Maternal health and child mortality in rural India

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Abstract

In this paper, the effect of maternal health on the under-five mortality has been examined. Third wave of micro-level National Family Health Survey 2005-06 data for rural India is used. Using various alternative measures of maternal health, the paper finds strong association between maternal health and child mortality. In particular, the effects of maternal height, weight, presence of any disease and anemia are found significant. Based on our findings, we argue that if the possible generational transfer of poor health from a mother to her child has to avoid, policies aimed at attaining the millennium development goal of reduced child mortality should be directed on improving the health of existing and future mothers.

Keywords: under-five mortality, maternal height, maternal weight, body mass index, anemia

JEL Classification: D6, I12, J13

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I. Introduction

Child mortality has been considered as not only the foremost indicator of the child health but it also measures public health performances of a country. Despite sustained reduction in its rate in the last few decades in almost all parts of the world, childhood mortality is still a matter of serious concern particularly for the developing countries. According to the United Nations Children's Fund (UNICEF) report, in the developing world every year over 10 million children under five years of age die and the large proportion of it is from causes that are preventable through a combination of good care, nutrition supply, and medical treatments. Considering desirability of reduction in child mortality, United Nations have also included it as its number four Millennium Development Goals (MDGs hereafter). Its main target was to reduce child mortality by two-third during 1990-2015. However, its recent report indicates that deaths of under-five children remain unacceptably high[2] and about 29,000 children under the age of five – 21 each minute – die every day. In India itself, in 2006 about 2.1 million children die before their fifth birthday and despite reduced rate of infant and child mortality in the last 15 years, it is still as high as 57 and 74, respectively (IIPS, 2007).

India has taken several steps to reduce child and infant mortality over last 30 years. In year 1978, a national goal of an infant mortality rate (IMR hereafter) of 60 was targeted by the year 2000. Two consecutive five year plans (sixth and seventh) adopted nationwide programmes to reduce child and infant mortality rates at targeted level and since then several health care programmes[3] were implemented. However, despite of these efforts, the death rates of children is still abysmally high in India.

[2] http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2008/MDG_Report_2008_ En.pdf#page=22

[3] some of them are the Expanded Programme of Immunization (EPI) 1979, Universal Immunisation Programme (UIP) 1985, Reproductive and Child Health (RCH) 1994 and recent National Rural Health Mission (NRHM) 2005

There are numerous studies available on the determinants of child mortality in India and maternal characteristics. For example, a number of demographic studies of infant and child mortality in many developing countries have shown a powerful association between mother's educational status and different mortality levels[4]. Another maternal factor is the employment. A negative relationship between maternal employment and child survival is indicated by many researchers. For example, Miller (1981) and Rosenzweig and Schultz (1982) find that though women's value to the household and consequently, higher investments in female children increases with women's labor force participation, child mortality increases with employment status of mother and it appears to be more a function of poor health outcomes for all children-including males-than an improvement in girls' health status (Basu and Basu, 1991). Kishor & Parasuraman (1998) also showed that mother's employment has its most negative effect on survival at ages 12-47 months of daughter birth orders with same-sex siblings, a group that considered the most at risk. This result is also consistent with the result of Murthi, Guio, and Dreze (1995) which concludes that higher female labor force participation is associated with higher levels of male and female child mortality.

Another attribute of mother in determining child mortality is age of mother at the time of birth. Different studies showed different types of relationship between these two. In one hand, some studies show that the pattern of the risk of infant deaths may be decreasing (Gubhaju, 1985), dispensable (Das Gupta, 1990) or may be increasing (Reichman aand Pagnini, 1997) with maternal age at the time of birth. On the other hand, some studies also show non-linear relationship between mother's age and child mortality. For example, Curtis et al. (1993) and Sastry (1997) found that the relationship between infant mortality and the age of the mother at the time of birth is J-shaped. However, Argeseanu (2004) empirically found that in rural South Africa, the effects are significant only in some specifications, and their effects are somewhat unusual, with high parity children and those with young and old mothers having better survival chances. It may be due to the spread of HIV among women of child bearing ages in the area, where younger and older women were less likely to have contracted or developed AIDS. Reichman and Pagnini

[4]see Bicego et al., 1993; Jacoby et al., 2003

(1997) found that in the United States this relationship varies by race. For whites, the relationship between maternal age and child mortality is U-shaped i.e. child mortality first decreases, remain constant for some age and then increases with increase in mother's age while for African Americans, risk of child mortality continuously increases with age of the mother. Many studies have confirmed association of lower child mortality with longer birth spacing.

