	(.012)	(.014)
Mid SES		0.052	-0.197**
		(0.091)	(0.094)
High SES		0.728	0.190
		(0.172)	(0.181)
Husband's Education			0.036***
			(.009)
Rural			-0.063
			(0.136)
Muslim			-0.093
			(0.112)
Other Religion			0.477
			(0.316)
Caste			0.038
			(0.106)
Employment Status			-0.283***
			(0.090)
Age			0.070***
			(0.004)
R^2	0.037	0.039	0.08
Const	18.062***	18.037***	15.885***
	(0.043)	(0.049)	(0.207)
N	6125	6125	6117

Rajasthan	Model 1	Model 2	Model 3
Education	0.182***	0.188***	0.184***
	(0.010)	(.012)	(.013)
Mid SES		-0.308***	-0.469***
		(0.084)	(0.087)
High SES		-0.136	-0.621***
		(0.140)	(0.153)
Husband's Education			0.040***
			(.009)
Rural			0.003
			(0.109)
Muslim			-0.166
			(0.140)
Other Religion			0.708**
			(0.281)
Caste			-0.072
			(0.081)
Employment Status			-0.164**
			(0.080)
Age			0.079***
			(0.004)
R^2	0.048	0.05	0.096
Const	18.455***	18.59***	16.126***
	(0.043)	(0.057)	(0.199)
N	6031	6031	6028

Tamil Nadu	Model 1	Model 2	Model 3
Education	0.300***	0.283***	0.248***
	(0.011)	(.013)	(.016)
Mid SES		0.118	0.013
		(0.139)	(0.139)
High SES		0.373**	-0.090
		(0.152)	(0.166)
Husband's Education			0.061***
			(.015)
Rural			-'0.300**
			(0.121)
Muslim			-0.416*
			(0.216)
Other Religion			1.055***
			(0.226)
Caste			1.252***
			(0.339)
Employment Status			-0.056**
			(0.114)
Age			0.053***
			(0.006)
R^2	0.139	0.14	0.171
Const	18.467***	18.357***	16.716***
	(0.077)	(0.111)	(0.276)
N	4185	4185	4174

Table 11: OLS Regression Results- Dependent Variable: Age at first childbirth

Dependent Variable: Disease Prevalence

Bihar	Model 1	Model 2	Model 3
Education	0.937***	0.960**	0.979*
	(0.013)	(.015)	(.018)
Mid SES		0.699***	0.721***
		(0.076)	(.083)
High SES		0.595	0.545**
		(0.143)	(0.142)
Husband's Education			0.985
			(0.011)
Rural			0.926
			(0.160)
Muslim			1.202
			(0.152)
Other Religion			2.034***
			(0.556)
Caste			0.966
			(0.128)
Employment Status			1.348***
			(0.132)
Age			1.030***
			(0.005)
Pseudo R^2	0.006	0.009	0.026
N	7024	7024	7024

Rajasthan	Model 1	Model 2	Model 3
Education	0.937***	0.936***	0.956**
	(0.013)	(.015)	(.017)
Mid SES		0.866	0.837*
		(0.096)	(.084)
High SES		1.017	0.888
		(0.167)	(0.165)
Husband's Education			0.996
			(0.011)
Rural			1.004**
			(0.132)
Muslim			1.151
			(0.184)
Other Religion			1.004
			(0.359)
Caste			0.894
			(0.086)
Employment Status			0.938
			(0.086)
Age			1.035***
			(0.005)
Pseudo R^2	0.006	0.007	0.019
N	6809	6809	6805

Tamil Nadu	Model 1	Model 2	Model 3
Education	0.948***	0.971	0.986
	(0.019)	(.023)	(.028)
Mid SES		0.731	0.686*
		(0.154)	(.148)
High SES		0.565**	0.429***
		(0.143)	(0.122)
Husband's Education			0.995
			(0.026)
Rural			0.783
			(0.164)
Muslim			1.136
			(0.410)
Other Religion			1.153
			(0.439)
Caste			1.039
			(0.636)
Employment Status			0.887
			(0.175)
Age			1.044***
			(0.011)
Pseudo R^2	0.006	0.006	0.026
N	4675	4675	4663

Table 12: Logistic Regression Results- Dependent Variable: Disease Prevalence

Women's education is significantly associated with their likelihood of suffering from morbid diseases in Rajasthan and Bihar (refer to table on page 35). After controlling for background variables, the association disappears for Tamil Nadu. Most extraneous variables are insignificant predictors of disease prevalence. The R^2 is less than 3 percent for all three states. In Rajasthan, all variables combined predict 1.9 percent variation in disease prevalence. For Bihar and Tamil Nadu, it is 2.6 percent. Interestingly, in Bihar working women are more likely to suffer from diseases as compared to non-working women.

