Household Decisions to Utilize Maternal Healthcare in Rural and Urban India

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Abstract
With the onset of pregnancy, a household must add the health of the expectant mother and the unborn child to its overall objective. Data from the Government of India's National Sample Survey Organization is utilized to analyze the determinants of women's decisions to register for pre- and postnatal healthcare, utilize maternal healthcare and select a place for childbirth. The data show that the level of schooling mothers have attained has a significant, positive effect on decisions to register and utilize these healthcare services in both rural and urban areas. In contrast, distance to a maternal health facility centre inhibits decisions to register for and utilize these services in rural India. In addition, awareness of healthy behaviour and factors that affect such knowledge at the household and community level are key determinants of whether maternal–child healthcare services are used. The findings demonstrate that the health status of women and children in India can be improved significantly by strengthening IEC (Information, Education and Communication) efforts on the demand side and reducing access barriers on the supply side.

1. Introduction

The United Nations' Millennium Development Goals, set to reduce poverty by 2015, place a strong emphasis on child and maternal health. Of the eight goals, one is to reduce the child mortality rate by two thirds and another is to improve maternal health. The combination of these two is an important input to a third goal: promote gender equality and empower women.

India is at the forefront of a struggle to achieve these Millennium Development Goals. While the child (under five) mortality rate has declined from 202 (per 1,000 live births) in 1970 to 93 in 2001, this is still above the average for all developing countries (United Nations Development Programme [UNDP] 2003: Table 8). Abusaleh Shariff and Geeta Singh (2000) report more than half the children have a low birth weight and a low probability of survival. The incidence of child stunting is reported as 46% (UNDP 2003: Table 7). Stunting is defined largely by malnutrition and secondarily by illness, and it often begins in the womb.

Maternal mortality in India is about 400 maternal deaths per 100,000 live births. Lack of access to and use of appropriate maternal healthcare services during pregnancy and childbirth are responsible for most of the deaths. Utilization of maternal healthcare services is often hindered by lack of literacy combined with limited access. Furthermore, many women in rural areas receive little additional nutrition during pregnancy. One World Bank report suggests that iron-deficiency anemia is widespread among Indian women and affects 50% to 90% of pregnant women adversely. In order to address the health status of women, the government of India initiated several programs in the 1990s (such as the Family Welfare Program, Child Survival and Safe Motherhood Program, Integrated Rural Development Program, etc.). Most of these programs were designed to improve the health status of women and children and reduce maternal and child mortality. Among other things, the safe motherhood component of the program emphasizes expansion of maternal healthcare facilities covering rural and remote areas for providing obstetric care.

An important means to reduce child mortality and improve health for mother and children is access to and use of appropriate pre- and postnatal care. The purpose of this paper is to analyze household decisions that determine utilization of pre- and postnatal care, including place of child delivery. Understanding the underlying decision processes of these three dominant forms of care is essential to designing effective health policy in developing countries. The basis for this analysis is data from the government of India's National Sample Survey Organisation.

After a brief overview of relevant literature, we summarize the information provided in the National Sample Survey on the number of pregnant women registered for pre- and postnatal care, the selected place for childbirth, and utilization of selected prenatal care services. A logit model is then employed to analyze the determinants of registration for pre- and postnatal care, utilization of maternal healthcare and choice of location for childbirth. In order to understand the determinants of the extent of utilization, a negative binomial regression model is employed to model the number of visits to pre- and postnatal health clinics.

The National Sample Survey has an urban and a rural component. This enables analysis of determining factors in rural and urban areas, plus some comparison of the results obtained from the two surveys. Specifically, comparing urban and rural results will shed some light on the peculiar rural–urban differences such as the provision of health services, perceived need and use among pregnant women, health-seeking behaviour, barriers to access, economic status, and the status or position of women in society that shapes decisions to register for pre- and postnatal healthcare.

2. The Maternal and Child Health Production Processes

With the onset of pregnancy, a household's utility function will be expanded to include the health of the expectant mother and the unborn child. Given a family's budget constraint, its knowledge of a health production function and all aspects of its ability to act on this knowledge, the household will strive to meet these new elements in its utility function. These efforts will be shaped as well by the maternal and child health production processes available to households.

Utilization of Maternal and Child Health Production Processes

Registering for pre- and postnatal care is a first step in decisions to utilize these services. A household decision to register for available maternal–child health production processes is a function of (1) household awareness of these processes, (2) household access to the processes and (3) the expectant mother's ability to act on her knowledge of accessible production processes.

Awareness at the household level is primarily the product of generations of accumulated wisdom and experience. This knowledge will be modified as a product of educating household members, especially the expectant mother, and of healthcare facilities being established in proximity to the household (Barrera 1990; Strauss and Thomas 1995). Current experience also modifies traditional knowledge. For example, previous pregnancies affect the timing of when women first seek some form of prenatal care. Difficulties in previous pregnancies are more likely to cause women to seek assistance relatively early in the pregnancy (Enderlein et al. 1994; Matthews et al. 2001).

Awareness of health production processes is hard to measure. A study carried out more than 20 years ago reported that only 11% of the women sampled were aware of maternal–child health programs (Smucker et al. 1980). To update this analysis, we utilize data on whether or not expectant mothers and new mothers have registered within the healthcare system as an indicator of awareness of pre- and postnatal healthcare.

Given a household's awareness level, there is then the question of access. Poverty may well limit access to adequate nutrition, potable water, sanitation facilities and sanitary practices. Further, limited household income can constrain access to better quality private healthcare (Matthews et al. 2001). Access also is defined by distance to available health services (e.g., an *Anganwadi* Child Care Centre), including convenience for women to travel that distance (Barrera 1990; Govindasamy 2000; Shariff and Singh 2000).

Given awareness and accessibility, the mother still makes decisions on whether or not to act on what she knows and what is accessible. Mothers, as primary healthcare providers within a household, may make allocation decisions that place the well-being of husbands and existing children above that of her own health and the health of children as yet unborn (Govindasamy 2000).

The literature indicates that several factors are significant in shaping such healthcare utilization decisions. The first is education levels within the household, including schooling completed by the mother. We have noted that education expands knowledge and reduces the cost of obtaining information. It also serves to indicate a willingness to invest in human capital, which would include better nutrition and household practices intended to affect the health of the child (Barrera 1990; Shariff and Singh 2000). Education also affects household preferences, given prices, income and knowledge (Barrera 1990; Govindasamy 2000; Smucker et al. 1980). Finally, education can affect efficiency by increasing the productivity of health inputs received and purchased (Barrera 1990). One example is the effect of education on fertility reduction, and hence the spacing of children (Vlassoff 1991). Also, education correlates negatively with breastfeeding, but the effect of education on other postnatal health processes more than offsets the negative effect of reduced breastfeeding (Strauss and Thomas 1995).

A second factor that affects maternal–child health utilization decisions in India is economic status and freedom of movement for women. Women with greater freedom obtain higher levels of prenatal care and are more likely to opt for safe delivery care. Bloom et al. (2001) conclude this effect of freedom of movement on utilizing maternal–child healthcare is comparable to that of 12 years of schooling.