Finally, we take stock of the association between maternal health and subsequent child mortality. Some recent studies have argued that height of mother increases the probability of child survival as (1) taller mother could have easier births and higher birth-weight babies, and hence less infant mortality[5], and (2) height is associated with better nutritional status and easy access to public health care[6]. Though there are recent evidences that suggest positive association between maternal height and child mortality in developing countries[7]. There are also some evidences which suggest either for no or negative association between maternal height and child survival rate[8]. And thus, there is no consensus over the kind of effect of maternal health on under-five mortality, in particular for rural India where all the mortality indicators are significantly higher than the national average.

In view of this, the aim of this paper is to examine the effect of maternal health on mortality of children under-five in the rural India using height, weight, presence of any of TB or asthma or diabetes or thyroid, anemia and body mass index as measures of maternal health. For the analysis purposes we use third wave of micro-level national family health survey (NFHS-III) data conducted in 2005-06.

The remaining paper is structured as under. Section II discusses different measures of maternal health, model specifications and estimation procedure adopted in the paper. Section III deals with the data used in the analysis and descriptive relationship between

[5] Kelly et al., 1996; Magadi et al., 2003; Batty and Leon, 2003; Prasad and A-Taher, 2002
[6] Crompton et al., 2002; Roberts et al., 1978; Sear et al., 2004; Silventoinen, et al., 2006
[7] See, for example, Allal et al., 2004 and Sear et al., 2004 for Gambian women; Baqui and Amin, 1994 for urban Bangladesh; Mueller (1979) for Columbian Women, Pollet and Nettle, 2008 for Guatemalan women, Subramanian, 2009 for Indian women and Monden et al., 2008 for 42 developing countries
[8]Devi et al., 1985; Frisancho et al., 1973; Kirchengast, 2000; Lasker et al., 1976; Strickland, 2002; Strickland et al., 1997

maternal health and child mortality is explored in section IV. Estimation results are discussed in section V and the paper concluded in section VI.

II. Methodology

In this section we will discuss different measures of maternal health, econometric model specifications and estimation procedures used in the analysis. Literature suggests many indicators of mother's health. For example, presence of one or more diseases, height, weight, body mass index (BMI[9] afterwards), presence of anemia and its level and so on. Adult height has been considered as an indicator of physical strength and general health potential[10]. Adult weight can also be considered as an indicator of health. However, overweight and obesity has been shown to be associated with the risk factors for cardiovascular diseases, hypertension, diabetes, gallstones and orthopaedic impairments (Colditz, 1992; Troiano et al., 1996) and therefore, BMI could be used as a good measure of nutritional status and health of adults. Besides this, BMI is generally related to body fat and higher BMIs usually mean higher body fat and being obese lowers one's life expectancy. Anemia is also considered as important measure of health as it is one of the more common blood disorders, occurs when the level of healthy red blood cells (RBCs) in the body becomes too low. This can lead to health problems because RBCs contain hemoglobin, which carries oxygen to the body's tissues. Anemia can cause a variety of complications, including fatigue and stress on bodily organs. We finally use six indicators such as presence of any disease, anemia, height, weight, BMI and nutritional level to test their effect on the child mortality.

For econometric purpose, we employ dichotomous variable of child mortality as dependent variable and classify explanatory variables into following categories: mother's characteristics, child characteristics, and household characteristics. Presence of any of the

[9] Body mass index (BMI), or Quetelet's index, for the respondent is defined as her weight in kilograms divided by the square of her height in meters (W/H^2). In our analysis the BMI has not been adjusted for pregnant women (IIPS, 2007).

[10] See Batty and Leon, 2003; Cavelaars et al., 2000; Engeland et al., 2003; Marmot et al., 1984; Silventoinen, 2003; Silventoinen et al., 1999; Wadsworth et al., 2002; Monden and Smits, 2008

TB, asthma, diabetes and thyroid; anemia, height, weight and body mass index are used as key explanatory proxies for maternal health. Maternal characteristics apart from their health performance indicators include their age, education, employment status, knowledge about reading news paper and magazines, listening to radio and watching TV. Child characteristics include sex, and birth order. Also we use caste, religion, size of the household, type of house, household head, and facilities of piped water as household characteristics. Finally, we include state level dummies to control for state wise variations.