Dependent Variable- Malnourishment

Bihar	Model 1	Model 2	Model 3
Education	0.941***	0.957***	0.981
	(0.007)	(.008)	(.009)
Mid SES		0.811***	0.891*
		(0.048)	(.055)
High SES		0.659***	0.755**
		(0.079)	(0.098)
Husband's Education			0.972***
			(0.006)
Rural			0.979
			(0.093)
Muslim			0.918
			(0.069)
Other Religion			2.717***
			(0.553)
Caste			0.981
			(0.072)
Employment Status			1.011
			(0.060)
Age			0.972***
			(0.006)
Pseudo R^2	0.008	0.01	0.016
N	7024	7024	7015

Rajasthan	Model 1	Model 2	Model 3
Education	0.983**	0.997	0.994
	(0.007)	(.009)	(.010)
Mid SES		0.828***	0.844***
		(0.050)	(.053)
High SES		0.74***	0.814**
		(0.076)	(0.092)
Husband's Education			1.002
			(0.007)
Rural			1.036**
			(0.084)
Muslim			1.092
			(0.112)
Other Religion			1.204
			(0.250)
Caste			0.890*
			(0.053)
Employment Status			0.997
			(0.057)
Age			0.982***
			(0.003)
Pseudo R^2	0.0007	0.0024	0.007
N	6809	6809	6809

Tamil Nadu	Model 1	Model 2	Model 3
Education	0.969***	0.991	0.989
	(0.007)	(.008)	(.010)
Mid SES		0.821**	0.823**
		(0.066)	(.067)
High SES		0.585***	0.608***
		(0.053)	(0.609)
Husband's Education			0.989
			(0.009)
Rural			1.098
			(0.081)
Muslim			1.343**
			(0.171)
Other Religion			1.088
			(0.152)
Caste			1.271
			(0.258)
Employment Status			0.877*
			(0.061)
Age			0.990***
			(0.004)
Pseudo R^2	0.003	0.01	0.013
N	4675	4675	4663

Table 13: Logistic Regression Results- Dependent Variable: Malnutrition

In all three states, education is associated with undernourishment and malnutrition in the univariate models. Once all SES and background variables are taken into account, women's education is not linked with malnutrition incidence. Most variables are insignificant predictors of malnutrition with R^2 being very low for all three states (1.6 percent for Bihar, 0.7 percent for Rajasthan and 1.3percent for Tamil Nadu). Age is significant at 1 percent in all three states with older women less likely to suffer from malnourishment.

Discussion

Main Effects

The univariate regression results show that women's education is strongly linked with their fertility and health indices. In the underdeveloped states of Bihar and Rajasthan as well as the developed state of Tamil Nadu, educated women are more likely to use contraception, have fewer children and delay their first childbirth. Women with better education are less likely to suffer from morbid diseases (tuberculosis, jaundice, malaria, asthma) or malnourishment. The findings are consistent with existing assumptions on health, education and fertility that education is correlated positively with women's health status and negatively with fertility levels.

However, once we consider the pathways through which the relationship might operate, the links are much less clear. Both fertility and health are impacted by husband's level of education, poverty, religion and a woman's independence within the family to make her own decisions. Overall, for the states of Bihar and Rajasthan, our results build a consistent picture of the education-fertility linkages. In both states, women's education is significantly associated with lower fertility, higher contraceptive usage and delays in childbirth and the significance is consistent across models. The effect is upheld even when we allow for other factors such as

husband's education, poverty, urbanization, caste, religion and employment status. This continued significance of women's education for Bihar and Rajasthan challenges the previous research, which finds that low fertility and education are jointly driven by some common third factor such as socioeconomic status and that the observed correlation is in that sense spurious. However, for Tamil Nadu, we find that education is not associated with contraceptive usage, indicating that non-educated women in Tamil Nadu are using contraception as much as the educated women when we take into account SES and background. Another study by McNay et al. (2003) on fertility determinants in India proposes the phenomenon of 'knowledge diffusion', which may be operating in Tamil Nadu. Since the overall use of contraception in Tamil Nadu is much higher than Bihar and Rajasthan, the environment of contraceptive usage in the state may impact women's behavior. In other words, where contraception is widespread, other individuals, irrespective of their own circumstances are more likely to adopt the same behavior. Mass media exposure also plays a positive role in contraceptive usage, and the population in Tamil Nadu has better access to mass media due to generally higher development in the state. Communication among women and diffusion of knowledge about family planning methods may play a part in enhancing contraceptive coverage among the uneducated female population in Tamil Nadu.

