Effects of Female Literacy in Villages in Rural Rajasthan

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I. Introduction.

The importance of education to economic development has long been recognized [1] The education of women is viewed as a particularly important instrument to promote both development of macro-economies and welfare of individuals and families[2]. Moreover, there is evidence that literacy is a public good within families, with an illiterate adult family member earning more when living within a family with literate members.[3] The process by which female literacy affects the well being of individual women and their families is, however, still not fully understood. Does literacy change women's tastes with respect to how resources are allocated within families? Does it give them more power in the decision making within families and shift the family utility function from one which merely reflects the tastes of the male head of household (a unitary function) to one that reflects cooperation or bargaining? [4] Since there may also be assortive mating in that men who marry literate women in traditional societies have more progressive views about gender roles than does the average male, female literacy may be associated with a different family utility function even when the male head is the dominant or sole decision maker.[5]

[1]See for instance, Behrman and Wolfe (1984), Behrman and Birdsall (1987), and) Dreze and Sen (1989).

[2]Rosenzweig and Wolpin 1994) and Rosenzweig (2000).

[3]Basu, K., et al., (2001).

[4]The unitary model is usually attributed to Becker (1981). Representative work on cooperative or bargaining models is that of Manser and Brown (1980) and Horney and McElroy (1981).

[5]This was tested by A. M. Basu by looking at the education of daughters in families into which literate women marry. (Basu, 2002).

There is, however, a broad consensus that literacy rates of children, particularly female children, are positively affected by the education level of the mother.[6] Child health has also been widely found to be positively associated with mother's education level,[7] and infant and child mortality negatively associated with it.[8] The relationship between female literacy and fertility is more complex, even though usually found to be negatively correlated. [9] The econometric analysis of fertility is complicated by the fact that family size and infant and child mortality are interdependent.[10] For developed nations, fertility is usually modeled as in part a trade-off between quantity and quality of children.[11] The same phenomenon is thought to apply in developing nations, once educational opportunities and availability of consumer goods begin to increase.[12]

This study examines the effects of literacy on women's own health, knowledge about health, fertility, infant mortality, and the health, literacy and marital status of adolescent daughters. A new data source is used to study female literacy in a group of traditional rural Indian villages. In 2004, personal interviews and medical examinations were conducted on approximately 1000 adult women (over 18 years of age) and 1000 adolescent girls (10 to 18 years of age) in nine villages near Jodhpur,

[6]Behrman and Rosensweig (2002), Wolfe and Behrman (1987).

[7]Sandiford, et al. (1995); Glewwe (1999).

[8]Bourne and Walker (1991), Cochrane (1979), Cleland and van Ginneken (1988), Aly and Grabowski (1990), Singh (1994).

[9]A.M. Basu (2002); Bhat, (2002). However, the relationship between desired family size and the actual number of surviving children may change in the course of economic development as infant and child mortality decline and as methods of fertility control become more available. There may be periods in which education of women and fertility are seen to be positively correlated, if mortality rates for children of literate women decline faster than desired family size.

[10]Mellington and Cameron (1999); Borooah (2003).

[11]Becker (1960).

[12]See, for instance, Basu (2002) op. cit.;Wolfe and Behrman (1986).

in the western part of the state of Rajasthan. [13] A natural experiment is provided by the intervention of an NGO, the Veerni Project, which provides rudimentary medical care, health education, and schooling for girls (classes in literacy and numeracy) in a subset of the villages in this region. The nine sample villages consist of three that experienced long-term (10 year) intervention from the Veerni Project, three that received help from the Veerni Project for 2 years, and three that had not been included in the Veerni Project at the time of the survey. The samples of women and girls were constructed with the number of respondents from each village randomly chosen so as to sample the same proportion of the populations in each of the villages.[14]

Since only a tiny fraction of the women and girls in this study group of rural villages have had more than primary education, and many have become literate at least partly through attending the classes provided by the NGO, we decided to use literate/illiterate as the measure of women's and adolescent girls' education levels throughout this paper.

A Profile of Adult Female Literacy in the Study Villages,

Only about 15 percent of the sample of 951 adult women are literate, and even fewer have completed primary level schooling. Literacy rates are particularly low for lower caste women. For instance, in 1991 the literacy rate for scheduled caste women in rural Rajasthan was only 4.73 percent, the lowest rate in any Indian state.[15] In our sample, the proportion of literate scheduled caste women was only about 0.7 percent; the proportion of scheduled tribal women was only 0.8 percent. The proportion of literate women in combined Castes 1 through 3 was only 6.5 percent.Since literacy rates are expected to vary among villages as well as by caste and religion, dummy variables for

[13] The survey was designed by Shirley Johnson-Lans, Vassar College, and overseen by Dr. Kanti Chandra Joshi, Veerni Project Coordinator, and Mr. Chandra Shekhar Joshi, Jodhpur University.

[14] This is a stratified sample of villages within the region.

[15] Table 2, page 40, Narayanamoorthy and Kamble (2003).

village effects are introduced, and a variable for each lower caste is included: caste 1 = "scheduled castes", caste 2 = "scheduled tribes", and caste 3 = "other backward castes" (OBC).[16] A dummy variable for "Muslim religion" distinguishes Muslim women who are in this part of the world a minority and generally disadvantaged.[17]

A probit was run to investigate the effects of personal characteristics (age, caste, and religion) and environmental (village) effects on the likelihood of a woman being literate. The equation is of form

$$p(i) = \beta(1) + \beta(2)x(i2) + \ldots + \beta(k)x(ik) + u(I) .$$

Results of this probit are shown in Table 1a. Lower caste and Muslim women were less likely to be literate when compared with higher caste Hindu women. Living in three of the villages was also associated with significantly lower literacy rates. Not surprisingly, the probability of being literate was also found to decline with age, with the marginal effect of an additional year = -0.73 percent. Variables for caste and religion are included in all estimating equations throughout this study.

Arranged marriages for young girls are common, although illegal, in India. Many girls are "effectively married" by early adolescence. Effective marriage means that a woman has been through a marriage ceremony and lives with her husband. In our sample of adolescent girls, 32.8 percent are effectively married. It is widely believed that age of marriage has an effect on female literacy and that literacy may also affect age of marriage.[18] Even though there were concerns about endogeneity between marital status, age of marriage and literacy, we estimated probit equations for probability of adult female literacy in which marital status and age of marriage were also included as

[16] The category, scheduled castes, or dalit, is roughly equivalent to the term, no longer used, "untouchable".

[17] Only one woman in the sample did not list herself as either Hindu or Muslim. The category "other" was therefore omitted from this study.

[18] Khan (1985); Field (2005).

explanatory variables. Being married was found to reduce the probability of a woman being literate by 21-24 percent. Later marriage increased it by 0.7 percent per year of delayed marriage. [See Tables 1b and 1c.]

II. Effects of Adult Female Literacy on Health.

The Health Conditions in the Study Villages.

Life in Rajasthani farming villages in the Thar desert is spartan, with income and nutrition dependant on rainfall, since no pipelines exist to bring water from less arid areas. There is little government investment in infra-structure that will reduce poverty or improve health. Only rudimentary NGO-sponsored health care facilities are available within any of the villages.[19] Malnutrition, particularly iron deficiency, is very common in women and adolescent girls.

The following table, summarizes the prevalence of anemia among the women and girls in our sample, using the Indian hemoglobin standard for anemia: <12 - 10 = mildly anemic, <10 - 7 = moderately anemic, and <7 = severely anemic.

Level of Anemia in Study Villages

Percentages of	Adolescent Girls	Adult Women
Total Anemic	76.3%	81.9%
Mildly Anemic	68.4%	59.2%
Moderately Anemic	6.7%	20.1%
Severely Anemic	1.3%	2.6%

In this environment, a higher rate of adult female literacy may by itself have little immediate effect on health. It may, however, affect future generations. Our null hypotheses are that female literacy does not significantly affect own-health status, infant and child mortality, or health status of

[19]The Veerni Project represents intervention on a very small-scale level. It provides health education classes for women and girls, training for local health workers, and a weekly visit from a mobile medical unit equipped with simple supplies such as iron pills, antiseptics, bandages, and one physician.

adolescent daughters.