Thus, our econometric specification is as follows.

$$CM = \alpha + \beta M + \gamma C + \theta H + \delta S + \varepsilon \quad \text{.....(1)}$$

where CM is the child mortality variable. M, C, H and S are the characteristics associated with mother, child and households. α is intercept term and β, γ, θ and δ are the parameters. ε is an error term distributed independently and identically (i.i.d).

We employ logistic regression procedure (Amemiya, 1981; Greene, 2003) to estimate equation (1). Using this procedure we will be able to determine the effect of different health measures of mother on mortality of their children, clustering by mother. In order to avoid any kind of collinearity issue, we use a single health variable in a model. Odds ratio, standard errors and marginal effects are reported in each of the estimation tables.

III. Data

The study is based on third round of National Family Health Survey (NFHS), a nationally representative cross-sectional data collected in 2005-06. It is a part of larger Demographic and Health Surveys (DHS) for more than 60 low-income countries since 1985. This wave provides information on fertility, family planning, infant and child mortality, reproductive and child health, anthropometric measures, nutritional status of women and children, anemia level, the quality of health and family welfare services, socioeconomic and environmental conditions, knowledge about diseases like tuberculosis, diabetes, asthma and thyroid etc. Interviews were conducted with women of age group 15-49 in rural areas from all 29 states of the Indian Territory. For the sake of our analysis and to avoid possible recall biasness, we will restrict our sample only to all

baby births that took place between 2001 and 2006 in rural areas. We also ignored cases with twin status and confined our analysis only to the single born babies. For the dead children we considered only those either who are alive or died at the most 5 years back from the date of interview. These restrictions finally lead to a sample size of 33,454 children with 1,998 under-five mortality.

IV. Descriptive Data

Table 1 documents trend in infant and child mortality rates in rural, urban and all India for 1991-92, 1998-99 and 2005-06. It can be observed that the rates of infant and child mortality are considerably higher in rural areas than in urban areas in each period.

[Table 1 about here]

While in 2005-06, the infant mortality rates were 62 per 1000 and 42 per 1000 respectively in rural and urban India; the under-5 mortality rates were 82 and 52 per 1000 respectively in rural and urban India. In both the neonatal and postneonatal periods, mortality in rural areas is about 50 percent higher than mortality in urban areas. Further, if we compare the change in mortality rates between 1991-92 and 2005-06, we observe that under-5 mortality has gone down from 119 to 82 in rural areas, compared with 75 to 52 in urban areas. Thus, it is suggestive that (1) over the time though mortality rates are declining in both rural and urban areas, the rate of reduction rate is slower and (2) rural children and infants are more vulnerable than their urban counterparts. These observations form the basis of why we focus our analysis for the rural areas only.

Now, in order to understand the foundation of relationship between maternal health and under-5 child mortality in India, we summarize the profiles of maternal health and nutritional status of all children, alive children below 5 and of those who died before their fifth birthday in Table 2.

[Table 2 about here]

Table suggests that for all dead or live children, in rural areas about 5 mothers per 1000 suffer from TB, 12 from asthma, 4 from diabetes and 5 from thyroid diseases. The

proportion of mothers suffering from at least one of these diseases is over 2.4%. Now, if we compare the disease profile of dead children under the age of 5 years with those who are alive, we find the difference of per 1000 corresponding figures negative. We can observe that difference is -2.69, -4.34, -3.89, -0.78 and -12.03 per 1000 for TB, asthma, diabetes, thyroid and at least one of these, respectively. The negative sign here suggests that prevalence of diseases are higher for those children who die as compared to those who still alive. Next, Table 2 also shows that per 1000 difference between underweight mothers of alive and dead children is about -16. This means the proportion of underweight mothers is higher for the children who died. Furthermore, if we compare the anemic level of mothers of alive children and those of dead children we find that former has more number per 1000 with no anemia or mild anemia while later are in majority for sever and moderate anemia level. Pearson chi-square test for independence of discrete health categories and child mortality suggests that except for thyroid health category, the null hypothesis is rejected and indicates for possible dependency relationships.

Now to see the variation in maternal height, weight and BMI, mean, standard error, difference of mean along with variance ratio and t-test results are presented in Table 3.