One indicator of freedom of movement is a woman employed outside the home. The evidence here is mixed. Shariff and Singh (2000) note women employed for wages face fewer movement restrictions. They conclude, though, that this primarily affects the choice of child delivery services. In contrast, women employed outside the home are less likely to opt for a trained birth attendant (Bloom et al. 2001). It appears that an important variable is whether the employment involves cash remuneration. If so, it increases the opportunity cost of taking time off to seek prenatal care, but it increases a household's ability to pay for health services, including a trained birth attendant (Shariff and Singh 2000). In Egypt, Govindasamy (2000) reports that women who were in the labor market, but not for cash income, were less likely to receive tetanus toxoid. Working for cash, at least when employed by the government, includes some maternity care services, and this affects health utilization decisions (Govindasamy 2000).

Two factors that have significant negative effects on the utilization of maternal–child healthcare are age of the mother and parity (i.e., the number of children a woman has). These two variables have a high, direct correlation, so studies tend to enter one or the other but not both (e.g., Bloom et al. 2001). Govindasamy (2000) reports a significant negative correlation between age/parity and utilizing prenatal care in general and receiving tetanus toxoid specifically. Shariff and Singh (2000) conclude that it is not possible to sort out whether this negative correlation means parents have more experience and hence require less external healthcare assistance, or whether a lower birth order signifies a feeling of "unwantedness" for the expected child.

Maternal and Child Health Production Processes

An ability to affect maternal–child health depends on the elements of health production available to households in a community. Primary elements of this production function include a clean environment, quality of water, sanitation practices and facilities, adequate nutrition and availability of healthcare facilities.

Water and sanitation tend to have a powerful impact on maternal and child health (Barrera 1990; Strauss and Thomas 1995). This is likely a factor in why infant mortality and child mortality and morbidity are typically lower in urban than in rural areas in countries such as India. Even so, environmental factors can significantly aggravate the situation. For example, the presence of tetanus spores within a household rises significantly if the household has large animals (Smucker et al. 1980).

The provision of adequate nutrition is the part of the health production function most directly within the household's control. This starts with the health of the mother and continues through breastfeeding and introducing supplementary nutrients for the young child. Poverty may well affect this process in several ways. There may not be an adequate supply of food or the range of nutrients available may be inadequate for maternal and child health. In addition, the quality and safety of the food is affected by the water and sanitation facilities and practices. Where inadequate, adverse effects such as diarrhea can rob mother and child of necessary strength and health.

Availability of healthcare facilities and programs can contribute significantly to the overall health and survival rates of children. Basic elements of such healthcare include the following:

- prenatal examinations for the mother to determine her nutritional and overall health status (e.g., weight recorded, blood pressure recorded, hemoglobin estimated and urine checked);
- advice on proper nutrition and sanitation;
- access to basic nutrient supplements as required (e.g., distribution of iron and folic acid supplements);
- identification of risk factors that might require specialized treatment and care, especially during child delivery;
- provision of immunization (e.g., tetanus toxoid for the mother and measles vaccine for the child);
- advice and guidance on breastfeeding;
- the timing and nature of food supplements for a young child;
- treatment for diarrhea and acute respiratory infections; and
- advice on fertility control and provision of related services to reduce the number of pregnancies and increase the time interval between pregnancies.

India has attempted to establish a universal public healthcare delivery system. Given severe resource constraints, the most notable achievements are in the areas of increased immunization and reduced fertility (Berman 1998). The most effective healthcare facilities in delivering prenatal care are the village-level *Anganwadi* Child Care Centres instituted as part of the Integrated Child

Development Program, popularly known as IRDP (Shariff and Singh 2000). While trained and untrained *dais* (i.e., traditional birth attendants or midwives) are primary caregivers for child delivery services, they play a limited role in providing prenatal care (Matthews et al. 2001). They admit having little to offer in the way of treatment and have no medicines to administer, so women seek such assistance elsewhere (Shariff and Singh 2000).

India has instituted a system of prenatal cards that are kept by the women. This form of record keeping, transferable among various providers of maternal and child health services, can facilitate a more comprehensive delivery of relevant services by the healthcare system. Adding notes of advice given and actions taken by private practitioners to these records would make them more complete and hence effective (Matthews et al. 2001).

3. Data Source

The data source for the empirical exercise is the 52nd round of the National Sample Survey (NSS) data, a nationally representative recent survey conducted by the National Sample Survey Organization (NSSO), Ministry of Statistics, Government of India from July 1995 to June 1996. The survey covered utilization of maternity and child healthcare services, morbidity and utilization of medical services, and problems of aged persons. In this paper, we are analyzing household responses related to the maternal and child healthcare components. The NSS survey also contains a wealth of socioeconomic and demographic information on individual, household and community-level characteristics.

The NSSO adopted a two-stage stratified sampling design. The first stage units were census villages in rural areas and NSSO urban blocks in urban areas; the second stage units were households in both rural and urban areas.[1] The actual numbers of households surveyed on healthcare in rural and urban areas were 71,284 and 49,658, spread over a sample of 7,663 villages and 4,991 urban blocks, respectively. The survey covered the whole of India, except for some interior areas of Nagaland, Andaman and Nicobar Islands, and the Ladakh, Kargil and Dodha districts of Jammu and Kashmir.

Regarding maternal and child healthcare utilization data, the survey collected information on the details of healthcare received by children below five years of age and maternity care received by pregnant women during 365 days prior to the date of survey for each sample household. The survey asked questions about immunization of children, pregnant women and nursing mothers, registration of children and women for pediatric care, pre- and postnatal care and food supplements received and medical attention during childbirth.

The ability to analyze household decisions to utilize maternal healthcare services is limited by the cross-sectional nature of the data. The content of the National Sample Survey limits the analysis primarily to characteristics of the women involved and the households in which they reside. Through the village characteristics data, we are also able to extract information on distance to a nearest maternal health centre and bus service to the village. Given the information available, we seek to address the following issues:

1) What is the effect of mother's schooling on her decision to register for pre- and postnatal care, use maternal healthcare services and select a place for childbirth?
2) What is the impact of the characteristics of the household – number of female adults available in the household, scheduled caste and scheduled tribe (the economically and socially disadvantaged class) – on a decision to register for pre- and postnatal care, use maternal healthcare services and select a place for childbirth?
3) What is the effect of awareness at the household level on a decision to register for pre- and postnatal care, use maternal healthcare services and select a place for childbirth?
4) What is the impact of distance from maternal–child health facility and whether or not this affects a decision to register for prenatal and postnatal care, use maternal healthcare services and select a place for childbirth?

4. A Summary of Survey Data on Maternal–Child Health in India

Maternal healthcare services consist of prenatal care, medical attention during child delivery and postnatal care. High maternal mortality rates coupled with lower utilization of prenatal care, delivery at home and postnatal care, and consequent high infant mortality rates, are observed widely across socioeconomic groups and geographical regions in India, particularly in rural areas. The substantial variation in utilization of maternal services may be due to striking differences in health-seeking behaviour of people across socioeconomic groups on the demand side and access barriers on the supply side. The social, economic and cultural dimensions embedded within the Indian social system may in turn govern the health-seeking behaviour of women.

Prenatal Care

Prenatal care services are part of primary healthcare services for pregnant women and include regular medical checkups, medical advice regarding health, hygiene and nutrition related to pregnancy and child-bearing. Pregnant women who register for prenatal care and who visit on a regular basis usually receive iron and folic acid tablets and are vaccinated against tetanus.