At the same time, higher contraceptive usage among the uneducated in Tamil Nadu has not resulted in lower fertility or delays in childbirth. The uneducated women in Tamil Nadu continue to have more children and have them at an earlier age as compared to the educated women. Close analysis indicates that these findings are not entirely conflicting. Contraceptive usage, as measured in the NFHS merely indicates whether a woman ever used contraception. Though this is a better indication of attitude towards contraception than mere knowledge, it still does not

necessarily indicate effective or continued usage. For family planning methods like condoms, oral contraceptive pills or intra-uterine devices, the understanding of proper usage cannot be overemphasized. If enhanced contraceptive usage among the uneducated is not resulting in lower birth rates, it is important that policies are directed to spread better awareness on more effective use of these family planning techniques.

Regional variations are also found in the education-disease incidence association. For Bihar and Rajasthan, multivariate analysis shows that even after taking into account extraneous variables, disease incidence is negatively associated with women's education. This association disappears in the case of Tamil Nadu. For both Bihar and Rajasthan, however, the odds ratios became less significant in the multivariate model indicating that other extraneous variables also impact disease prevalence among women.

In Bihar and Rajasthan, where women have limited physical and social access to healthcare, education potentially helps these women gain tools and knowledge necessary to overcome these obstacles to reduce the prevalence of morbid diseases. Literacy tools may help a woman venture outside the house and use healthcare services independent of a host of other factors (eg limited availability of healthcare services). Diseases like tuberculosis, jaundice, malaria and asthma are impacted by the health behavior of the individual and the family. Prevalence of such diseases can be drastically reduced if cleanliness and infection avoidance practices are adopted. Education can also be a marker for such healthy practices. It can protect against diseases by influencing lifestyle behavior. Education can also facilitate the acquisition of positive social and psychological skills.

On the other hand, in Tamil Nadu, education is not a significant predictor of disease prevalence. It is noteworthy that disease prevalence among women in Tamil Nadu to be less than 3 percent, a

level much lower than that of both Bihar and Rajasthan (both around 9 percent). The diffusion of knowledge phenomenon that potentially explains higher contraceptive use among the uneducated women in Tamil Nadu could also explain why the education-disease prevalence link is weak in the state. The uneducated women imbibe community norms of healthy behavior as much as the educated women. Another factor responsible for this link could be the effective public healthcare system and promotion of health education in the state. The state government in Tamil Nadu has been a pioneer in spearheading promotion of health care messages along with the micro credit programs in the state (Sankaraswaminathan, 2002). The public sector has a dominant presence in healthcare within the state and owns 78 percent of the hospitals (Bhat, 1991). The non-government sector has also been a frontrunner in interventions for TB and malaria. By contrast, Bihar and Rajasthan are more dependent on private sector providers. Private healthcare in both states, especially in Bihar, is not adequately regulated, leading to sub-standard services. It is therefore possible that the more effective public health care system in Tamil Nadu plays a role in the low disease prevalence among the less- educated women in Tamil Nadu.

Women's nutritional status is not associated with their education level in any of the three states studied; education-nutrition linkages disappear after including the socioeconomic status variables. Respondents living in poor households are more likely to be malnourished than those from households of higher economic status. In this context, the challenge of malnourishment is the lack of access to sufficient nutritious food. It seems that women’s education may not be able to address the issue of poor nutritional status.

Other Effects

Husband's Education: The association between husband's education and fertility-related indicators is found to be pervasive for all outcomes where women's own education is significant. Therefore, husband's education is not a significant predictor of contraceptive use and disease prevalence (in Tamil Nadu) and nutritional status (for all three states).

Urbanization*:* Urbanization impacts contraceptive usage in all three states. Urban women are more likely to use family planning methods possibly due to better availability of contraception in urban areas. Other potential factor could be a culture of acceptance in urban areas for contraceptive usage. Also, the urban poor live in more cramped conditions that could influence their desire for smaller families.