[Table 3 about here]

If we compare average BMI, height and weight for mothers of dead and alive children we find that the difference of mean is positive which suggests that height, weight and BMI of mothers with alive children are higher as compared with those whose children died. Two sample t-test results support this hypothesis and suggest for significantly higher mean height, weight and BMI of mothers having alive child.

Thus, in all, Table 2 and Table 3 strongly suggest for health disadvantage of mothers of under-5 dead children. However, this is suggestive only and we will verify the effect of maternal health on the child mortality in the next stage when we do econometric exercises to test the significance of effects of these health measures separately on the incidences of child mortality in the next section.

V. Estimation results

V.1. Explaining the effect of maternal health on child mortality

Definition and descriptive statistics for variables used in the analysis are presented in Table 4.

[Table 4 about here]

We use six different specifications for six indicators of health and nutritional status, keeping all other explanatory variables same in all the specifications. Specification 1 uses presence of at least one of the TB, asthma, diabetes and thyroid diseases in the mother as an indicator of poor health. Specification 2 includes two dummies of anemia level: severe/moderate and mild as explanatory variables excluding the cases with no anemia as reference category. The result for specification 1 and 2 are presented in Table 5. Specification 3 and 4 uses height and weight of mother as indicators of good health. We also include their square terms to test whether the effect of height and weight has a non-linear form. Estimation results for both the specifications are reported in Table 6. Body mass index and its square are used in specification 5 and specification 6 includes dummies for underweight and normal body mass index leaving overweight category outside the model as reference one. Estimation results are given in Table 7. In each table odds ratio, standard error along with marginal effect is reported for each of the explanatory variables.

[Table 5 about here]

Results of specification 1 in Table 5 indicate that presence of a disease in mother significantly increases the risk of child mortality. Marginal effect result suggests that as the probability of mortality is 3% higher for children of mothers suffering from a disease as compared to those who do not. Here, we note that the disease we had taken into account are TB, asthma, diabetes and thyroid and the percentage increase in risk could be higher if we would be able to include other diseases.

Similarly, odds ratio and corresponding marginal effect value of specification 2 suggests that as compared to women without anemia, the morality risk of children of women with severe or moderate anemia level is higher by about 1 percentage points. However, the effect of being suffered from mild anemia is not significant as compared to non-anemic mothers. Here, we may claim that mild level anemia of mother does not have any significant effect on the child mortality but beyond that severe and moderate anemia level among mothers of children is negatively associated with the child survival.

Effect of height and weight are recorded in Table 6 in specification 3 and specification 4, respectively. We observe that both height and weight are negatively associated with child mortality. We notice that one centimetre increase in maternal height would increase the survival probability of children by 0.015. Also, the significance of height square indicates that effect of height on child mortality has a non-linear form.

[Table 6 about here]

However, the odd ratio corresponding to height square is very low though is significant at 5% level of significance. Similarly, one kilogram increase in the maternal weight would reduce the probability of under-5 mortality by 0.002. Again, we find non-linear effect of weight on the child mortality with low odds ratio.

Estimation results of specification 5 and specification 6 presented in Table 7 suggests that body mass index and being overweight or underweight of mother does not have a significant impact on the survival of child under five.

[Table 7 about here]

V.2. Explaining the effects of covariates other than maternal health

Apart from maternal health variable, the effect of other characteristics related to mother, child and households on child survival are also presented in Table 5, 6 and 7. Maternal age is significant in all the six specifications. Estimates consistently suggest that as compared to age group 15-19 the probability of child survival is higher in age group of

20-34 and 35-49 years. As compared to maternal age group 15-19, the reduction in the probability of child mortality ranges between 0.025-0.026 for age group 20-34 and 0.020-0.022 for age group 35-49. Maternal education is not significant in any of the specifications and we suspect that possible confounding effect of education could be a reason for this. Reading newspapers/magazines and watching TV by mother of a child is positively related with child survival in each of the specifications. However, listening to radio is not significant in our specifications. This result further support the results of Gaiha et al., (2009) which suggests that media exposure triggers public action, and helps avert child under-nutrition and mortality. Another maternal characteristic which does not turn up significant in any of the specifications is the employment status.

Our analysis supports theory of gender biasness in child mortality as it is found consistently in all the specifications that male has advantages in terms of higher survival probability. However, birth order of child is significant in specification 1 only which suggests that increase in birth order increases the risk of child mortality (OR 1.038; ME 0.002).