The NSS data (see Table 1) show that only 45% of rural and 70% of urban pregnant women aged 15 to 49 were registered for prenatal care (including those registered because they were ill, and advice of ANM (Auxiliary Nurse Midwife), and others). This is a marked increase from the 11% reported by Smucker et al. (1980) some twenty years earlier. Table 2 shows the type of institutions where pregnant women registered for prenatal care. This distribution shows that health-seeking behaviour and provision of adequate prenatal care services remain critical in rural India and need the attention of public policy makers.

Table 1. Number of pregnant women registered for prenatal care in rural and urban areas by reasons for seeking care (aged 15–49 years)

Reasons for seeking care	Rural		Urban	
	Sampled	Estimated (00)	Sampled	Estimated (00)
Routine prenatal care	5,873 (28.58)	59,304 (25.19)	6,982 (57.50)	28,081 (53.15)
Felt ill	675 (3.29)	7,036 (2.99)	442 (3.64)	1,849 (3.5)
ANM/LHV advised	2,039 (9.92)	25,028 (10.63)	572 (4.71)	2,396 (4.53)
Other	420 (2.04)	3,721 (1.58)	411 (3.38)	1,711 (3.24)
Registered	**9,175 (44.65)**	**96,667 (41.06)**	**8,544 (70.37)**	**34,619 (65.52)**
Total	20,549	235,442	12,142	52,834
Non-registered	**11,374 (55.35)**	**138,775 (58.04)**	**3,598 (29.63)**	**18,215 (34.48)**

Figures in parenthesis are respective percentages. These numbers differ slightly from the NSSO Report as we do not account for missing cases.
Source: Based on NSSO (1998).

Ideally, two doses of the vaccine against tetanus are required for pregnant women. Table 3 shows that in rural areas 93% of pregnant women who had registered for prenatal care and 30% who had not registered took tetanus toxoid. The corresponding figures in urban areas were 96% and 50%

respectively. This indicates that those who register for prenatal care undoubtedly receive a much better level of services, including the tetanus toxoid vaccine.

Table 2. Number of pregnant women registered for prenatal care per 1,000 Pregnant Women in Rural and Urban Areas by Type of Institution Care

Type of Institution	Rural	Urban	All
Public hospital	293	433	341
PHC	357	68	258
Public dispensary	50	18	39
Private hospital	133	219	163
Nursing home	39	135	72
Charitable home	2	14	6
ESI doctor/AMA	3	4	3
Private doctor	113	102	110
Other	6	6	6
Total[a]	1,000	1,000	1,000

[a] Includes not-reported cases.
Source: Based on NSSO (1998).

Table 3. Distribution of pregnant women by number of doses of tetanus toxoid received in rural and urban areas

Doses	Rural		Urban	
	Registered for Prenatal Care	Not Registered for Prenatal Care	Registered for Prenatal Care	Not Registered for Prenatal Care
One dose	2,452 (27.56)	1,254 (12.47)	2,149 (25.91)	590 (19.61)
Two doses	5,850 (65.75)	1,762 (17.52)	5,782 (69.70)	925 (30.74)
Not received	596 (6.7)	7,042 (70.01)	364 (4.39)	1,494 (49.65)
Total	8,898	10,058	8,295	3,009
Total[a]	**8,951 (47.02)**	**10,087 (52.98)**	**8,324 (73.4)**	**3,017 (26.6)**

[a] Includes cases for which no tetanus information was available.
Figures in brackets are respective percentages.
The sample size differs from the NSSO (1998) because the numbers are calculated from the sample generated from the NSSO Data after missing cases are deleted.

In addition, anemia is a major health concern among pregnant women in India. To control for this, iron and folic acids (IFA) are distributed at designated prenatal care centres. Table 4 shows that in rural areas 81% of those registered for prenatal care and 13% of those not registered received some

IFA tablets. The corresponding figures in urban areas are 83% and 24% respectively.

Although some pregnant women have received IFA tablets and one or two doses of vaccine against tetanus without registering for prenatal care, continuous monitoring of the health of pregnant women and issues relating to child-bearing necessitates registration. Moreover, provision of this formal care is limited in rural areas and eligibility for food supplements during pregnancy is determined only if the woman is registered for prenatal care.

Table 4. Distribution of pregnant women by number of IFA tablets received in rural and urban areas

Number of Tablets Received	Rural		Urban	
	Registered for Prenatal Care	Not Registered for Prenatal Care	Registered for Prenatal Care	Not Registered for Prenatal Care
1–49	2,154 (24.27)	474 (4.82)	1,863 (22.52)	258 (8.82)
50–99	3,589 (40.44)	597 (6.07)	3,258 (39.38)	311 (10.63)
100 or more	1,463 (16.48)	181 (1.84)	1,721 (20.8)	147 (5.02)
Not received	1,669 (18.81)	8,581 (87.27)	1,432 (17.31)	2,210 (75.53)
Total	8,875	9,833	8,274	2,926
Total[a]	**8,951 (47.02)**	**10,087 (52.98)**	**8,324 (73.4)**	**3,017 (26.6)**

[a] Includes cases for which no IFA information was available.
Figures in brackets are respective percentages.
The sample size differs from the NSSO (1998) because the numbers are calculated from the sample generated from the NSSO Data after missing cases are deleted.

Healthcare during Child Delivery

Provision of adequate medical attention during and after delivery is important for the well-being of mother and child. Absence of such care and lack of hygienic conditions at the time of birth may lead to complications leading to increased risk of maternal or child death, or both.

Table 5 shows that 75% and 38% of childbirths are taking place at home in rural and urban areas respectively. The NSS data show that 36% of births in rural areas and 16% of births in urban areas lacked medical attention. This suggests a sizable proportion of home births do not receive adequate medical care.

Postnatal Care

Postnatal care is another important component of maternal healthcare in India. Postnatal registration is vital to receive appropriate medical advice and to regain health after the strains of child-bearing on the mother and for the well-being of the newborn baby. For instance, postnatal care includes advice on nutrition in food for the mother so as to feed her baby with her own milk, and advice on receiving free medicine, tonic, other vitamins, and food supplements, etc. Moreover, treatment of complications that might have occurred during the delivery requires attention of trained professionals.

The NSS data show that only 40% of urban mothers and 24% of rural mothers who delivered in the year prior to the survey date had registered for postnatal care. Table 6 shows the type of institutions where the mothers registered for this care.

Table 5. Distribution of mothers by place of childbirth (pregnant women during last 365 days and aged 15–49 years)

Place of Birth	Rural		Urban	
	Sampled	Estimated (00)	Sampled	Estimated (00)
Home	13,283 (75.2)	144,112 (77.87)	3,443 (32.12)	15,518 (37.76)
Medical facility	3,635 (20.58)	33,139 (11.91)	6,978 (65.1)	24,397 (59.37)
Other place	142 (0.8)	1,539 (0.83)	52 (0.5)	226 (0.55)
Total	**17,664**	**185,069**	**10,719**	**41,093**
Non-medical institution	**14,029 (79.42)**	**151,930 (88.09)**	**3,741 (34.9)**	**16,696 (40.63)**

Figures in parenthesis are respective percentages. These numbers differ slightly from the NSSO Report as we do not account for missing cases.
Source: Based on NSSO (1998).