A. Effects of Female Literacy on Own-Health.

Our estimating equations use several measures of health as dependent variables. A probit was estimated for the probability of a woman showing symptoms of anemia. OLS regressions were estimated for determinants of two measures of health: haematocrit level and body mass index (BMI). Our regression equations are of general form

$$Y(i) = a + \beta_1 X_1(i) + \ldots\ldots\ldots\ldots\ldots \beta_k X_k(i) + \mu(i)$$

The estimating equations encompass both supply and demand-side factors, and hence are reduced form equations. Demand-side explanatory variables include a vector of socio-economic variables (caste, religion, family monthly income in rupees[20], and whether the home has electricity[21]) and a vector of personal characteristics (woman's age, marital status, number of children she has borne, and whether she is literate). The vector of environmental variables (village dummy variables and NGO effects) are the supply-side factors. Equations are estimated using alternatively village and NGO dummy variables.,

The null hypothesis that her literacy had no effect on the health status of a woman could not be rejected when health was measured by BMI or haematocrit level. However, when a probit was run with dependent variable "exhibits anemia symptoms," and village fixed effects were included, being literate was associated with a reduction in the probability that the woman would exhibit anemia symptoms of approximately 12.4 percent. [Table 2a] Economic status did not appear to

[20]Throughout this study, family income is measured by income of head of household. This was a reasonably good approximation for total family monetary income, in the past since women were generally not employed outside the family home and fields.t. As a result of the Veerni Project, this may soon no longer be true. Women in the villages are being given sewing machines and lessons in fashion and are now producing articles to sell in the cities. These textile products are becoming a major "cash crop" of the villages.

It should also be noted that since income does not include imputed values for home-produced, home-consumed food and other products, here as in other rural village economies throughout the world, monetary income is a very imperfect measure of the family's standard of living.

[21]Having electricity in the home is used as a proxy variable for family wealth.

affect this aspect of an adult woman's health nor did her age or the number of children she had borne. However, several villages had significantly lower rates of adult female anemia symptoms, and belonging to a scheduled tribe (Caste 2) was associated with an increase of 20 percent in risk of anemia.

When NGO effects were substituted for village fixed effects, literacy status became less significant (0.072) and the magnitude of its effect as reduced.. [See Table 2b.] This suggests that the effect of the Veerni Project's medical intervention overcame some of the negative effects of illiteracy on the health of village women.

It is well known that in rural India women and girls often receive less food and other goods than do men and boys.[22] Since we control for income and wealth, our findings are at least consistent with the notion that a woman's literacy may be associated with a different intra-family allocation of goods, and that literacy may help to overcome women's inferior status in the family.

An alternative hypothesis, well substantiated in studies of high-income industrialized nations, is that education makes people more efficient in the production of health.[23] The observed relationship between literacy and fewer anemia symptoms may also be a reflection of this, since we do not know that other family members are not also healthier when adult women are literate.

Another indication that this may be true is provided by an examination of the relationship between literacy and knowledge about health. Both adult women and adolescent girls were asked a number of questions about their knowledge of diseases. A variable "knowledge of how HIV is transmitted" is used in this study as a measure of knowledge about health. A probit was run for "probability of a woman knowing how HIV is transmitted.". We included the same set of personal, environmental and family characteristics as explanatory variables plus a dummy variable for "has a radio or TV", since the media may be an important source of information about HIV. Being

[22]Pitt et al. (1990).

[23]Grossman (1972) and Kenkel (1991).

literate was found to be associated with a 28 percent increase in the probability of an adult woman knowing how HIV is transmitted. And having a radio or TV raised it by about 19 percent. [Table 3] This finding is consistent with the hypothesis that literacy promotes efficiency in the production of health, in that it increases ability to absorb information about the transmission and prevention of disease.

B. Effect of Women's Literacy on Fertility.

Observed fertility can be decomposed into intentional fertility and unintentional fertility. Educating women may result in reduced intentional fertility and/or better control over fertility level. The latter will reduce unintentional fertility. If education reduces child and infant mortality, it may well reduce intentional fertility even if it does not affect the demand for children. However, given the lack of observed effects of mother's literacy on infant and child mortality rates in these villages [See C (1) below] we would only expect to see female literacy associated with lower fertility if it reduces the demand for children or leads to better control over fertility. Educating women is likely to reduce the demand for number of children, since literate mothers are likely to want more education (quality) for each child and thus make the well-known quantity/quality trade off. Being literate is also likely to be associated with having more knowledge about controlling fertility. It was therefore not surprising to find a negative correlation coefficient between female literacy and number of children born.

In order to refine our understanding of the relationship between literacy and family size, regressions were run with "number of children born" and "number of living children" as the dependent variables. In addition to the usual set of environmental and socio-economic variables, both age of mother and her age at marriage were included as explanatory variables. Female literacy was found to be highly significant in this set of regressions. It was associated with a reduction of 0.85 children ever born and a reduction of 0.78 living children per woman, when village fixed effects

were included. [Tables 4a and 5a] Being literate was associated with reductions of 0.68 children born and 0.64 living children per woman when NGO effects were substituted for village effects. [Tables 4b and 5b] Economic status did not appear to be significant, unlike the usual findings for high-income western nations.[24] Our findings lend support to the hypotheses that intentional fertility decreases with education of women and that education improves control over fertility. The expected reduction in fertility (family size) associated with increases in female literacy rates should have at least a modest effect on infant and child mortality, given the findings reported in Section C (1) below.

C. Effect of Female Literacy on Health of Children.

(1) Infant Mortality

Frequently used measures of child health are infant and child mortality rates. Research studies conducted in many countries have shown that female literacy reduces infant mortality, and this has been especially true for studies of India.[25] Since Indian culture has a strong son preference, we examine separately the statistics on female and male infant mortality within a family. . Using the adult women sample, regressions were run for male and female infant mortality rates and levels.[26] Employing the usual set of environmental (village or NGO) and socio-economic (caste, religion, income, and wealth) variables, plus mother's age, marital status, literacy, and number of children

[24]The variable which was found to have the largest effect on number of children born and number of surviving children was the presence of the Veerni Project, which provides information about and access to clinics that offer voluntary sterilization. The net effect of long-term intervention from the NGO was a reduction in average fertility per woman of 2.7 children. Where the Veerni project has operated health clinics for only two years, its presence was still associated with a reduction in average number of children born per woman of 1.66. The long- and short-term NGO effects on average number of living children per woman were reductions of 2.15 and 1.08 respectively.

[25]See Gleason (2003) and Caldwell (1986).

[26]The rate is obtained by dividing the number of male or female infants reported died in infancy by the number of children ever born to a woman. Regressions were also run, using the number of male and number of female children who died in infancy that were reported by individual women. In the latter case, number of children born to a woman is used as a control variable.

in the family, we could not reject the null hypothesis that female literacy has no effect on either the male or female infant mortality.[27]

It should be noted, however, that the model was poor in its overall ability to predict infant mortality. (Adjusted R^2s in the range of + .02 to +.03 were obtained.) The only variable which was significant was "number of children", and the value of its regression coefficient is questionable given the degree of likely interdependency between mortality rates and family size.[28] With this disclaimer in mind, we report that an extra child in a family was associated with a .07 increase in average male infant mortality and with a .077 increase in the female infant mortality per family.[See Tables 6a - 6b]. The male infant mortality rate in our sample of adult women respondents was approximately 3 percent. The female infant mortality rate was closer to 3.7 percent.

(2) Effects of Mother's Literacy on Adolescent Girls' Health and Nutrition.

We next looked at effects of mother's literacy on adolescent daughters' health. As is common in health economics studies, we use the outcome, daughter's health status, as a measure of the demand for health. The demand model we use is similar to the one employed by Henriques et al.[29] Demand for child health is modeled as a function of a set of child characteristics, household or parental characteristics, and community characteristics. Demand for adolescent girl health is based on the girl i's characteristics [age (A); marital status (EM)[30]; education, e.g. whether literate (E); caste (C); and religion (R)], household or parental characteristics [mother's education (M), number of brothers (B), number of sisters (S), father's income (Y), and family wealth (W)] and community

[27]As Borooah (2003) points out, many other factors besides literacy of women, including safe drinking water and access to medical facilities are necessary to improve infant and child health and survival.