Now, turning to household characteristics to which children and their mothers belong to we find that as compared to other castes, being SC, ST and OBC do not have a significant effect on the child mortality. Similarly, as compared to other religions being a Hindu does not have an advantage as far as child survival is concerned. However, the marginal effect of household size and facility of piped water are consistently turning up negative and significant in all the specifications which suggests that larger family size and purified water supply in the household could help in averting child mortality. Male household head and facilities of pucca household do not have significant effect on child mortality.

VI. Concluding observations

Despite sustained reduction in under-five mortality rates in India, the rate is slower and the rural children are still the most vulnerable with very high risk of mortality in their early lives. The role of many mother's characteristics such as autonomy, employment status, education etc. in determining child mortality are well-researched. However, the

maternal health as a possible determinant of under-five mortality has received little attention. Based on various measures of mother's health and nutritional status, our analysis tried to analyse the effect of maternal health on the survival of under-five mortality.

The analysis indicates that being free from any disease, height and weight are the key maternal health determinants of child under five. We also find non-linear effect of both weight and height on the mortality. The findings of the paper extends the hypothesis that height and weight of a girl child is not associated with their poor health but also transfers its effect on the health and survival of her children, the next generation. However, our specifications are not able to establish any kind of effect of body mass index and nutritional status of mother on the mortality of the children. Further, our findings are in accordance with Monden and smits (2008) but do not support findings of Devi et al., 1985; Frisancho et al., 1973; Kirchengast, 2000; Lasker and Thomas, 1976; Strickland and Tuffrey, 1997. These studies suggest either for no relationship between maternal height and child mortality or confirm non-linear association.

The paper also found positive and significant effect of mothers' age, media exposures, household size and facility of piped water on the child survival and confirmed that higher birth order increases the risk of under-five child mortality.

If our analysis is valid, then the findings have many policy implications. The possible transfer of poor health on the next generation through poor health of girl child is a matter of grave concern and if India wishes to attain its child mortality MDG goal, it has to focus on possible future mother's health and nutritional status, particularly in rural areas.

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Table 1: Childhood mortality trend in India: 1991-2006

Mortality rates	1991-92			1998-99			2005-06		
	Rural	Urban	All India	Rural	Urban	All India	Rural	Urban	All India
Neonatal mortality rates (NMR)[11]	52.9	34.1	48.6	46.7	31.7	43.4	42.5	28.5	39.0
Postneonatal mortality rates (PNMR)[12]	32.2	22.0	29.9	26.6	15.4	24.2	19.7	13.0	18.0
Infant mortality rates ($_1q_0$)[13]	85.0	56.1	78.5	73.3	47.0	67.6	62.2	41.5	57.0
Child mortality rates ($_4q_1$)[14]	37.6	19.6	33.4	32.8	16.9	29.3	21.0	10.6	18.4
Under-5 mortality rates ($_5q_0$)[15]	119.4	74.6	109.3	103.7	63.1	94.9	82.0	51.7	74.3

Source: derived from IIPS (2007)

[11] defined as the probability of dying in the first month of life
[12]defined as the probability of dying after the first month of life but before the first birthday and computed as the difference between the infant and neonatal mortality rates
[13]defined as the probability of dying before the first birthday
[14]defined as the probability of dying between the first and fifth birthdays
[15] defined as the probability of dying before the fifth birthday

Table 2: Per 1000 child mortality and maternal health profile in rural India

Disease and Nutritional status	Children: alive	Children: dead	Difference	Pearson Chi-square test&
Suffer from TB (per 1000)	5.06	7.75	-2.69	chi2(1) = 6.48**
Suffer from Asthma (per 1000)	11.47	15.81	-4.34	chi2(1) = 6.2029**
Suffer from Diabetes (per 1000)	3.37	7.26	-3.89	chi2(1) = 15.42***
Suffer from Thyroid (per 1000)	5.20	5.98	-0.78	chi2(1) = 0.1776
Suffer from any diseases (per 1000)	23.55	35.58	-12.03	chi2(1) = 17.60***
Underweight (per 1000)	422.41	438.31	-15.9	chi2(1) = 8.26***
Normal (per 1000)	539.26	529.22	10.04	chi2(1) = 2.85*
Overweight (per 1000)	38.33	32.47	5.86	chi2(1) = 6.498**
No Anemia (per 1000)	377.27	353.03	24.24	chi2(3) = 63.73***
Severe Anemia (per 1000)	17.94	31.90	-13.96	
Moderate Anemia (per 1000)	183.21	231.92	-48.71	
Mild Anemia (per 1000)	421.58	383.15	38.43	

&here, the null hypothesis of independence of discrete health and child mortality attributes are tested.
Figures in parenthesis are the degrees of freedom. ***p<0.01, **p<0.05, *p<0.10.