Table 6. Number of mothers registered for postnatal care per 1,000 mothers in rural and urban areas by type of institution care

Type of Institution	Rural	Urban	All
Public hospital	325	421	360
PHC	336	65	236
Public dispensary	45	21	36
Private hospital	125	229	163
Nursing home	45	146	82
Charitable home	5	14	8
ESI doctor/AMA	8	5	7
Private doctor	86	78	83
Other	7	9	8
Total[a]	1,000	1,000	1,000

[a] Includes not-reported cases.
Source: Based on NSSO (1998

5. The Sample Size and Variable Construction

In this paper, we considered seven binary dependent variables: (a) **prenatal registration** – the decision to register (or not) for prenatal care of the sub-sample of women reported pregnant during the year preceding the survey date, (b) **prenatal use** – whether (or not) prenatal healthcare services were utilized (i.e., made at least one visit to the prenatal health centre) by the sub-sample of women, (c) **tetanus toxoid** – whether (or not) one or two doses of tetanus toxoid were received by the sub-sample, (d) **IFA tablets** – whether (or not) iron folic tablets were received by the sub-sample, (e) **childbirth** – the decision to deliver a child in a health institution (or not) of the sub-sample of

pregnant women delivered during the year preceding the survey date, (f) **postnatal registration** – the decision to register (or not) for postnatal care of the sub-sample of pregnant women delivered during the year, and (g) **postnatal use** – whether (or not) postnatal care was utilized (i.e., made at least one visit to the postnatal health centre) by the sub-sample of pregnant women delivered during the year preceding the survey date. In order to analyze the extent of utilization of pre- and postnatal care, we used the number of visits as our measure of outcome. Note that the number of visits to prenatal care centres is truncated at 11 as there are small numbers of observations beyond this limit. Similarly, the number of visits to postnatal care centres is truncated at seven.

Table 7. Summary data on pregnancies of ever-married women below 50 years of age

A LOOK AT THE RAW DATA **Particulars of pregnancy(ies) of ever married women of age below 50 years**			
	Response Items	Urban	Rural
Whether pregnant during last year	Yes	12,143 (25.22%)	20,555 (27.38%)
	No	36,000 (74.78%)	54,507 (72.62%)
Whether registered for prenatal care (if pregnant during last year)	Yes	8,544	9,176
	No	3,094	10,376
	Missing	505	1003
Place of childbirth (if delivered during last year)	Institution	6,978	3,635
	Non-institution	3,495	13,425
	Missing	246	601
Whether registered for postnatal care (if delivered during last year)	Yes	4,641	4,556
	No	5,682	12,307
	Missing	396	798
Used prenatal care	>0 visits	8,448	9,017
Used postnatal care	>0 visits	4,436	4,333

The number of ever married women aged below 50 years who were pregnant during the last 365 days preceding the date of the NSS survey who were interviewed in rural and urban areas were 20,555 and 12,143, respectively. However, after deleting non-responses and missing cases, we are left with 19,032 and 11,337 relevant observations for prenatal care in rural and urban areas, respectively.[2] For those who were pregnant and delivered, the relevant observations are appropriate for studying the factors governing childbirth and the decision to utilize postnatal care. The corresponding valid observations for these two cases are 16,592 and 10,179 in rural and urban areas, respectively.

Individual Specific Variables

The individual level variables considered in this study are mother's age and mother's education. Age is represented by a continuous variable ranging from 14 to 49. Education is included as three dummies for primary, secondary, and higher secondary and above, with no education being the reference category. This representation has a nice interpretation since each coefficient provides incremental effects of education.

Household Specific Variables

At the household level, relevant explanatory variables within the data include the number of women aged 15 and above other than mother and caste. Presence of other household members in the family, especially adult and older women, has profound implications for a number of reasons. Presence of older women in the family may not only provide maternity and child health advice from their own experiences, but also render assistance at the time of delivery and caring for the baby. So, presence of the number of women other than mother in the household is considered an important familial variable.

Certain household characteristics are associated with stylized facts that are embedded in the economic, cultural and social values within the society. Four such important factors are considered here to reflect a complicated social system that is functional and governs important family decisions including utilization of maternal healthcare.

The scheduled caste and scheduled tribe people in rural India are, generally, not integrated well into society and the economy. So one might expect a different behavioural response from these groups. A dummy variable is entered that takes a value of 1 if the household belongs to the scheduled caste or scheduled tribe category; otherwise, the value is 0.

Awareness

Awareness at the household level is an important dimension of knowledge and health-seeking behaviour of people in both rural and urban areas. Sources of knowledge could be the direct product of past accumulated knowledge at the household level or new knowledge acquired through the IEC (Information, Education and Communication) program being implemented by the Ministry of Health and Family Welfare, Government of India. We have two such important dummy variables to measure knowledge that affects the awareness dimension in this study. One dummy variable takes the value 1 if any member of the household has knowledge of immunization of pregnant woman. The other dummy variable takes the value 1 if any member of the household has knowledge of oral rehydration therapy (ORT) for severe diarrhea.

Accessibility

The NSS survey collects no information about accessibility issues. Accessibility may not be a big issue in urban areas, but lack of access to primary maternal health services in rural areas is well documented. In this study, the access variables of interest are gleaned from the sample village characteristics provided with the NSS survey data.

Distance to a nearby maternal and child healthcare centre may be an important inhibiting factor governing utilization of maternal health services. After controlling for all other factors, we would that expect the higher the distance to a maternal health centre, the lower the utilization rates. Transportation may be another major impediment affecting utilization of maternal health services in rural areas. This is because availability of public transportation is poor, and private transportation is costly and unaffordable for the vast majority. Greater distance and lack of transportation may be a huge barrier to access in rural areas. In order to examine the interaction of distance and transportation availability, we conducted statistical tests of interaction effects (interaction terms of distance variables and a dummy variable that takes a value 1 if the village is connected by a bus service [operated publicly or privately]). We expected that access to transportation in the presence of distance barriers would lessen the impact of the barriers on utilization of maternal healthcare.

6. Estimation and Discussion of the Results

For the dichotomous outcome variables, logit or probit models are appropriate. However, one advantage of using a logit model is that it can be interpreted conveniently in terms of changes in the odds of observing the outcome 1 versus 0. Thus, we use a logit model for each binary outcome variable and present the odds ratios. For the non-negative integer outcome variables (i.e., the number of visits to pre- and postnatal centres), we employed a negative binomial model. Although a Poisson regression

model can be used to model such non-negative integer outcome variables, the equidispersion property that the conditional mean is equal to the conditional variance of Poisson regression model is a very restrictive assumption. In fact, the likelihood ratio test rejects the null hypothesis of equidispersion in favour of overdispersion, suggesting that the negative binomial model is preferable. For technical discussion on these issues, see Cameron and Trivedi (1998) and Sarma and Simpson (2006).