[28] Using this data set, there does not appear to be a way to instrument for this.

[29]Henriques, Strauss and Thomas (1991).

[30]The state "effectively married" (EM) is singled out, since in this case the girl is no longer living with her parental family but with her husband.

characteristics (SS).[31] The community characteristic, in this case the availability of health care and health education, is proxied by the dummy variables for the long- or short-term presence of the NGO (Veerni Project). We thus attain a demand function where

$$H(i) = f[A(i), EM(i), E(i), C(i), R(i), M(i), B(i), S(i), Y(i), W(i), SS(i)]$$

On the assumption that mother's literacy does not affect the price of providing food and health care to daughters, it is reasonable that a change in the amount of "daughter's health" demanded by the family is a reflection of a different family utility function.[32] Here we remain agnostic about the way in which the family utility function is determined. All tests are simply concerned with determining whether the utility function of a family in which the mother is literate is different from one in which she is illiterate. If a literate mother is associated with the family maximizing utility by directing more of its resources to daughters, this should be reflected in such indicators as daughter's body mass index (BMI) and the probability of her showing anemia symptoms.

Throughout the analysis of the determinants of adolescent girls' health, the null hypothesis is that mother's literacy has no effect. Using the adolescent girl data set, OLS regressions were run for determinants of adolescent girls' body mass index (BMI) and haematocrit level. In the case of haematocrit level, the null hypothesis could not be rejected. However, BMI of daughters was found to be positively associated with having a literate mother, at a significance level of .06 [Table 7a]

Female Literacy and Son Preference

An additional brother in the family was found to have a small but significant negative effect on a girl's BMI. The marginal effect of having a literate mother outweighed the negative effect of having additional brothers as long as there were no more than three additional brothers.[33] The negative

[31]Village variables were not included in any probits or regressions employing the adolescent girl survey due to high levels of multi-collinearity.

[32]Behrman and Wolfe (1984); Behrman and Deolaliker (1990).

[33]This assumes that the marginal effect of an additional brother is a constant.

marginal effect of an additional sister was slightly less than half the magnitude of the effect of an additional brother, and the regression coefficient was only significant at a 20 percent level. These findings are consistent with the widespread view that there is discrimination in favor of sons in this part of the world.[34]

There is, however, disagreement among scholars about the effect of female literacy on the degree of gender bias in India. For instance, Murthi, Guio, and Dreze find that increasing female literacy reduces the degree of discrimination in favor of sons. They find this result to be robust across all regions in India.[35] On the other hand, Sarmistha Pal has found mother's literacy to be associated with an increase in the degree of gender bias.[36] In our study, an additional regression that included an interaction term between mother's literacy and number of brothers was estimated for determinants of a girl's BMI . The interaction variable, "bias", proved to be significant and to have a larger negative effect than number of brothers by itself, which, in the new estimation, was no longer statistically significant. [Table 7b] When an F test was run on "mother" + "brothers" + "bias", the effect of the combination was found to be significant. This provides indirect support for the notion that literacy in women reinforces the preference for male children or that it makes women more efficient in implementing this preference. However, since BMI of daughters was still significantly and positively related to mother's literacy, it appears that literate mothers do allocate more of the family's resources to children.

A probit was run for "probability of a girl exhibiting anemia symptoms". In our probit

[34]Behrman (1988).

[35]Murthi et al (1995).

[36] Pal (1999).

estimation, we determine the likelihood of an adolescent girl showing anemia symptoms according to the index function

$$y^*(i) = \beta(1) + \beta(2)x(i2) + \ldots + \beta(k)x(ik) + u(i)$$

where $y^*(i)$ is interpreted as the additional utility that family i would get by choosing $y(i) = 0$ rather than $y(i) = 1$.

In this test, a mother being literate was associated with a reduction of approximately 9 percent in the probability of a daughter having anemia symptoms. [Table 8] If the daughter herself was literate, this lowered the probability by an additional 8 percent. The likelihood of a girl showing anemia symptoms appeared unrelated to her number of brothers but increased with the number of sisters, an additional sister being associated with about a 2.2 percent increase. The absence of any significant effect of brothers was initially surprising. [37]

It is likely that there are omitted variables in operation here. For example, the family's expected or permanent income (wealth) may be reduced by the birth of an additional daughter which requires the drain on family resources associated with having to supply her with a dowry, whereas permanent income may be increased by the birth of a son to the extent that he is an expected source of future income for the family and, in particular, support for parents in their old age.

In addition, when we use the adolescent girl data file to regress number of sisters on mother's literacy, we obtain a highly significant negative coefficient, but when we substitute number of brothers, the coefficient is not significant.[38] This lends further support to the discouraging hypothesis that sex selection is still important in these villages and that literate women are more

[37] It should be noted that there is a significant positive correlation between number of sisters and number of siblings reported by the girls, but no such relationship between number of brothers and number of siblings.

[38] Having a literate mother reduces the predicted number of sisters by 0.47when we control for caste, religion, and family income.

likely to successfully engage in it. In summary, it seems that illiterate mothers are likely to have more daughters, but both mothers and daughters are more likely to exhibit symptoms of anemia.

III. Effect of Mother's Literacy on Daughters' Education.

Parents have to decide that it is worthwhile to allocate resources to daughters' education or girls will not be allowed to attend government schools or even the local NGO sponsored classes in reading and arithmetic. An important component of the cost of educating a daughter in this environment is the opportunity cost, e.g. the cost of not having her available to help in the household or fields.[39] Her number of siblings may be important in two ways. The opportunity cost of allowing a daughter to attend classes will vary with the number of substitutes available for her contribution to home or agricultural production., and the per capita budget constraint will be tighter if the family income must be spread over more family members.

We employ a demand model similar to that described in II C (2) above. A probit is run to test for the effect of mother's literacy on the probability of an adolescent girl being literate. The same set of personal and family explanatory variables are employed, plus a dummy variable for "family has a TV or radio." Again, we consider separately the effects of the number of sisters and the number of brothers. We take into account whether a girl is effectively married, since her family's willingness to invest in her education is likely to be conditional on her marital status.[40] Age is included since

[39]This is the only cost in the case of the NGO sponsored village classes, since attendance at these classes, unlike the free government schools, does not require travel, a uniform, or the purchase of books and other supplies .

[40]An alternative probit estimation used "married" instead of "effectively married." The results were virtually the same.

being literate cannot be assumed to have been attained by age 10, especially where literacy is acquired in the local village classes run by the NGO rather than in government schools.

The relevant supply-side effect is the availability of schooling. This is measured by dummy variables for long- and short-run Veerni Project presence and by distance to school. The latter is a dummy variable ("proble~e") based on the girl's response to the question, "Did you encounter difficulty pursuing studies due to distance to school?" The response to this question is used as a proxy variable for distance to school, since no reliable information was obtained on actual availability and location of government schools.[41]

Having a literate mother was associated with a 14 percent increase in the probability that an adolescent girl would be literate.[Table 9] The marginal effect of having an additional brother was a reduction of approximately 2 percent in the probability that a girl would be literate, and the coefficient was significant at a 10.9 percent level. Having an additional sister reduced the probability of a girl being literate by 1.6 percent (significant at a 9.3 percent level).

Since 85 percent of the adolescent girls in the sample were literate compared with only 15 percent of the adult women, factors other than mother's literacy, such as availability of tuition-free schools, are necessary to explain the increase in literacy rates of the younger generation. It should also be noted that the effect of caste is much less important in predicting literacy of adolescent girls than of adult women. Only scheduled tribal status (caste 2) had a significant (negative) effect on the probability of an adolescent girl attaining literacy. This suggests that the combination of the targeted programs in government schools and the availability of Veerni Project classes has helped to overcome the caste differences in educational attainment of previous generations of village women. However, Muslim girls continue to have much lower literacy rates than Hindu girls of all castes. Although literacy rates are higher for girls than for women, and higher for younger than for older

[41] Government statistics on schools could not be used since many schools exist "on the books" but are not actually providing education.

adult women (See Table 1), it is still the case that less than three percent of the girls in our sample have acquired a secondary level education.