Table 3: Per 1000 child mortality and maternal health profile in rural India

Maternal Health	Children: alive		Children: dead		Diff.	Variance ratio test	Two-sample t test with unequal variances^
	Mean	Standard error	Mean	Standard error	Mean		
Average height (in cm)	151.69	0.03	150.54	0.14	1.16	F (30666, 1944)= 0.9331**	t (2180.42)= 8.2262***
Average weight (in kg)	45.53	0.04	44.26	0.16	1.27	F (30667, 1944)= 1.1529***	T(2237.93) = 7.5249***
BMI	19.76	0.02	19.50	0.06	0.26	F (30640, 1944)= 1.1381***	t (2234.3)= 4.0221***

Note: figures in parenthesis are degrees of freedom. Based on results of variance ratio test unequal variance is assumed and Satterthwaite's degrees of freedom for t-distribution are used. ***p<0.01, **p<0.05, *p<0.10.

Table 4: Definition and descriptive statistics for variables used in the analysis

Variables	Definition	%	Mean	SD	Min	Max
Dependent variable						
Child mortality	1 if under-5 death	6.60	-	-	0	1
Explanatory variables						
Mother's health characteristics						
Presence of any disease	1 if suffer from any of the TB, asthma, diabetes and thyroid	2.43	-	-	0	1
Anemia level: no anemia (reference category)	1 if not suffer from anemia	37.57	-	-	0	1
Anemia level: severe/moderate	1 if level of anemia is severe or moderate	20.53	-	-	0	1
Anemia level: mild	1 if level of anemia is mild	41.90	-	-	0	1
Height	Height (cm)	-	151.35	5.78	121.40	198.90
Height square	Square of height (cm^2)	-	22941.16	1754.90	14737.96	39561.21
Weight	Weight (kg)	-	44.46	7.26	15.10	148.70
Weight square	Square of weight (kg^2)	-	2029.37	722.77	228.01	22111.69
BMI	Body mass index	-	19.38	2.74	12.04	59.62
Square of BMI	Square of BMI	-	383.14	117.79	144.96	3554.54
Underweight	1 if BMI<18.5	42.35	-	-	0	1
Normal	1 if BMI>18.5-24.99	53.86	-	-	0	1
Overweight (reference category)	1 if BMI>25.0	37.95	-	-	0	1
Mother's other characteristics						
Age group: 15-19 (reference category)	1 if age group 15-19 years	7.20	-	-	0	1
Age group: 20-34	1 if age group 20-34 years	83.46	-	-	0	1
Age group: 35-49	1 if age group 35-49 years	9.34	-	-	0	1
Education: higher	1 if education is higher than …….	2.10	-	-	0	1
Ever-employed	1 if ever employed	21.31	-	-	0	1
Reading newspaper and magazine	1 if reading newspaper and or magazines	19.07	-	-	0	1
Listening radio	1 if listening radio	39.22	-	-	0	1
Watching TV	1 if watching TV	44.11	-	-	0	1
Child characteristics						
Gender of child	1 if child is male	51.76				
Birth order	Number of birth order	-	2.89	1.98	1.00	14.00
Household characteristics						
SC	1 if scheduled castes	22.17	-	-	0	1
ST	1 if scheduled tribes castes	12.13	-	-	0	1
OBC	1 if other backward castes	42.51	-	-	0	1
Others (reference category)	1 if other castes	23.09	-	-	0	1
Hindu	1 if religion is Hindu	80.22			0	1
Size of household	Number of family members	-	7.09	3.34	1.00	35.00
Household type: pucca	1 if household is pucca, 0 if kachha or semi pucca	23.26	-	-	0	1
Household head: male	1 if household head is male	88.19	-	-	0	1
Water facility: piped water	1 if piped water facility is variable	8.83	-	-	0	1

Table 5: Effect of disease presence and anemia level of mother on child mortality