Muslim*:* Being Muslim is found to be significant for contraceptive usage and the number of childbirths. Muslim women are less likely to use contraception and on an average have more number of children as compared with the majority Hindu women. Muslim families are characterized by less autonomy and greater pronatalism (Morgan, Stash, Smith & Mason, 2002). Religious perceptions against contraceptive usage among Muslims could also explain why fertility among Muslim women is much higher.

Employment Status: As expected, working women are more likely to use contraception and have fewer children. However, employed women are also more likely to bear their first child at a younger age. In Bihar, they are more likely to suffer from morbid diseases. It is unclear why we do not see consistent trends for women's employment. A potential explanation is that in many regions, employment status could be an indicator of family's poverty and therefore not a good

proxy for women's autonomy. Further research is required to investigate these associations in detail.

Age: Age is significant for all outcome variables. Younger women are less likely to use contraception and have fewer children. This outcome, however, may mean nothing more than younger women having a desire to have more children in the future, after which they would start using contraception. Nevertheless, younger women do have delayed childbirth in all three states, which indicates a gradual cultural shift with women of latter generations preferring to have children at an older age. Younger women are more likely to suffer from malnutrition. Women typically require more nutrition during childbearing age and during pregnancy. This explains why younger women, who are more likely to be in the childbearing age, are undernourished. At the same time, older women are more likely to suffer from diseases possibly due to lessened immunity.

Policy Implications and Areas of Further Research

A few findings in this research have been especially striking. First, we find that relationship between women's education and health/fertility related variables show different patterns in different regions. Second, different health and fertility outcomes have different associations with education levels.

In Tamil Nadu, contraceptive use has a weak link with women's education. At the same time, we also note that the relationship between disease incidence and the education of women is non-significant in the more developed state. Several factors could be potentially responsible for this phenomenon. First, as we discussed in the earlier section, when a majority of women start using contraception, there is a cultural shift towards an acceptance of family planning methods and

healthy behavior. The uneducated women might begin to act in a similar fashion as their educated counterparts. Another potential hypothesis is that the educated women, even if they live in poorer regions like Bihar and Rajasthan, may invest more time and effort in gaining access to contraception and healthcare in comparison to their less educated counterparts. They may adopt healthy behavior despite obstacles like lack of proper water and sanitation facilities. The less educated, in contrast, may not do so, due to lack of exposure to the outside world and their inability to gather information. On the other hand, if states have effective healthcare systems, the non-educated women may become more likely to use contraception and adopt healthier practices. It is possible that the exposure to mass media (which is only possible in regions that are developed) influences the behavior of uneducated women. Further research is required to investigate more about these potential explanations. The lack of association in a developed region also raises questions on whether education should be considered a vital pathway to better health status at all. If effective healthcare services are made available to the women, will that not have more of an impact on health and fertility? At the same time, this finding also might indicate that health education messages can play a significant role in improving women's health.

Another finding that requires policy attention is that although women's education is not associated with contraceptive usage in Tamil Nadu, it is linked to their fertility level and childbearing age. Uneducated women are as likely to use contraception as the educated women but on an average have more children and bear children at a significantly younger age in comparison to the more educated women. Contraception usage indicates a positive attitude and belief change among the non-educated. However, in Tamil Nadu, this behavior change has not resulted in lower fertility for this group of women, perhaps indicating that the contraceptives are

not being used very effectively. When behavior change has already been achieved, health education and health messages can play a huge role in providing information on the correct use of contraception. Further investments in this area might result in lowering fertility among the non-educated women in Tamil Nadu.

Previous research on the education-health and education-fertility link assumes both health and fertility to be one generalized outcome. Our research shows that different indicators of health and fertility do not have the same relationship with education. In our multivariate models, we found that nutritional status is not associated with education in any of the three states, though disease prevalence is associated with educational status in Bihar and Rajasthan. Also, patterns of contraceptive usage are not the same as that of fertility rate and childbirth age in some regions. Therefore, the very generalized health-education association can be divided into multiple outcomes since health is a multifaceted variable. Distinct aspects of health are not linked to education in a similar fashion.