IV. Effect of Mother's Literacy on the Marital Status of Adolescent Girls.

An adolescent girl may be unmarried; she may be married in the sense that her parents have entered into a marriage contract on her behalf, but not yet living with her husband and his family; or she may be effectively married, in which case she has left her parental family and probably her village and gone to live in the home of her husband. [42]

Probits were run for the probability that an adolescent girl would be effectively married and for the probability that she would be unmarried. The usual set of personal and family characteristics were employed as explanatory variables with the exception that the girl's literacy was omitted from these estimating equations, since it is almost certainly conditional on her marital status. Families are less likely to invest in a daughter's education if she is already married, since any return on their human capital investment will accrue to the husband's not the parental family. Families that favor child marriages are also less likely to be "progressive" in attitude toward the value of educating daughters.

Whether her mother is literate was found to be a significant predictor of an adolescent girl's marital status. The probability that an adolescent girl would be effectively married was reduced by approximately 16 percent if her mother was literate. [Table 10a] The probability of her being unmarried was increased by 14 percent if her mother was literate. [Table 10b] Number of sisters did

[42] As noted above, approximately 33 percent of these adolescent girls are effectively married.

not have any observed effects. The marginal effect of an additional brother was to increase the probability of a girl being effectively married, but only by 2 ½ percent.

V. Discussion.

Does this study shed any light on the mechanisms by which women's literacy promotes the well-being of themselves and their daughters? Are women empowered by their education so that they have more say in family decisions about such matters as family size, allocation of food, and education of children, particularly daughters? Since we do not have data on the education of husbands and fathers and can not estimate its effect on intra-family allocation of resources, the process of decision making within the family still remains opaque, and takes place within a grey if not a black box. [43] However, the empirical results require at least one of the following assumptions to be true:

(1) Women's tastes are changed by becoming literate so that they prefer to have fewer children and to allocate more goods (food and education) to daughters.

(2) Literacy gives women more power in decision making within the family.

(3) Men who are married to literate women have different and more progressive tastes: They favor more control over fertility or smaller family size, and are willing to allocate more goods (food, education) to daughters.

If it were the case that assortive mating results in fathers who are married to literate women still controlling the allocation of goods within the family but themselves preferring to allocate more education and other goods to daughters, as in the third scenario, then women's literacy would be merely a 'signal' of the way in which the family allocates resources. In that case policy implications

[43] The study is currently being enlarged to include information on literacy of fathers, husbands, and siblings.

might be different. Simply increasing educational opportunities for girls without changing the way males are educated might not bring about the desired effects on future generations, since it would merely increase the supply of literate brides. However, given the finding of Kaushik Basu et al. that men who marry literate women are more likely to have literate sisters, we might tentatively conclude that the education of girls may lead to a greater demand for sons' wives who are literate.[44] This may be a positive spill-over effect of educating girls.

On the reasonable alternative assumptions that the men in these villages are quite homogeneous and traditional in their attitudes about control over family decisions and that it is women who generally want to allocate more resources to children, and in particular to daughters, it is likely that being literate empowers women in intra-family decision making. It makes it easier for them to limit family size, to provide food and education for daughters, and to allow daughters to grow up before being married off. This interpretation is buttressed by the demonstration of Murthi, Guio, and Dreze that female literacy increases the bargaining power of Indian women in the family enough to reduce fertility levels.[45] The fact that daughters have greater body mass and fewer anemia symptoms when their mothers are literate provides some modest support for the notion that literate women in this part of the world allocate more resources to their adolescent daughters.

On a less optimistic note, although we have provided evidence that adult women's literacy is associated with allocating more resources to surviving adolescent daughters, the evidence is compelling that literate women in these villages also engage in more sex selection of children than do illiterate women. This assertion is supported by the fact that adolescent daughters of literate

[44]Basu et al.(2002).

[45]Murthi, et al (1995).

women in these villages have fewer sisters, but not fewer brothers, than do their peers whose mothers are illiterate.

VI. Conclusions.

The main findings of this study are that literate adult women in rural Rajasthan are healthier, at least on one measure (probability of exhibiting anemia symptoms), that they have a better understanding of how diseases (HIV/AIDS) are contracted/transmitted, that they have, on average, fewer children, or at least fewer daughters, and that adolescent daughters of literate women are more likely to be better nourished and literate themselves, when control variables include daughter's age, number of sisters and brothers, environmental effects, and family's socio-economic status and religion. Mother's literacy also significantly reduces the probability that an adolescent girl will be already contracted into marriage or effectively married before the age of eighteen. However, adult female literacy has not succeeded in removing the bias in favor of sons in rural Rajasthan.

Except for the apparent lack of effect of women's literacy on infant mortality, the results of the empirical analysis reinforce a large number of other studies which find that female literacy has, on balance, positive effects on the health and education levels of both present and future generations of women. The lack of evidence of literacy improving infant/child survival directly is not surprising, given the poor standard of living and extremely high rates of malnutrition that still exist in these villages. Improvements require significant investment in infrastructure, including clean drinking water and desalinated water for irrigation.

Although literacy does not by itself appear to give women the ability to significantly reduce infant mortality, it may be a public good within families, with an illiterate adult family member having greater success in the labor market when living with literate family members. Increasing

women's literacy rates may thus improve families' welfare in this indirect way. This effect will not, however, be apparent when family income is included as a control variable in estimating equations. Improving female literacy rates is also likely to increase women's own earning power and labor force participation over time. Moreover, it may help women to acquire more political power. This is already beginning to happen in rural Rajasthan as more women, and more lower caste women, are becoming politically active in local government in these villages.[46] Perhaps over time the further education and empowerment of women will also reduce the degree of son preference in the villages.

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Alphabetical List of Variables

1. age: Tables 1-4b = age of adult woman; Tables 5a-8b = age of adolescent girl

2. age_at_mar~e: adult woman's age at marriage

3. bias: interaction (brothers*mother)

4. brothers: number of brothers of adolescent girl

5. caste: Tables 1-4b = dummy variable for caste 1,2,or 3,of adult woman
Tables 5a-8b = dummy variable for caste 1,2, or 3 of adolescent girl

6. effective~e:1 if adolescent girl is effectively married, otherwise 0

7. electr~y: Tables 1-4b = family home of adult woman has/ has no electricity
Tables 5a-8b = family home of adolescent girl has/ has no electricity

8. family~: monthly income of head of family in rupees

9. female ~ y: number of female children in family who died in infancy
male ~ y: number of male children in family who died in infancy

10.literate: 1 if adult woman is literate, Tables 1-4b, otherwise 0
1 if adolescent girl is literate, Tables 5a-8b, otherwise 0

11. married: 1 if adult woman is married, Tables 1-4b.

12. mother: 1 if mother of adolescent girl is literate, Tables 5a-8b.

13. muslim: 1 if adult woman is muslim religion, Tables 1-4b, otherwise 0
1 if adolescent girl is muslim religion, Tables 5a-8b, otherwise 0
14 .number~n: number of children ever born to a woman

15. number~1: number of living children which a woman has

16. proble~e: 1 if adolescent girl has a problem with education because of distance to school

17. radio_TV: Tables 1-4b: 1 if home of adult women has electricity, otherwise 0
Tables 5a-8b: 1 if home of adolescent girl has electricity, otherwise 0

18. sisters: number of sisters of adolescent girl

19. .veerni~m: 1 if Veerni Project has been in one's village for 10 years, otherwise 0
20. veerni~s: 1 if Veerni Project has been in one's village for 2 years, otherwise 0
21. veerni~t: 1 if the village has had no help from the Veerni project, otherwise 0

22. villag~1 - villag~8: 1 if adult woman lives in village 1,.....8, otherwise 0.