Dependent variable	Child mortality			
Specification	Specification 1		Specification 2	
Explanatory variables	Odds Ratio	Marginal Effects	Odds Ratio	Marginal Effects
Mother's Health Characteristics				
Presence of any disease	1.619***(0.286)	0.033**(0.015)	-	-
Anemia level: severe/moderate	-	-	1.225**(0.100)	0.012** (0.005)
Anemia level: mild	-	-	0.904(0.064)	-0.006(0.004)
Mother's other characteristics				
Age group: 20-34	0.660***(0.079)	-0.026***(0.008)	0.662***(0.080)	-0.026***(0.009)
Age group: 35-49	0.629***(0.105)	-0.022***(0.007)	0.663**(0.113)	-0.020*** (0.007)
Education: higher	0.693(0.226)	-0.017(0.013)	0.669(0.220)	-0.019(0.013)
Ever-employed	1.008(0.075)	0.000(0.004)	1.026(0.077)	0.001(0.004)
Reading news paper and magazine	0.777***(0.077)	-0.013***(0.005)	0.780** (0.078)	-0.013***(0.005)
Listening radio	1.053(0.070)	0.003(0.004)	1.099(0.074)	0.005(0.004)
Watching TV	0.866**(0.060)	-0.008**(0.004)	0.841**(0.059)	-0.010**(0.004)
Child characteristics				
Gender of child	0.852***(0.050)	-0.009***(0.003)	0.856***(0.051)	-0.009***(0.003)
Birth order	1.038*(0.022)	0.002*(0.001)	1.023(0.023)	0.001(0.001)
Household characteristics				
SC	1.143(0.107)	0.008(0.006)	1.141(0.108)	0.008(0.006)
ST	1.089(0.122)	0.005(0.007)	1.054(0.119)	0.003(0.007)
OBC	0.936(0.083)	-0.004(0.005)	0.895(0.081)	-0.006(0.005)
Hindu	0.889(0.076)	-0.007(0.005)	0.868(0.076)	-0.008(0.005)
Size of household	0.895***(0.018)	-0.006***(0.001)	0.902***(0.018)	-0.006***(0.001)
Household type: pucca	1.048(0.088)	0.003(0.005)	1.041(0.089)	0.002(0.005)
Household head: male	1.134(0.119)	0.007(0.005)	1.159(0.124)	0.008(0.005)
Water facility: piped water	0.749**(0.098)	-0.014**(0.006)	0.733** (0.098)	-0.016***(0.006)
Wald chi2(46)	228.98***	-	232.47***	-
Pseudo R2	0.0272	-	0.0276	-
Log pseudolikelihood	-6794.7866	-	-6384.6386	-
Number of observations	28916	-	27053	-

Note: estimation results for 28 state level dummies are not presented here; however, these can be obtained from the author. ***p<0.01, **p<0.05, *p<0.10

Table 6: Effect of maternal height and weight on child mortality

Dependent variable	Child mortality			
Specification	Specification 3		Specification 4	
Explanatory variables	Odds Ratio	Marginal Effects	Odds Ratio	Marginal Effects
Mother's health characteristics				
Height	0.762**(0.087)	-0.015**(0.006)	-	-
Height square	1.001**(0.000)	0.000**(0.000)	-	-
Weight	-	-	0.966**(0.014)	-0.002**(0.001)
Weight square	-	-	1.000**(0.000)	0.000**(0.000)
Mother's other characteristics				
Age group: 20-34	0.673***(0.080)	-0.025***(0.008)	0.667***(0.080)	-0.026***(0.009)
Age group: 35-49	0.668**(0.113)	-0.020***(0.007)	0.664**(0.113)	-0.020***(0.007)
Education: higher	0.728(0.228)	-0.016(0.013)	0.731(0.230)	-0.015(0.014)
Ever-employed	1.029(0.077)	0.002(0.004)	1.020(0.076)	0.001(0.004)
Reading news paper and magazine	0.791(0.078)	-0.012**(0.005)	0.788**(0.078)	-0.013***(0.005)
Listening radio	1.077(0.072)	0.004(0.004)	1.074(0.072)	0.004(0.004)
Watching TV	0.849**(0.059)	-0.009**(0.004)	0.853**(0.060)	-0.009**(0.004)
Child characteristics				
Gender of child	0.867**(0.051)	-0.008**(0.003)	0.864**(0.051)	-0.008**(0.003)
Birth order	1.025(0.023)	0.001(0.001)	1.025(0.023)	0.001(0.001)
Household characteristics				
SC	1.116(0.105)	0.006(0.006)	1.130(0.107)	0.007(0.006)
ST	1.055(0.118)	0.003(0.006)	1.059(0.119)	0.003(0.007)
OBC	0.900(0.080)	-0.006(0.005)	0.906(0.081)	-0.006(0.005)
Hindu	0.870(0.075)	-0.008(0.005)	0.874(0.075)	-0.008(0.005)
Size of household	0.902***(0.018)	-0.006***(0.001)	0.902***(0.018)	-0.006***(0.001)
Household type: pucca	1.058(0.090)	0.003(0.005)	1.058(0.090)	0.003(0.005)
Household head: male	1.138(0.120)	0.007(0.005)	1.140(0.120)	0.007(0.005)
Water facility: piped water	0.748**(0.098)	-0.015**(0.006)	0.748**(0.098)	-0.015**(0.006)
Wald chi2(47)	236.66***	-	222.39***	-
Pseudo R2	0.0276	-	0.0260	-
Log pseudolikelihood	-6769.6569	-	-6780.8092	-
Number of observations	28691	-	28691	-