We use the same set of exogenous covariates for all the models and apply them to both rural and urban samples in order to make an assessment of how mother's education, awareness at the household level and access factors (in rural areas) determine utilization of maternal healthcare services in rural and urban India. The NSS data enable analysis of differences among states (i.e., provinces) in the utilization of maternal health services. In order to control for potential unobserved heterogeneity, we have used a state-fixed effects model in our analysis. This is captured by entering state dummy variables with Kerala as the reference category in our model. Although not presented here, the coefficients on state dummy variables are statistically significant in most instances and the detailed results are available from the authors upon request. In the rest of this section, we discuss the key policy interventions called for, based on the empirical findings, to improve upon utilization of and access to maternal healthcare services in rural and urban India.

The odds ratios for prenatal registration, prenatal use, tetanus toxoid received and IFA tablets received in rural areas are presented in Table 8a. Corresponding results for urban areas are presented in Table 8b. Table 9a presents the odds ratios for institutional birth, postnatal registration and postnatal use in rural areas. Corresponding results for urban areas are presented in Table 9b. Columns 1 and 3 of Table 10 present the negative binomial regression results for the number of visits to pre- and postnatal health facilities in rural areas. The corresponding results for urban areas are presented in columns 2 and 4 of Table 10.

Individual Factors Shaping Decisions

The effect of education on decisions to register and utilize prenatal care increases with higher levels of schooling attained. This result holds in both rural and urban areas. Holding all other variables constant, the odds of registering for prenatal care increases by 35%, 106%, and 180% respectively for primary, secondary and higher secondary levels of schooling relative to illiterates in rural areas. Similar results are found regarding use of prenatal care in rural areas. The odds of using prenatal care increase by 34%, 104% and 171% respectively for the three educational dummies. It can be clearly seen that educated women are more likely to have received tetanus toxoid and IFA tablets, the medications necessary for pregnant women. In urban areas, we find similarly strong results regarding the importance of education in utilization of prenatal care. As far as the extent of utilizing prenatal care is concerned, the negative binomial regression results show that educational dummies are positively significant at the 1% level of significance. Our results show that having primary, secondary and higher secondary levels of education lead to an increase in visits to prenatal care centres by 23%, 48% and 73% in rural areas and 28%, 52% and 91% in urban areas.

The positive contribution of education in the utilization of postnatal care and institutional birth. can be clearly seen from Tables 9a and 9b. Our results show that the odds of registering for postnatal care increase by 31%, 46% and 117% respectively for primary, secondary and higher secondary levels of schooling relative to illiterates in rural areas. For the use of postnatal care, the corresponding odds ratios in rural areas are 28%, 45% and 108%. In urban areas, the corresponding odds ratios for postnatal registration are 32%, 72% and 140%, and the odds ratios for postnatal use are 32%, 71% and 141% for primary, secondary and higher secondary and above. As far as the extent of utilization of postnatal care is concerned, our results show that having primary, secondary and higher secondary levels of education leads to an increase in visits to postnatal care centres by 24%, 36% and 69% in rural areas and 25%, 46% and 77% in urban areas.

Consistent with the findings in the literature, our empirical results show that the mother's education is a strong, positive determinant of registration and utilization of maternal healthcare services in both rural and urban areas. Moreover, we find that the incremental effects of education are

Table 8a. Determinants of prenatal care utilization in rural areas: logistic regression estimation
(All specifications include a set of State variables)

Variable	Registered for Prenatal Care	Utilized Prenatal Care	Tetanus Toxoid Received	IFA Tablets Received
	Odds Ratio	Odds Ratio	Odds Ratio	Odds Ratio
Mother's age	0.984*** (0.003)	0.985*** (0.003)	0.989*** (0.003)	0.990*** (0.003)
Mother's education – illiterate (reference category)				
Primary	1.352*** (0.064)	1.336*** (0.063)	1.549*** (0.075)	1.340*** (0.062)
Secondary	2.060*** (0.130)	2.042*** (0.129)	2.295*** (0.152)	1.995*** (0.121)
≥ Higher secondary	2.799*** (0.379)	2.706*** (0.365)	3.176*** (0.507)	2.241*** (0.292)
Number of women in the household	1.052*** (0.019)	1.053*** (0.019)	1.063*** (0.019)	1.026 (0.018)
Caste – upper caste (reference category)				
Scheduled caste or tribe	1.034 (0.042)	1.039 (0.043)	0.885*** (0.035)	1.057 (0.042)
Awareness on immunization	4.349*** (0.234)	4.514*** (0.246)	5.979*** (0.283)	4.087*** (0.219)
Awareness on ORT	1.095** (0.046)	1.102** (0.046)	1.088** (0.046)	1.279*** (0.046)
Average distance to the maternity or child centre – less than 2 km (reference category)				
2–5 km	0.782*** (0.046)	0.804*** (0.047)	0.936 (0.056)	0.896* (0.051)
5–10 km	0.716*** (0.042)	0.728*** (0.042)	0.936 (0.054)	0.850*** (0.048)
≥ 10 km	0.666*** (0.035)	0.669*** (0.035)	0.782*** (0.041)	0.846*** (0.043)
Bus service	1.269*** (0.052)	1.286*** (0.053)	1.332*** (0.054)	1.256*** (0.050)
McKelvey and Zavoina's R^2	0.474	0.480	0.388	0.418
Log likelihood	-9191.554	-9140.81	-9561.875	-9494.333
Observations	19032	19032	18950	18702
Test of interactions effects (interaction of bus service and distance variables)				
$\chi^2(3)$	7.72**	7.15*	2.76	2.27
$P > \chi^2(3)$	0.0521	0.0672	0.4305	0.5183

Robust standard errors in parentheses
*Significant at 10%. **Significant at 5%. ***Significant at 1%.

substantially higher since the magnitude of each education coefficient is substantially higher than the preceding level of education in all models. In order to attain the Millennium Development Goals, one of the government of India's long-term strategies is to invest in secondary and higher secondary education for girls. Adequate investment in education would produce better health outcomes for mothers and children and improve the health status of Indian women.

Table 8b. Determinants of prenatal care utilization in urban areas: logistic regression estimation ***(All specifications include a set of State variables)***

Variable	Registered for Prenatal Care	Utilized Prenatal Care	Tetanus Toxoid Received	IFA Tablets Received
	Odds Ratio	Odds Ratio	Odds Ratio	Odds Ratio
Mother's age	0.980*** (0.005)	0.978*** (0.005)	0.986** (0.006)	0.987*** (0.005)
Mother's education – illiterate (reference category)				
Primary	1.685*** (0.116)	1.637*** (0.112)	1.614*** (0.122)	1.370*** (0.088)
Secondary	2.594*** (0.179)	2.505*** (0.171)	2.476*** (0.196)	1.702*** (0.106)
≥ Higher secondary	4.611*** (0.411)	4.198*** (0.362)	3.766*** (0.405)	2.647*** (0.205)
Number of women in the household	1.012 (0.024)	1.000 (0.024)	1.125*** (0.032)	1.080*** (0.023)
Caste – upper caste (reference category)				
Scheduled caste or tribe	0.953 (0.062)	0.942 (0.061)	0.813*** (0.056)	1.049 (0.062)
Awareness on immunization	4.168*** (0.384)	4.054*** (0.370)	5.983*** (0.537)	3.530*** (0.316)
Awareness on ORT	1.381*** (0.088)	1.396*** (0.088)	1.204*** (0.086)	1.571*** (0.090)
McKelvey and Zavoina's R^2	0.386	0.372	0.284	0.274
Log likelihood	-4894.261	-5031.0129	-4033.475	-5847.232
Observations	11337	11337	11300	11196

Robust standard errors in parentheses
*Significant at 10%. **Significant at 5%. ***Significant at 1%.