Table 1a
Determinants of Adult Female Literacy

Number of obs = 951
Log likelihood = -343.28833
Pseudo R2 = 0.1510

Marginal effects after probit y = Pr(literate) (predict) = .11707913

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
villag~1*|	-.0121355	.05874	-0.21	0.836	-.127258	.102987	.060988
villag~2*|	-.1235411	.01948	-6.34	0.000	-.16172	-.085363	.095689
villag~3*|	-.0688548	.0395	-1.74	0.081	-.146267	.008557	.191377
villag~4*|	-.0591821	.04128	-1.43	0.152	-.140091	.021727	.111462
villag~5*|	-.0302487	.04877	-0.62	0.535	-.125841	.065344	.139853
villag~6*|	-.0899369	.03271	-2.75	0.006	-.154046	-.025828	.053628
villag~7*|	-.0600634	.04187	-1.43	0.151	-.142131	.022004	.176656
villag~8*|	-.0790649	.03528	-2.24	0.025	-.148207	-.009922	.128286
age |	-.0073397	.00141	-5.19	0.000	-.010112	-.004567	31.0273
caste1*|	-.1666766	.01631	-10.22	0.000	-.198649	-.134704	.185068
caste2*|	-.1044347	.01743	-5.99	0.000	-.13859	-.070279	.073607
caste3*|	-.1577064	.02374	-6.64	0.000	-.204243	-.11117	.416404
muslim*|	-.1220614	.0142	-8.59	0.000	-.149901	-.094222	.036803

Table 1b
Determinants of Adult Female Literacy with Marital Status

Number of obs = 951
Log likelihood = -339.72577
Pseudo R2 = 0.1598

Marginal effects after probit y = Pr(literate) (predict) = .11508823

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
villag~1*|	.0054368	.06561	0.08	0.934	-.123165	.134039	.060988
villag~2*|	-.1159707	.02144	-5.41	0.000	-.157995	-.073947	.095689
villag~3*|	-.0575765	.04263	-1.35	0.177	-.141131	.025978	.191377
villag~4*|	-.0516136	.04407	-1.17	0.242	-.137998	.03477	.111462
villag~5*|	-.016847	.05318	-0.32	0.751	-.121083	.087389	.139853
villag~6*|	-.0872662	.03347	-2.61	0.009	-.152866	-.021666	.053628
villag~7*|	-.0473246	.04556	-1.04	0.299	-.136626	.041976	.176656
villag~8*|	-.0761347	.03632	-2.10	0.036	-.147315	-.004954	.128286
age |	-.0076182	.00141	-5.42	0.000	-.010373	-.004863	31.0273
caste1*|	-.1630296	.01633	-9.99	0.000	-.195028	-.131031	.185068
caste2*|	-.1038783	.01701	-6.11	0.000	-.137225	-.070531	.073607
caste3*|	-.1542406	.02357	-6.54	0.000	-.200438	-.108044	.416404
muslim*|	-.1202245	.01406	-8.55	0.000	-.147777	-.092672	.036803
married*|	-.2116292	.09825	-2.15	0.031	-.4042	-.019059	.970557

(*) dy/dx is for discrete change of dummy variable from 0 to 1

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Table 1c
Determinants of Adult Female Literacy
With Marital Status and Age of Marriage

```
Probit regression                                 Number of obs   =        951
                                                  Log likelihood =  -337.7382
                                                  Pseudo R2       =     0.1647

Marginal effects after probit         y  = Pr(literate) (predict) =  .11429146
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.      z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
villag~1*|    .009482      .06692    0.14   0.887  -.121672  .140636   .060988
villag~2*|  -.1001026      .02794   -3.58   0.000  -.154858 -.045348   .095689
villag~3*|  -.0393926      .04754   -0.83   0.407  -.132568  .053782   .191377
villag~4*|  -.0489123      .04476   -1.09   0.274  -.136634   .03881   .111462
villag~5*|  -.0152632      .05354   -0.29   0.776  -.120203  .089677   .139853
villag~6*|   -.082551      .03568   -2.31   0.021  -.152476 -.012626   .053628
villag~7*|  -.0440837      .04624   -0.95   0.340  -.134709  .046541   .176656
villag~8*|  -.0742303       .0367   -2.02   0.043  -.146152 -.002308   .128286
     age |  -.0074272       .0014   -5.29   0.000   -.01018 -.004674   31.0273
  caste1*|  -.1586637      .01653   -9.60   0.000  -.191071 -.126256   .185068
  caste2*|  -.0985921      .01816   -5.43   0.000  -.134185 -.062999   .073607
  caste3*|  -.1469407      .02383   -6.17   0.000  -.193645 -.100236   .416404
  muslim*|  -.1186205      .01438   -8.25   0.000  -.146811  -.09043   .036803
 married*|  -.2358181      .10171   -2.32   0.020  -.435158 -.036478   .970557
age_at~e |   .0071141       .0036    1.98   0.048   .000057  .014171   16.3617
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

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Table 2a
Probability of Women Exhibiting Anemia Symptoms
With Village Fixed Effects

```
                                                  Number of obs   =        947
                                                  LR chi2(18)     =      68.44
                                                  Prob > chi2     =     0.0000
Log likelihood = -609.77654                       Pseudo R2       =     0.0531


Marginal effects after probit
      y  = Pr(anemia_symptoms) (predict)   =  .58735272
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.      z    P>|z|  [    95% C.I.   ]       X
---------+--------------------------------------------------------------------
villag~1*|   .1561908      .09899    1.58   0.115  -.037835  .350216   .061246
villag~2*|  -.2809352      .10043   -2.80   0.005  -.477782 -.084089   .096093
villag~3*|  -.1738407      .09461   -1.84   0.066  -.359269  .011588   .190074
villag~4*|  -.0981108      .10134   -0.97   0.333   -.29674  .100518   .111932
villag~5*|  -.1714542       .0978   -1.75   0.080  -.363129   .02022   .139388
villag~6*|  -.0829328      .12444   -0.67   0.505  -.326826  .160961   .053854
villag~7*|  -.1189242      .09698   -1.23   0.220  -.309001  .071153   .177402
villag~8*|  -.1611797      .09979   -1.62   0.106  -.356759  .034399   .127772
     age |  -.0012587      .00275   -0.46   0.647  -.006651  .004134   31.0275
  caste1*|   .0501288      .05765    0.87   0.385  -.062862   .16312   .184794
  caste2*|    .205122       .0603    3.40   0.001   .086931  .323313   .073918
  caste3*|  -.0005473      .04727   -0.01   0.991  -.093195  .092101   .417107
  muslim*|   .1240263      .09888    1.25   0.210  -.069779  .317831   .036959
 married*|  -.0775445      .09686   -0.80   0.423  -.267382  .112293   .971489
literate*|  -.1244518      .05218   -2.38   0.017  -.226729 -.022175   .151003
family~_ |  -6.09e-06      .00001   -0.65   0.516  -.000024  .000012    2826.5
electr~y*|  -.0379448      .03723   -1.02   0.308  -.110907  .035017   .485744
number~n |   .0049495      .00863    0.57   0.566  -.011968  .021867   3.54699
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

Table 2b
Probability of Women Exhibiting Anemia Symptoms
With NGO Effects

```
                                                  Number of obs   =        945
                                                  LR chi2(12)     =      40.17
                                                  Prob > chi2     =     0.0001
Log likelihood = -622.49711                       Pseudo R2       =     0.0313

Marginal effects after probit
      y  = Pr(anemia_symptoms) (predict)
         =  .58435543

------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.      z    P>|z|  [    95% C.I.   ]       X
---------+--------------------------------------------------------------------
veerni~m*|   -.014278      .04175   -0.34   0.732  -.096111  .067555   .348148
veerni~s*|  -.0138687      .04136   -0.34   0.737  -.094932  .067195    .30582
     age |   -.001522      .00271   -0.56   0.574  -.006828  .003784   31.0265
  caste1*|   .1170477      .05039    2.32   0.020   .018293  .215802   .185185
  caste2*|   .2486306      .05211    4.77   0.000   .146489  .350772   .073016
  caste3*|   .0534829       .0414    1.29   0.196   -.02765  .134616   .416931
  muslim*|   .1983501      .07673    2.58   0.010   .047953  .348747   .037037
 married*|  -.0984542      .09691   -1.02   0.310  -.288392  .091483   .973545
literate*|  -.0912117      .05068   -1.80   0.072  -.190552  .008129   .151323
family~_ |  -6.69e-06      .00001   -0.73   0.465  -.000025  .000011    2821.9
electr~y*|  -.0315089       .0365   -0.86   0.388  -.103038  .040021   .484656
number~n |     .00678      .00839    0.81   0.419  -.009672  .023232   3.54392
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1

.
```