Disturbingly, few factors are associated with women's nutrition apart from their socioeconomic status, indicating a need for continued commitment from the Indian Government to ensure food security for the poor. Distribution of supplement tablets should also be prioritized through public and voluntary sector interventions. Anemia among women is associated with higher maternal mortality, lower immunity, as well as with fatigue and depression. Considering the high incidence of malnutrition among women in India, especially in the states of Bihar and Rajasthan and its high association with SES (an explanatory variable that is least impacted by policy interventions), it is important that programs are aimed to address the challenge.

Another significant finding is that in models where women's education is significant, husband's education is also found to be an important predictor of women's health. The models where husband's education is non-significant are contraceptive usage and disease prevalence in Tamil Nadu and women's nutrition in all three states. This finding reiterates the role of men in women's well being. Women's education programs will yield better influence on the welfare of the family if men are included as a target group.

Our study suffers from two major limitations. First, our results suggest a need for explicitly measuring community content and incorporating it in studies of women's health. There is considerable variation in the education-health relationship across regions, but given the paucity of information on community level demographics across states, this information is not included. Our findings highlight the importance of directing attention to community characteristics like primary healthcare facilities, the number of physicians and nurses in the community, the nature of water and sanitation facilities in order to develop effective policies on women's health and private returns to education. Second, the data used in the study was collected in the year 1998-99 making many of the figures dated. Data from subsequent NFHS (third round collected in 2003-04) are not available for public use. Recent surveys[14] indicate that many Indian states have made significant strides in both education and health. Nevertheless, the regional variations still persist with Bihar and Rajasthan occupying the lowest position in Human Development Indicators in the country. Tamil Nadu continues to be one of the better performing states. Therefore, there is reason to believe that the associations have not changed even though the actual numbers may be different.

[14] These surveys do not collect comprehensive information on women's health and therefore could not be used for this study.

Final Comments

Overall, we have shown that women's education does correlate with fertility and health but for some of the variables, the relationship is considerably altered once socioeconomic and background variables are accounted for. Relationships are much more robust in underdeveloped states as compared with the developed regions. The most significant point being made in this study is that there is little empirical justification for sweeping bold assertions that education has a strong causal relationship with health status. Investments in women's education are desirable on grounds other than health improvements. Evaluation of education-health link is important so that unrealistic expectations are not set whereby education is expected to play a huge role in certain aspects of health. At the same time, healthcare development may play a more decisive role in women's health than their education. The issue is particularly vital in the current climate of privatization in which public investments in healthcare delivery systems, fixed subsidies, water supply and sanitation are declining and focus on public healthcare systems is replaced by focus on selective healthcare (Pebley, 1993; World Bank, 1993).

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Appendix

Determinants of SES Index

	Bihar	Rajasthan	Tamil Nadu
Electricity	17.91%	65.67%	82.57%
Radio	32.32%	56.30%	54.51%
Telephone	1.85%	7.09%	10.73%
Toilet facility	17.14%	26.98%	43.56%
Transportation	50.80%	50.07%	57.57%
Television	14.66%	31.67%	46.98%

Correlations

Bihar: Association between education and primary outcome variables[15]

Education	Education	Cont	No.C'n	Age- childb	Disease	Malnourishment
Cont	0.198***	1.000				
No. C'n	-0.180***	0.189***	1.000			
Age-Childb	0.193***	-.023**	-0.214***	1.000		
Disease	-0.054***	0.01	0.070***	-0.020	1.000	
Malnourishment	-0.101***	-.078***	-0.005	-0.028**	0.027**	1.000

[15] ***p<0.01, **p<0.05, * p<0.1

Rajasthan: Association between education and primary outcome variables

	Education	**Cont**	**No.C'n**	**Age- childb**	**Disease**	**Malnourishment**
Cont	0.184***	1.000				
No. Children	-0.234***	0.221***	1.000			
Age-Childb	0.220***	-.036***	-0.183***	1.000		
Disease	-0.056***	0.031**	0.077***	0.000	1.000	
Malnourishment	-0.027***	-0.10***	-0.032***	0.027**	0.017	1.000

Tamil Nadu: Association between education and primary outcome variables

Education	**Education**	**Cont**	**No.C'n**	**Age- childb**	**Disease**	**Malnourishment**
Cont.	0.059***	1.000				
No. Children	-0.293***	0.324***	1.000			
Age-Childb	0.373***	-.056***	-0.354***	1.000		
Disease	-0.038***	0.024	0.027**	0.000	1.000	
Malnourishment	-0.068***	-.082***	-0.012	0.027**	0.007	1.000