The effect of age of women on prenatal care registration and utilization is negative and statistically significant across all models in both rural and urban areas. But the magnitude of the effect of age is very small. The effect of age on postnatal care registration and utilization is statistically insignificant in both rural and urban areas. Although the magnitudes are small, age is found to be negatively significant for institutional birth and visits to prenatal care centres.

Age of mother captures past experience related to pregnancy, childbirth and care of infants. The inverse relationship between age of the mother and decisions to register and utilize prenatal care may reflect accumulated experience, including a reduced demand for prenatal care because, for

Table 9a. Determinants of institutional birth and postnatal care utilization in rural areas: logistic regression estimation *(All specifications include a set of State variables)*

Variable	Institutional Birth	Registered for Postnatal Care	Utilized Postnatal Care
	Odds Ratio	Odds Ratio	Odds Ratio
Mother's age	0.979*** (0.005)	0.998 (0.004)	0.997 (0.004)
Mother's education – illiterate (reference category)			
Primary	1.872*** (0.109)	1.314*** (0.065)	1.277*** (0.064)
Secondary	3.705*** (0.247)	1.456*** (0.088)	1.453*** (0.089)
≥ Higher secondary	6.083*** (0.808)	2.171*** (0.267)	2.081*** (0.255)
Number of women in the household	1.036 (0.024)	0.962** (0.019)	0.964* (0.019)
Caste – upper caste (reference category)			
Scheduled caste or tribe	0.644*** (0.034)	1.027 (0.044)	1.026 (0.045)
Awareness on immunization	1.665*** (0.134)	2.604*** (0.171)	2.805*** (0.191)
Awareness on ORT	1.168*** (0.061)	1.230*** (0.054)	1.221*** (0.054)
Average distance to the maternity or child centre -- less than 2 km (reference category)			
2–5 km	0.973 (0.066)	0.760*** (0.044)	0.777*** (0.046)
5–10 km	0.920 (0.065)	0.732*** (0.044)	0.746*** (0.045)
≥ 10 km	0.840*** (0.054)	0.757*** (0.041)	0.751*** (0.041)
Bus service	1.487*** (0.078)	1.169*** (0.052)	1.178*** (0.053)
McKelvey and Zavoina's R^2	0.423	0.271	0.283
Log likelihood	-6105.931	-8300.214	-8097.22
Observations	16592	16592	16592
Test of interactions effects (interaction of bus service and distance variables)			
$\chi^2(3)$	13.15***	8.56**	5.66
$P > \chi^2(3)$	0.0043	0.0357	0.1295

Robust standard errors in parentheses
*Significant at 10%. **Significant at 5%. ***Significant at 1%.

many mothers, there were no serious complications with previous pregnancies or with the health of the infants involved. Alternatively, a negative sign for the age variable can be seen as evidence of diminishing willingness within a household to "invest" in the good health of another child. Such a decision may well be shaped by increased knowledge and experience for a number of women who had delivered previously with relative ease and without complications.

Table 9b. Determinants of institutional birth and postnatal care utilization in urban areas: logistic regression estimation *(All specifications include a set of State variables)*

Variable	Institutional Birth	Registered for Postnatal Care	Utilized Postnatal Care
	Odds Ratio	Odds Ratio	Odds Ratio
Mother's age	0.991* (0.005)	1.002 (0.005)	1.002 (0.005)
Mother's education – illiterate (reference category)			
Primary	1.713*** (0.118)	1.322*** (0.084)	1.321*** (0.085)
Secondary	3.744*** (0.255)	1.718*** (0.104)	1.715*** (0.104)
≥ Higher secondary	13.268*** (1.329)	2.405*** (0.167)	2.413*** (0.168)
Number of women in the household	1.080*** (0.026)	1.006 (0.020)	1.006 (0.020)
Caste – upper caste (reference category)			
Scheduled caste or tribe	0.612*** (0.041)	0.940 (0.054)	0.960 (0.056)
Awareness on immunization	2.279*** (0.228)	2.321*** (0.234)	2.242*** (0.228)
Awareness on ORT	1.355*** (0.089)	1.305*** (0.076)	1.279*** (0.075)
McKelvey and Zavoina's R^2	0.449	0.150	0.144
Log likelihood	-4669.362	-6417.657	-6399.333
Observations	10179	10179	10179

Robust standard errors in parentheses
*Significant at 10%. **Significant at 5%. ***Significant at 1%.

The Effect of Household Characteristics

The number of women in the household has a positive effect on the registration and use of prenatal care in rural areas, where registration for prenatal care increases with each additional woman in a family. However, the effect of the number of additional women is positively significant on receiving tetanus toxoid and IFA tablets in urban areas, but is significant only for tetanus toxoid in rural areas. The number of women in the household has a positive effect on the number of visits to prenatal health centres in rural areas but is insignificant in urban areas. Additional women in the household is also positively associated with institutional birth in urban areas, but is insignificant in rural areas. As

Table 10. Determinants of pre- and postnatal care utilization in rural and urban areas: negative binomial regression estimates *(All specifications include a set of State variables)*

Variable	Prenatal Care Utilization		Postnatal Care Utilization	
	Rural Areas	Urban Areas	Rural Areas	Urban Areas
	Coefficient	Coefficient	Coefficient	Coefficient
Mother's age	-0.005** (0.002)	-0.006*** (0.002)	0.001 (0.003)	0.001 (0.003)
Mother's education – illiterate (reference category)				
Primary	0.203*** (0.027)	0.248*** (0.029)	0.216*** (0.043)	0.223*** (0.049)
Secondary	0.395*** (0.031)	0.420*** (0.026)	0.307*** (0.051)	0.382*** (0.046)
≥ Higher secondary	0.549*** (0.055)	0.646*** (0.028)	0.527*** (0.097)	0.574*** (0.049)
Number of women in the household	0.028*** (0.010)	0.004 (0.007)	-0.016 (0.017)	0.008 (0.013)
Caste – upper caste (reference category)				
Scheduled caste or tribe	0.006 (0.024)	-0.062** (0.024)	0.043 (0.037)	-0.046 (0.043)
Awareness on immunization	1.044*** (0.046)	0.758*** (0.059)	0.920*** (0.063)	0.634*** (0.088)
Awareness on ORT	0.105*** (0.024)	0.156*** (0.025)	0.201*** (0.037)	0.165*** (0.044)
Average distance to the maternity or child centre – less than 2 km (reference category)				
2–5 km	-0.118*** (0.029)		-0.216*** (0.050)	
5–10 km	-0.178*** (0.032)		-0.308*** (0.050)	
≥ 10 km	-0.150*** (0.030)		-0.266*** (0.047)	
Bus service	0.139*** (0.026)		0.181*** (0.039)	
Constant	0.306*** (0.086)	0.655*** (0.085)	-1.283*** (0.140)	-0.920*** (0.139)
Log likelihood	-29554.331	-25019.923	-15901.003	-14194.532
Estimate of (	.979	.450	2.645	1.452
LR test (H0: (=0)	7700.92***	4411.92***	6076.58***	3810.83***
Observations	19032	11337	16592	10179
Test of interactions effects (interaction of bus service and distance variables)				
$\chi^2(3)$	1.83		3.97	
$p > \chi^2(3)$	0.6074		0.2644	

Robust standard errors in parentheses
*Significant at 10%. **Significant at 5%. ***Significant at 1%.

far as postnatal care is concerned, we find that additional women in the household tends to decrease registration and use of postnatal care in rural areas but is insignificant in urban areas. It is statistically insignificant for the number of visits to postnatal centres in both rural and urban areas.