Table 3
Probability of Women Knowing How HIV/AIDS is Spread

```
Number of obs   =        948
Log likelihood = -359.97909
Pseudo R2       =     0.3393
```

Marginal effects after probit

y = Pr(hiv_aids_spread_knowledge) (predict)= .18122807

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
villag~1*|	.0011248	.05578	0.02	0.984	-.108202	.110452	.061181
villag~2*|	-.0829196 *	.03841	-2.16	0.031	-.158194	-.007646	.095992
villag~4*|	-.1808433 **	.02398	-7.54	0.000	-.227849	-.133838	.111814
villag~5*|	-.1945018 **	.02279	-8.53	0.000	-.239171	-.149833	.139241
villag~6*|	-.1592025 **	.02747	-5.80	0.000	-.213037	-.105368	.053797
villag~7*|	-.0149678	.10353	-0.14	0.885	-.21788	.187944	.177215
villag~8*|	.0848749	.12387	0.69	0.493	-.157909	.327659	.126582
veerni~t*|	-.340122**	.06374	-5.34	0.000	-.465059	-.215185	.345992
age |	-.0031666	.00189	-1.68	0.094	-.006867	.000534	31.0137
caste1*|	-.1460707**	.03285	-4.45	0.000	-.210451	-.081691	.184599
caste2*|	-.1051772**	.03686	-2.85	0.004	-.177431	-.032924	.07384
caste3*|	-.1039818**	.03495	-2.98	0.003	-.172478	-.035486	.417722
muslim*|	-.0430576	.06995	-0.62	0.538	-.18015	.094035	.03692
married*|	-.2410941*	.1223	-1.97	0.049	-.480806	-.001382	.972574
literate*|	.2847581**	.0557	5.11	0.000	.17558	.393937	.151899
family~_ |	.0000102	.00001	1.31	0.189	-5.0e-06	.000025	2820.89
electr~y*|	.0699122	.03637	1.92	0.055	-.001376	.1412	.485232
radio_tv*|	.1869186	.04818	3.88	0.000	.092492	.281345	.235232

(*) dy/dx is for discrete change of dummy variable from 0 to 1

In this case one variable for NGO is used: No Veerni Project = veerni~t.

Table 4a
Number of Children Ever Born as Function of Literacy, Age, and Age of Marriage of Mother With Village Fixed Effects

Source	SS	df	MS	Number of obs =	948
				F(17, 930) =	47.50
Model	2864.73594	17	168.513879	Prob > F =	0.0000
Residual	3299.62693	930	3.54798594	R-squared =	0.4647
				Adj R-squared =	0.4549
Total	6164.36287	947	6.50935889	Root MSE =	1.8836

number_of_~n	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
village_1	-1.515076	.394333	-3.84	0.000	-2.288961	-.74119
village_2	-2.632678	.4004665	-6.57	0.000	-3.418601	-1.846756
village_3	-1.49823	.3445541	-4.35	0.000	-2.174424	-.8220366
village_4	-1.666196	.3556117	-4.69	0.000	-2.36409	-.9683017
village_5	-1.484171	.3478563	-4.27	0.000	-2.166845	-.8014965
village_6	-1.825864	.4402826	-4.15	0.000	-2.689927	-.9618019
village_7	-1.955145	.3393315	-5.76	0.000	-2.621089	-1.289201
village_8	-1.807052	.3537816	-5.11	0.000	-2.501355	-1.11275
age	.1939376	.0081925	23.67	0.000	.1778597	.2100155
caste1	.150643	.2222045	0.68	0.498	-.2854374	.5867233
caste2	.0953751	.2685638	0.36	0.723	-.4316862	.6224364
caste3	-.2152241	.1791555	-1.20	0.230	-.56682	.1363718
muslim	.8917688	.4075005	2.19	0.029	.0920416	1.691496
literate	-.8484652	.1893811	-4.48	0.000	-1.220129	-.4768014
age_at_mar~e	-.1448564	.0212262	-6.82	0.000	-.1865133	-.1031995
family_mon~_	-9.15e-06	.0000353	-0.26	0.796	-.0000785	.0000602
electricity	-.0657754	.1392496	-0.47	0.637	-.3390552	.2075044
_cons	1.813234	.5940664	3.05	0.002	.647368	2.9791

Table 4b
Number of Children Ever Born as Function of Literacy, Age, and Age of Marriage of MotherWith NGO Effects

```
    Source |       SS       df       MS              Number of obs =     946
-------------+------------------------------           F( 11,   934) =   65.17
       Model |  2674.14928    11   243.10448           Prob > F      =  0.0000
    Residual |  3484.01563   934  3.73020945           R-squared     =  0.4342
-------------+------------------------------           Adj R-squared =  0.4276
       Total |   6158.1649   945  6.51657662           Root MSE      =  1.9314

------------------------------------------------------------------------------
number_of_~n |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
veerni_has~m |  -.0132778   .1713423    -0.08   0.938    -.3495382    .3229827
veerni_has~s |   .0562103   .1590898     0.35   0.724    -.2560046    .3684252
         age |   .1956057   .0083839    23.33   0.000     .1791522    .2120591
      caste1 |   .5188806    .207636     2.50   0.013     .1113934    .9263677
      caste2 |   .3038294   .2633376     1.15   0.249    -.2129725    .8206313
      caste3 |   .0146828   .1633789     0.09   0.928    -.3059495     .335315
      muslim |   1.101472   .3613889     3.05   0.002     .3922441    1.810701
    literate |  -.6783982    .192173    -3.53   0.000    -1.055539   -.3012572
age_at_mar~e |  -.1277574   .0211963    -6.03   0.000    -.1693552   -.0861595
family_mon~_ |  -.0000313   .0000359    -0.87   0.384    -.0001017    .0000391
 electricity |   .0032106   .1412239     0.02   0.982    -.2739423    .2803635
       _cons |  -.4156601   .5067581    -0.82   0.412    -1.410177    .5788563
------------------------------------------------------------------------------
```

Table 5a.
Number of Living Children as Function of Literacy, Age, and Age of Marriage of Mother:
With Village Fixed Effects

Source	SS	df	MS		
Model	2037.4927	17	119.852512	Number of obs	948
Residual	2500.92397	930	2.68916556	F(17, 930)	44.57
Total	4538.41667	947	4.79241464	Prob > F	0.0000
				R-squared	0.4489
				Adj R-squared	0.4389
				Root MSE	1.6399

number_of_~1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
village_1	-.9915021	.3433057	-2.89	0.004	-1.665246	-.3177585
village_2	-2.109348	.3486454	-6.05	0.000	-2.793571	-1.425125
village_3	-1.117411	.2999682	-3.73	0.000	-1.706104	-.5287179
village_4	-1.088841	.3095949	-3.52	0.000	-1.696426	-.481255
village_5	-1.060465	.3028431	-3.50	0.000	-1.6548	-.4661299
village_6	-1.279544	.3833093	-3.34	0.001	-2.031795	-.5272922
village_7	-1.128683	.2954214	-3.82	0.000	-1.708453	-.5489132
village_8	-1.136616	.3080017	-3.69	0.000	-1.741075	-.5321572
age	.1656072	.0071324	23.22	0.000	.1516098	.1796045
caste1	-.0773119	.1934509	-0.40	0.690	-.4569627	.3023389
caste2	.0134808	.2338112	0.06	0.954	-.4453778	.4723395
caste3	-.2216009	.1559725	-1.42	0.156	-.5276997	.0844979
muslim	.9869699	.3547693	2.78	0.006	.2907288	1.683211
literate	-.7816883	.1648748	-4.74	0.000	-1.105258	-.4581185
age_at_mar~e	-.1147397	.0184795	-6.21	0.000	-.1510061	-.0784733
family_mon~_	.0000123	.0000308	0.40	0.690	-.0000481	.0000727
electricity	-.1547798	.1212305	-1.28	0.202	-.3926968	.0831372
_cons	1.209998	.5171932	2.34	0.020	.1949969	2.224999