Note: estimation results for 28 state level dummies are not presented here; however, these can be obtained from the author. ***p<0.01, **p<0.05, *p<0.10

Table 7: Effect of maternal body mass index (BMI) on child mortality

Dependent variable	Child mortality			
Specification	Specification 5		Specification 6	
Explanatory variables	Odds Ratio	Marginal Effects	Odds Ratio	Marginal Effects
Mother's health characteristics				
BMI	0.965(0.043)	-0.002(0.003)	-	-
Square of BMI	1.001(0.001)	0.000(0.000)	-	-
Underweight	-	-	0.801(0.143)	-0.012(0.010)
Normal	-	-	0.763(0.134)	-0.015(0.010)
Mother's other characteristics				
Age group: 20-34	0.663***(0.079)	-0.026***(0.009)	0.661***(0.079)	-0.026***(0.009)
Age group: 35-49	0.657**(0.112)	-0.020***(0.007)	0.654**(0.111)	-0.021*** (0.007)
Education: higher	0.718(0.226)	-0.016(0.013)	0.713(0.226)	-0.017(0.013)
Ever-employed	1.024(0.076)	0.001(0.004)	1.023(0.076)	0.001(0.004)
Reading news paper and magazine	0.778**(0.077)	-0.013***(0.005)	0.775** (0.077)	-0.013***(0.005)
Listening radio	1.076(0.072)	0.004(0.004)	1.077(0.073)	0.004(0.004)
Watching TV	0.846**(0.059)	-0.009**(0.004)	0.844**(0.059)	-0.009**(0.004)
Child characteristics				
Gender of child	0.863**(0.051)	-0.008**(0.003)	0.862**(0.051)	-0.008** (0.003)
Birth order	1.026(0.023)	0.001(0.001)	1.025(0.023)	0.001(0.001)
Household characteristics				
SC	1.146(0.108)	0.008(0.006)	1.147(0.108)	0.008(0.006)
ST	1.071(0.120)	0.004(0.007)	1.072(0.120)	0.004(0.007)
OBC	0.911(0.081)	-0.005(0.005)	0.912(0.081)	-0.005(0.005)
Hindu	0.878(0.076)	-0.008(0.005)	0.878(0.076)	-0.008(0.005)
Size of household	0.900*** (0.018)	-0.006***(0.001)	0.901***(0.018)	-0.006***(0.001)
Household type: pucca	1.042(0.089)	0.002(0.005)	1.041(0.089)	0.002(0.005)
Household head: male	1.142(0.121)	0.007(0.005)	1.140(0.120)	0.007(0.005)
Water facility: piped water	0.745**(0.098)	-0.015**(0.006)	0.744**(0.097)	-0.015** (0.006)
Wald chi2(47)	218.30***	-	220.03***	-
Pseudo R2	0.0256	-	0.0258	-
Log pseudolikelihood	-6781.5115	-	-6779.9206	-
Number of observations	28667	-	28667	-

Note: estimation results for 28 state level dummies are not presented here; however, these can be obtained from the author. ***p<0.01, **p<0.05, *p<0.10.