This suggests the role of additional women in the family is a source of additional knowledge in some circumstances, especially utilization of prenatal care and institutional birth. However, for postnatal care, other women in a household may provide assistance for certain types of this care in rural areas.

Members of the scheduled caste and the scheduled tribe are less likely to have received tetanus toxoid: the odds of receiving it decrease by about 19% in urban areas and 12% in rural areas. The effect of this variable on all other prenatal care models is statistically insignificant in both rural and urban areas, except that it is negatively significant for the number of visits in urban areas. Members of the scheduled caste and the scheduled tribe are less likely to have an institutional birth: the odds decrease by about 39% in urban and 36% in rural areas. We do not find any statistically significant effect of the scheduled caste/scheduled tribe variable on registration and utilization of postnatal care in both rural and urban areas.

Our results suggest that members of the scheduled caste/scheduled tribe use significantly less maternal healthcare services in some instances, especially, they are less likely to have received tetanus toxoid and less likely to deliver in institutions. We cannot determine whether this indicates discrimination or whether social and cultural factors are involved. It is likely that cultural factors may facilitate the delivery of scheduled caste/scheduled tribe women at home (perhaps in the presence of traditional birth attendants) and inhibit delivering in institutions. If this is so, then education and awareness among women in those groups would likely improve the rate of institutional births. To the extent that lower caste women are unable to access institutional facilities, more targeted programs need to be tailored to improve access among those population groups.

A willingness to choose maternal–child health is shaped by knowledge of what is available and some knowledge of the likely effects of particular treatments or services. Of the four variables in the survey that measure awareness, two can be used as indictors of such knowledge: First, that any member of the household is aware of immunization specifically for pregnant women and second, that any member of the household is aware of oral rehydration as treatment for diarrhea. For both variables, the coefficients are positive and statistically significant in all models. This indicates that household knowledge of specific health services has a strong and positive effect on prenatal care, institutional delivery and postnatal care.

Consistent with the theoretical discussion, our empirical results show that knowledge and awareness at the household level is another strong, positive determinant of registration and utilization of maternal healthcare services in both rural and urban areas. Another strategy to improve the health status of Indian women and accomplish the Millennium Development Goals is to put a strong emphasis on awareness within households and local communities.

The Impact of Accessibility to Health Services

As is shown in the literature, an ability to act on knowledge of health services is affected by access to such services. In rural areas, a measure of access is the distance to the nearest health clinic. Using within two kilometers as the reference, distance consistently has a negative effect on the registration for and utilization of pre- and postnatal care and on the choice of childbirth facility. For pre- and postnatal care registration and utilization, the negative effect is stronger, whereas for the choice of a health institution for childbirth, the negative effect is evident only for distances beyond 10 kilometers. Given the negative impact of distance in rural areas, the availability of bus services between the home village and the health clinic can serve to overcome this barrier. Regression results bear this out: Access to bus service is an important, positive determinant of maternal healthcare services in rural India.

In order to assess the role of both distance and access to bus service, we extend our analysis by including interaction of distance variables with the indicator for bus service. It is necessary to test

the interaction effects to determine whether the model fits over and above the case where no interaction terms are included (Jaccard, 2001). The χ^2 test results are reported at the bottom of Tables 8a, 9a and 10 and suggest that the interaction terms are statistically significant in only four cases. However, interpretation of an interaction term is very complex and the literature lacks a consensus. For instance, Jaccard (2001) suggests computing odds ratios manually while Ai and Norton (2003) argue that marginal effects should be the focus, and odds ratios have no meaningful interpretation for the interaction terms. We report both direct and indirect effects of distance and bus service for these four cases in which the interaction terms are statistically significant. The interaction effects are presented in the Appendix and the detailed results are available from the authors upon request. It can be seen from the Appendix that the effect of the interaction terms on the probability of registration and utilization of prenatal care is positive for less than 10 kilometers of distance to prenatal care centre, and negative beyond 10 kilometers. This suggests that bus service reduces the negative effect of distance within a 10-kilometer range. However, for institutional birth, the interaction effect is consistently positive, suggesting that bus service reduces the negative effect of distance in choosing institutions for child birth. For postnatal care registration, the interaction effects are negative and the two interaction terms are not individually significant.

Our results suggest that an important strategy to improve access to maternal healthcare services in rural areas is to reduce distance to health centres. However, reducing distance may be a long-term strategy, as it would generally take a huge investment in the infrastructure to build health centres within an acceptable distance. Another way to minimize the effect of distance and improve access to care in the short-term is to provide regular public transportation facilities to the nearest health centre outside the village so that mothers can access the necessary care. At the same time, adequate capacity in existing health centres needs to be built to meet the challenges of additional demand pressures.

7. Conclusions and Policy Implications

Other things equal, the level of schooling that mothers have completed significantly increases the likelihood of a decision to register for pre-and postnatal care and to use available maternal–child health services. Analysis of decisions to utilize maternal–child healthcare indicates that awareness of specific pre- and postnatal care procedures have a strong, direct effect on decisions to register for and utilize both pre- and postnatal care. In rural areas, along with awareness of healthcare programs, access to healthcare facilities is an important determinant of the decision to utilize the programs. Taken together, these conclusions point to the importance of education, knowledge of the health production function and access to available health-care facilities as key variables that shape decisions to utilize maternal–child healthcare.

In order to attain the Millennium Development Goals and improve the health status of Indian women and children, India needs to adopt a multifaceted strategy. In spite of India's satisfactory economic growth in the post-economic-reform era, it is neither necessary nor binding that the benefits of economic growth will trickle down to the health sector. The experience of Haryayna, high economic growth rate coupled with worse health outcomes and low literacy is well known in this regard. The long-term strategy lies in the educational attainments of female children and building adequate capacity in the social infrastructure. Although India has made substantial progress in improving literacy and expanding primary and secondary educational facilities in the past decade, concerted efforts need to be made in the area of enrollment and retention of female students in the secondary and higher secondary educational institutions in both rural and urban areas. Universal access to comprehensive primary healthcare services on a continuing basis, including maternal healthcare services, is the basic foundation for development and growth. Although India is a signatory to the Alma Ata Declaration, more needs to be done in terms of building adequate infrastructure, along with trained manpower and reasonable distance within various jurisdictions, especially in the rural and remote areas. The long-term strategy needs to be supported by various short-term strategies. Dissemination of knowledge and awareness of health-seeking behaviours would allow households, and women in particular, to make informed choices about maternal–child healthcare.