Table 5b.
Number of Living Children as Function of Literacy, Age, and Age of Marriage of Mother:
With NGO Effects

```
      Source |       SS       df       MS              Number of obs =     946
-------------+------------------------------           F( 11,   934) =   63.50
       Model |  1937.78549    11  176.162317           Prob > F      =  0.0000
    Residual |  2591.26843   934  2.77437733           R-squared     =  0.4279
-------------+------------------------------           Adj R-squared =  0.4211
       Total |  4529.05391   945  4.79264964           Root MSE      =  1.6656

------------------------------------------------------------------------------
number_of_~1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
veerni_has~m |  -.2305268   .1477681    -1.56   0.119    -.5205227    .0594691
veerni_has~s |  -.1079476   .1372014    -0.79   0.432    -.3772064    .1613111
         age |   .1664717   .0072304    23.02   0.000     .1522819    .1806614
      caste1 |   .2674927   .1790684     1.49   0.136    -.0839302    .6189156
      caste2 |   .2217096   .2271062     0.98   0.329     -.223988    .6674072
      caste3 |   .0156468   .1409004     0.11   0.912    -.2608711    .2921648
      muslim |    1.19032   .3116671     3.82   0.000     .5786714    1.801969
    literate |  -.6477311   .1657329    -3.91   0.000     -.972983   -.3224791
age_at_mar~e |  -.0962904     .01828    -5.27   0.000     -.132165   -.0604158
family_mon~_ |   1.16e-06   .0000309     0.04   0.970    -.0000596    .0000619
 electricity |  -.1055158   .1217936    -0.87   0.387    -.3445365    .1335049
       _cons |  -.3661565   .4370357    -0.84   0.402    -1.223842     .491529
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Table 6a
Number of Male Infant Deaths
As a Function of Number of Children Born, Age, and Literacy Status of Mother

```
      Source |       SS       df       MS              Number of obs =     947
-------------+------------------------------           F( 19,   927) =    7.61
       Model |   29.350643    19  1.54477069           Prob > F      =  0.0000
    Residual |  188.250202   927  .203074651           R-squared     =  0.1349
-------------+------------------------------           Adj R-squared =  0.1172
       Total |  217.600845   946  .230022035           Root MSE      =  .45064