This can be done through Gram Panchayats and Municipalities (the lowest levels of democratic institutions in rural and urban India) or Non-Governmental Organizations or similar local institutions. This indicates that the government's existing IEC program needs to be strengthened and extended to include the health awareness component. Another short-term strategy would be to provide good transportation facilities from residential areas to primary, secondary and tertiary healthcare facilities to improve access to and use of basic healthcare services. In order to meet the challenges of additional demand pressures, it would be necessary to create additional capacity within existing health infrastructures.

The analysis in this paper is limited to whether or not women decide to register for and use pre- and postnatal care and the selection of a place for childbirth. It does not give information on the differences in the quality of healthcare received, nor does it asses the relative advantages of public versus private health facilities. Additional analysis is required to enable a detailed assessment of the effects of India's approach to delivering maternal–child healthcare.

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Endnotes

1 The details on sample design are described in the Report Number 445, National Sample Survey Organization, Government of India, 1998.

2 The missing category excludes 62 cases of stillbirth, 88 cases of spontaneous abortion, 27 cases of induced abortion, and 17 cases of medical termination pregnancy in urban areas. The corresponding numbers for the rural areas are 113, 165, 39 and 22 respectively.

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Appendix
Interaction Effects of Bus Service and Distance Variables in Rural Areas

Logit (.) = $\beta_0 + \beta_1$BUS + β_2 DISTANCE1 + β_3 DISTANCE2 + β_4 DISTANCE3 + β_5 BUS*DISTANCE1 + β_6 BUS*DISTANCE2 + β_7 BUS*DISTANCE3 + $\beta\mathbf{X}$
Where DISTANCE1 = 2-5 km, DISTANCE2 = 5-10 km and DISTANCE3 = ³10 km

a) Registered for Prenatal Care
β_1 = 0.391654***, β_2 = -0.12092, β_3 = -0.27907***, β_4 = -0.27302***, β_5 = -0.21665*, β_6 = -0.06451 and β_7 = -0.25025***

BUS Service	Distance	Logit	Logit Diff.	Estimate
0	<2 km	$\beta_0 + \beta\mathbf{X}$		
1	<2 km	$\beta_0 + \beta_1 + \beta\mathbf{X}$	β_1	0.391654
0	2-5 km	$\beta_0 + \beta_2 + \beta\mathbf{X}$	β_2	-0.12092
1	2-5 km	$\beta_0 + \beta_1 + \beta_2 + \beta_5 + \beta\mathbf{X}$	$\beta_1 + \beta_2 + \beta_5$	0.054086
0	5-10 km	$\beta_0 + \beta_3 + \beta\mathbf{X}$	β_3	-0.27907
1	5-10 km	$\beta_0 + \beta_1 + \beta_3 + \beta_6 + \beta\mathbf{X}$	$\beta_1 + \beta_3 + \beta_6$	0.048073
0	≥10 km	$\beta_0 + \beta_4 + \beta\mathbf{X}$	β_4	-0.27302
1	≥10 km	$\beta_0 + \beta_1 + \beta_4 + \beta_7 + \beta\mathbf{X}$	$\beta_1 + \beta_4 + \beta_7$	-0.13161

b) Utilized Prenatal Care
β_1 = 0.404366***, β_2 = -0.09158, β_3 = -0.2585***, β_4 = -0.26955***, β_5 = -0.217*, β_6 = -0.07386 and β_7 = -0.24511***

BUS Service	Distance	Logit	Logit Diff.	Estimate
0	<2 km	$\beta_0 + \beta\mathbf{X}$		
1	<2 km	$\beta_0 + \beta_1 + \beta\mathbf{X}$	β_1	0.404366
0	2-5 km	$\beta_0 + \beta_2 + \beta\mathbf{X}$	β_2	-0.09158
1	2-5 km	$\beta_0 + \beta_1 + \beta_2 + \beta_5 + \beta\mathbf{X}$	$\beta_1 + \beta_2 + \beta_5$	0.095782
0	5-10 km	$\beta_0 + \beta_3 + \beta\mathbf{X}$	β_3	-0.2585

1	5-10 km	$\beta_0 + \beta_1 + \beta_3 + \beta_6 + \beta\mathbf{X}$	$\beta_1 + \beta_3 + \beta_6$	0.072001
0	≥10 km	$\beta_0 + \beta_4 + \beta\mathbf{X}$	β_4	-0.26955
1	≥10 km	$\beta_0 + \beta_1 + \beta_4 + \beta_7 + \beta\mathbf{X}$	$\beta_1 + \beta_4 + \beta_7$	-0.11029

c) Institutional Birth

β_1 = 0.272163***, β_2 = -0.02585, β_3 = -0.11925, β_4 = -0.39273***, β_5 = -0.03133, β_6 = 0.032536 and β_7 = 0.371896***

BUS Service	Distance	Logit	Logit Diff.	Estimate
0	<2 km	$\beta_0 + \beta\mathbf{X}$		
1	<2 km	$\beta_0 + \beta_1 + \beta\mathbf{X}$	β_1	0.272163
0	2-5 km	$\beta_0 + \beta_2 + \beta\mathbf{X}$	β_2	-0.02585
1	2-5 km	$\beta_0 + \beta_1 + \beta_2 + \beta_5 + \beta\mathbf{X}$	$\beta_1 + \beta_2 + \beta_5$	0.214982
0	5-10 km	$\beta_0 + \beta_3 + \beta\mathbf{X}$	β_3	-0.11925
1	5-10 km	$\beta_0 + \beta_1 + \beta_3 + \beta_6 + \beta\mathbf{X}$	$\beta_1 + \beta_3 + \beta_6$	0.185453
0	≥10 km	$\beta_0 + \beta_4 + \beta\mathbf{X}$	β_4	-0.39273
1	≥10 km	$\beta_0 + \beta_1 + \beta_4 + \beta_7 + \beta\mathbf{X}$	$\beta_1 + \beta_4 + \beta_7$	0.251324

d) Registered for Postnatal Care

β_1 = 0.203582***, β_2 = -0.11513, β_3 = -0.3173***, β_4 = -0.26842***, β_5 = -0.27016*, β_6 = 0.031844 and β_7 = 0.007308

BUS Service	Distance	Logit	Logit Diff.	Estimate
0	<2 km	$\beta_0 + \beta\mathbf{X}$		
1	<2 km	$\beta_0 + \beta_1 + \beta\mathbf{X}$	β_1	0.203582
0	2-5 km	$\beta_0 + \beta_2 + \beta\mathbf{X}$	β_2	-0.11513
1	2-5 km	$\beta_0 + \beta_1 + \beta_2 + \beta_5 + \beta\mathbf{X}$	$\beta_1 + \beta_2 + \beta_5$	-0.18171
0	5-10 km	$\beta_0 + \beta_3 + \beta\mathbf{X}$	β_3	-0.3173
1	5-10 km	$\beta_0 + \beta_1 + \beta_3 + \beta_6 + \beta\mathbf{X}$	$\beta_1 + \beta_3 + \beta_6$	-0.08187
0	≥10 km	$\beta_0 + \beta_4 + \beta\mathbf{X}$	β_4	-0.26842
1	≥10 km	$\beta_0 + \beta_1 + \beta_4 + \beta_7 + \beta\mathbf{X}$	$\beta_1 + \beta_4 + \beta_7$	-0.05753

*Significant at 10%. **Significant at 5%. ***Significant at 1%.