------------------------------------------------------------------------------
___male_di~y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
number_of_~n |   .0716514   .0078547     9.12   0.000     .0562363    .0870664
   village_1 |   .1562849   .0953997     1.64   0.102    -.0309396    .3435093
   village_2 |   .1658597   .0985618     1.68   0.093    -.0275705    .3592899
   village_3 |   .2350992    .083562     2.81   0.005     .0711065    .3990919
   village_4 |   .1160435   .0861573     1.35   0.178    -.0530425    .2851294
   village_5 |   .0931774   .0843186     1.11   0.269       -.0723    .2586549
   village_6 |    .129251   .1063056     1.22   0.224    -.0793766    .3378785
   village_7 |   .0206308   .0828073     0.25   0.803    -.1418808    .1831424
   village_8 |   .0855083   .0858335     1.00   0.319    -.0829422    .2539588
         age |  -.0052779   .0024916    -2.12   0.034    -.0101677   -.0003881
      caste1 |   .0751125   .0533103     1.41   0.159    -.0295104    .1797355
      caste2 |   .0463562   .0643218     0.72   0.471     -.079877    .1725894
      caste3 |   .0279952   .0428981     0.65   0.514    -.0561935    .1121839
      muslim |  -.0082675   .0977426    -0.08   0.933    -.2000899    .1835549
     married |   .0051193   .0905967     0.06   0.955    -.1726791    .1829177
age_at_mar~e |   .0040079   .0052342     0.77   0.444    -.0062644    .0142801
    literate |   .0086937   .0460742     0.19   0.850     -.081728    .0991155
family_mon~_ |  -4.53e-06   8.46e-06    -0.54   0.593    -.0000211    .0000121
 electricity |  -.0005153   .0333763    -0.02   0.988    -.0660172    .0649866
       _cons |  -.1568177   .1632307    -0.96   0.337    -.4771623    .1635268
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Table 6b
Number of Female Infant Deaths
As a Function of Number of Children Born, Age, and Literacy Status of Mother

```
      Source |       SS       df       MS              Number of obs =     948
-------------+------------------------------           F( 19,   928) =    6.95
       Model |  31.0830621    19  1.63595064           Prob > F      =  0.0000
    Residual |  218.431706   928  .235378993           R-squared     =  0.1246
-------------+------------------------------           Adj R-squared =  0.1067
       Total |  249.514768   947  .263479164           Root MSE      =  .48516

------------------------------------------------------------------------------
___female_~y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
number_of_~n |   .0778635   .0084538     9.21   0.000     .0612727    .0944543
   village_1 |   .2239298   .1027075     2.18   0.029     .0223639    .4254956
   village_2 |   .2303645   .1061069     2.17   0.030     .0221272    .4386018
   village_3 |   .2078074    .089962     2.31   0.021     .0312549      .38436
   village_4 |   .1472515   .0927538     1.59   0.113      -.03478    .3292831
   village_5 |   .1227072   .0906964     1.35   0.176    -.0552866     .300701
   village_6 |   .1026282   .1144488     0.90   0.370    -.1219802    .3272366
   village_7 |   .0459627   .0891505     0.52   0.606    -.1289973    .2209227
   village_8 |    .156432   .0924083     1.69   0.091    -.0249215    .3377854
         age |  -.0062471   .0026815    -2.33   0.020    -.0115095   -.0009847
      caste1 |   .0639185   .0573146     1.12   0.265    -.0485627    .1763997
      caste2 |  -.0329361   .0692488    -0.48   0.634    -.1688386    .1029664
      caste3 |   .0226898   .0461831     0.49   0.623    -.0679456    .1133251
      muslim |  -.1096015   .1052293    -1.04   0.298    -.3161164    .0969134
     married |  -.0307472   .0975341    -0.32   0.753    -.2221602    .1606658
age_at_mar~e |   .0035448   .0056328     0.63   0.529    -.0075096    .0145992
    literate |   .0133946   .0495912     0.27   0.787    -.0839294    .1107185
family_mon~_ |  -2.98e-06   9.11e-06    -0.33   0.743    -.0000209    .0000149
 electricity |   .0030372   .0359203     0.08   0.933    -.0674572    .0735316
       _cons |   -.109406   .1757344    -0.62   0.534    -.4542889    .2354768
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Table 7a
Adolescent Girl's BMI as a Function of Mother's Literacy

Source	SS	df	MS		Number of obs =	902
Model	407629.862	14	29116.4187		F(14, 887) =	4.87
Residual	5302736.22	887	5978.2821		Prob > F =	0.0000
					R-squared =	0.0714
Total	5710366.08	901	6337.80919		Adj R-squared =	0.0567
					Root MSE =	77.319

bmi_weight~2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
mother	19.85599	10.53208	1.89	0.060	-.8147137	40.5267
literate	-3.373795	6.586292	-0.51	0.609	-16.30033	9.552738
veerni_has~m	-6.898515	6.435138	-1.07	0.284	-19.52839	5.731356
veerni_has~s	12.56758	6.836346	1.84	0.066	-.8497194	25.98488
caste1	-3.912365	8.440889	-0.46	0.643	-20.47881	12.65408
caste2	22.51594	10.1726	2.21	0.027	2.550759	42.48111
caste3	-9.694841	6.861189	-1.41	0.158	-23.1609	3.771217
muslim	-2.245836	16.26448	-0.14	0.890	-34.16719	29.67552
age	.0204572	1.150919	0.02	0.986	-2.238384	2.279299
family_mon~_	.009624	.0014455	6.66	0.000	.0067871	.012461
brothers	-4.975956	2.365593	-2.10	0.036	-9.618767	-.3331439
sisters	-2.181253	1.734967	-1.26	0.209	-5.586373	1.223866
effective_~e	1.295391	5.994371	0.22	0.829	-10.46941	13.06019
electricity	-9.112647	5.77603	-1.58	0.115	-20.44893	2.223632
_cons	15.68312	19.60276	0.80	0.424	-22.79007	54.15632

Table 7b

Adolescent Girl's BMI as a Function of Mother's Literacy with Interaction Term

Source	SS	df	MS		
Model	444620.78	15	29641.3853		
Residual	5265745.3	886	5943.27912		
Total	5710366.08	901	6337.80919		

Number of obs	=	902			
F(15, 886)	=	4.99			
Prob > F	=	0.0000			
R-squared	=	0.0779			
Adj R-squared	=	0.0623			
Root MSE	=	77.093			

bmi_weight~2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
mother	64.8147	20.85743	3.11	0.002	23.87897	105.7504
literate	-2.281766	6.581554	-0.35	0.729	-15.19902	10.63549
veerni_has~m	-7.358092	6.418915	-1.15	0.252	-19.95614	5.23996
veerni_has~s	12.21304	6.817785	1.79	0.074	-1.167856	25.59393
caste1	-3.46021	8.418093	-0.41	0.681	-19.98194	13.06152
caste2	21.65013	10.14871	2.13	0.033	1.731809	41.56845
caste3	-9.744799	6.841102	-1.42	0.155	-23.17146	3.681856
muslim	-3.683823	16.22704	-0.23	0.820	-35.53174	28.16409
age	-.0304872	1.147726	-0.03	0.979	-2.283066	2.222092
family_mon~_	.0097509	.0014421	6.76	0.000	.0069205	.0125813
brothers	-3.288863	2.453685	-1.34	0.180	-8.104577	1.52685
sisters	-2.121604	1.730046	-1.23	0.220	-5.51707	1.273862
effective_~e	.8992222	5.978905	0.15	0.880	-10.83525	12.63369
electricity	-9.908995	5.767935	-1.72	0.086	-21.2294	1.411414
bias	-21.86652	8.764865	-2.49	0.013	-39.06884	-4.664204
_cons	12.19114	19.59534	0.62	0.534	-26.26756	50.64984

Table 8.
Probability of Anemia Symptoms in Adolescent Girls

N = 902

Marginal effects after probit
y = Pr(anemia_symptoms) (predict) = .17479484

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
mother*|	-.0888108	.03933	-2.26	0.024	-.165892	-.01173	.070953
literate*|	-.08094	.03463	-2.34	0.019	-.148808	-.013072	.749446
veerni~m*|	.0242111	.03183	0.76	0.447	-.038171	.086593	.363636
veerni~s*|	-.0691022	.03144	-2.20	0.028	-.130728	-.007477	.283814
caste1*|	-.0014888	.03976	-0.04	0.970	-.079408	.07643	.185144
caste2*|	.0719229	.05456	1.32	0.187	-.035008	.178854	.083149
caste3*|	-.0778049	.03409	-2.28	0.022	-.14462	-.010989	.484479
age	.016951	.00533	3.18	0.001	.006501	.027401	13.2051
effect~e*|	-.0211059	.02875	-0.73	0.463	-.077447	.035235	.327051
muslim*|	-.1039068	.0514	-2.02	0.043	-.204649	-.003164	.032151
family~_	-8.75e-06	.00001	-1.15	0.249	-.000024	6.1e-06	3028.16
brothers	.00193	.01196	0.16	0.872	-.021506	.025366	2.1918
sisters	.0222919	.00859	2.60	0.009	.005456	.039128	2.57761
electr~y*|	-.0069962	.02911	-0.24	0.810	-.064055	.050063	.562084

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Table 9.
Probability of An Adolescent Girl Being Literate

N = 907

Marginal effects after probit
y = Pr(literate) (predict)= .79184427 N = 907

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
age	-.0488199	.00569	-8.59	0.000	-.059963	-.037676	13.2051
caste1*|	-.013131	.04747	-0.28	0.782	-.106168	.079906	.185144
caste2*|	-.1278035	.06371	-2.01	0.045	-.252663	-.002944	.083149
caste3*|	-.001167	.03928	-0.03	0.976	-.078148	.075814	.484479
muslim*|	-.2880137	.11234	-2.56	0.010	-.508191	-.067836	.032151
veerni~m*|	.1140606	.03205	3.56	0.000	.051249	.176873	.363636
veerni~s*|	.1135478	.03204	3.54	0.000	.050747	.176349	.283814
effect~e*|	-.062661	.03408	-1.84	0.066	-.129463	.004141	.327051
family~_	.0000276	.00001	2.95	0.003	9.3e-06	.000046	3028.16
brothers	-.0205877	.01284	-1.60	0.109	-.045756	.004581	2.1918
sisters	-.0161546	.00962	-1.68	0.093	-.035016	.002707	2.57761
mother*|	.1416215	.04128	3.43	0.001	.060717	.222526	.070953
electr~y*|	.1142339	.03648	3.13	0.002	.042742	.185726	.562084
radio_tv*|	.0513067	.03983	1.29	0.198	-.026766	.12938	.288248
proble~e*|	.0058396	.04093	0.14	0.887	-.074378	.086057	.146341

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Table 10a.
Probability of an Adolescent Girl being Effectively Married

N = 904

Marginal effects after probit
y = Pr(effective_marriage) (predict) = .29935245

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
mother*|	-.1574522	.05403	-2.91	0.004	-.263349	-.051556	.070953
age |	.0484347	.00631	7.67	0.000	.036062	.060807	13.2051
veerni~m*|	-.0170199	.0392	-0.43	0.664	-.09385	.059811	.363636
veerni~s*|	-.0399403	.04071	-0.98	0.327	-.119739	.039858	.283814
caste1*|	.2172221	.05922	3.67	0.000	.101153	.333292	.185144
caste2*|	.03037	.06853	0.44	0.658	-.103944	.164684	.083149
caste3*|	.3070998	.04123	7.45	0.000	.226286	.387914	.484479
muslim*|	-.1389466	.09121	-1.52	0.128	-.317721	.039828	.032151
family~_ |	-5.73e-06	.00001	-0.59	0.558	-.000025	.000013	3028.16
electr~y*|	-.1312543	.03998	-3.28	0.001	-.209622	-.052887	.562084
radio_tv*|	.0245714	.04677	0.53	0.599	-.0671	.116242	.288248
brothers |	.0258737	.01481	1.75	0.081	-.003151	.054898	2.1918
sisters |	.0053172	.01085	0.49	0.624	-.015958	.026592	2.57761

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Table 10b.
Probability of an Adolescent Girl Being Unmarried

N = 904

Marginal effects after probit
y = Pr(unmarried) (predict) = .63669901

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
mother*|	.141208	.06407	2.20	0.028	.015625	.266791	.070796
age |	-.045728	.00672	-6.81	0.000	-.058898	-.032558	13.2046
veerni~m*|	.0317306	.04145	0.77	0.444	-.049506	.112967	.363938
veerni~s*|	.0260971	.04333	0.60	0.547	-.058833	.111027	.283186
caste1*|	-.2997663	.05623	-5.33	0.000	-.40997	-.189562	.184735
caste2*|	-.222457	.07103	-3.13	0.002	-.361669	-.083245	.082965
caste3*|	-.3640231	.04134	-8.81	0.000	-.44504	-.283006	.484513
muslim*|	.1580417	.10373	1.52	0.128	-.045265	.361348	.03208
family~_ |	-2.72e-06	.00001	-0.27	0.785	-.000022	.000017	3033.41
electr~y*|	.1395968	.04074	3.43	0.001	.059756	.219438	.561947
radio_tv*|	-.001405	.04852	-0.03	0.977	-.0965	.09369	.288717
brothers |	-.0132388	.01555	-0.85	0.395	-.043721	.017243	2.19027
sisters |	-.0109418	.01142	-0.96	0.338	-.033325	.011442	2.57743

(*) dy/dx is for discrete change of dummy variable from 0 to 1