Promoting Institutional Deliveries In Rural India: The Role of Antenatal-Care Services

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India's first and second National Family Health Surveys (NFHS-1 and NFHS-2) were conducted in 1992–93 and 1998–99 under the auspices of the Ministry of Health and Family Welfare. The surveys provide national and state-level estimates of fertility, infant and child mortality, family planning practice, maternal and child health, and the utilization of services available to mothers and children. The International Institute for Population Sciences, Mumbai, coordinated the surveys in cooperation with selected population research centres in India, the East-West Center in Honolulu, Hawaii, and ORC Macro in Calverton, Maryland. The United States Agency for International Development (USAID) provided funding for the NFHS, and United Nations Population Fund (UNFPA) provided support for the preparation and publication of this report.

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ABSTRACT

India's maternal and child health programmes have not aggressively promoted institutional deliveries, except in high-risk cases. The reason is that provision of facilities for institutional delivery on a mass scale in rural areas is viewed as a long-term goal requiring massive health infrastructure investments. Institutional delivery is nevertheless desirable, inasmuch as it reduces the risk of both maternal and infant mortality. This report examines the role of existing antenatal-care services in promoting institutional delivery in rural areas of four Indian states—Andhra Pradesh, Gujarat, Bihar, and Rajasthan, selected from the southern, western, eastern, and northern parts of the country, respectively. Currently, about one in two births in Andhra Pradesh and Gujarat, about one in five births in Rajasthan, and about one in six births in Bihar are delivered in medical institutions.

Because the likelihood of delivering in a medical institution is influenced not only by use of antenatal-care services but also by such potentially confounding factors as mother's age, education, exposure to mass media, household standard of living, and access to health services, these other factors are statistically controlled (i.e., held constant) when estimating the effects of antenatal care on institutional delivery. Logistic regression is used for this purpose. The analysis is based on data from India's first and second National Family Health Surveys (NFHS-1 and NFHS-2).

The results indicate that, even after statistically controlling for other factors, mothers who received antenatal check-ups are two to five times more likely to give birth in a medical institution than mothers who did not receive any antenatal check-up. Among the other factors considered, mother's age and education and child's birth order also have strong effects on the likelihood of institutional delivery. Household standard of living also has a substantial effect in most cases. Contrary to expectation, access to health services, as measured by availability of a hospital within 5 km of the village and by availability of an

all-weather road connecting the village to the outside, does not have a statistically significant effect on institutional delivery in most cases.

Overall, antenatal care is the strongest predictor of institutional delivery, a finding that has important programme implications. It suggests that it is possible to promote institutional delivery by promoting antenatal check-ups and associated counseling. Given that distance to a hospital does not have a significant effect on institutional delivery, it may not be necessary to create new hospitals (at least not for the purpose of encouraging institutional delivery), but rather to focus on expanding the availability and quality of services at existing facilities, as well as counseling and educating mothers about the importance of giving birth in medical institutions under the supervision of trained professionals. Because a much higher proportion of institutional deliveries take place in private-sector facilities than in public-sector facilities in three of the four states, efforts should also be made to strengthen private-sector health facilities to make them more accessible to rural mothers, in terms of cost and quality of services. In addition, since half or more of deliveries in all four states still occur at home, efforts to train traditional birth attendants, increase the availability of trained midwives, promote home visits by paramedics for antenatal check-ups, distribute iron and folic acid tablets, and vaccinate against tetanus should continue.

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INTRODUCTION

It is well established that giving birth in a medical institution under the care and supervision of trained health-care providers promotes child survival and reduces the risk of maternal mortality. In India, both child mortality (especially neonatal mortality) and maternal mortality are high. Seven out of every 100 children born in India die before reaching age one, and approximately five out of every 1,000 mothers who become pregnant die of causes related to pregnancy and childbirth. India accounts for more than one-fifth of all maternal deaths from causes related to pregnancy and childbirth worldwide.

Despite the many benefits associated with institutional delivery, India's maternal and child health programmes have not aggressively promoted institutional deliveries, except in high-risk cases. The reason is that providing facilities for institutional delivery on a mass scale in rural areas is viewed as a long-term goal requiring massive health infrastructure investments. In recent years, however, there has been a shift in this policy with the establishment of the Child Survival and Safe Motherhood (CSSM) and the Reproductive and Child Health (RCH) programmes. The new programmes aim at expanding existing rural health services to include facilities for institutional delivery. Existing maternal and child health services at primary health centres (PHCs) are being upgraded, and new first-referral units (FRUs) are being set up at the subdistrict level to provide comprehensive emergency obstetric and new-born care (Ministry of Health and Family Welfare, n.d.).

Despite the uniformity in programme design throughout the country, there is considerable regional diversity in the availability and quality of health services, including maternal health services. In 1992–93, according to NFHS-1, the proportion of mothers receiving antenatal check-ups ranged from 31 percent in Bihar to 94 percent in Tamil Nadu, and the proportion giving birth in medical institutions ranged from 11 percent in Rajasthan and Uttar Pradesh to 88 percent in Kerala (IIPS 1995). In 1998–99, according to NFHS-2, the proportion receiving antenatal check-ups ranged from to 34–36 percent in Uttar Pradesh and Bihar to 98 percent in Kerala and Tamil Nadu, and the proportion giving birth in medical institutions ranged from 22–23 percent in Uttar Pradesh and Bihar to 95 percent in Kerala (IIPS and ORC Macro 2000a).

The explanation of this diversity is complex. Utilization of health services is affected by a multitude of factors including not only availability, distance, cost, and quality of services, but also by socioeconomic factors and personal health beliefs. In an attempt to understand the factors that determine women's utilization of health services, Chatterjee (1990) posited the role of need, permission, ability, and availability. He reasoned that when permission and ability interact with need, a demand for

health services is generated. Actual utilization of health services occurs when this generated demand overlaps with availability. In the Indian context, the situation is further complicated by women's perceptions of illness, which are affected by women's cultural conditioning to tolerate suffering. Because of this tolerance, which varies considerably across regions of India, the perceived need for health services can be small even when the actual need is great.

Another factor affecting women's health-seeking behavior, especially as related to pregnancy and childbirth, is that traditionally in rural India pregnancy is considered a natural state of being for a woman rather than a condition requiring medical attention and care. Such perceptions and beliefs constitute a "lay-health culture" that is an intervening factor between the presence of a morbidity condition and its corresponding treatment. Postnatal care and infant and child health care are similarly affected by this culture, with the result that women often do not avail themselves of preventive and curative medical services intended to safeguard their own and their children's health and well-being. The lay-health culture presumably has substantial effects on utilization of maternal health services in regions of the country where poverty and illiteracy are widespread. This culture is difficult to measure directly, but it is possible to include socioeconomic factors that are correlated with it when analyzing utilization of maternal health services.

Several studies have attempted to identify and measure the effects of the factors that contribute to differential use of maternal health services. Based on data from NFHS-1, a multivariate analysis of utilization of maternal and child health services in India and four major northern states concluded that utilization of maternal and child health services in rural areas is driven primarily by socioeconomic factors, such as education, media exposure, and standard of living, that create a demand for services and much less so by physical access to and availability of health and family welfare services (Das et al. 2001). Another study, also based on data from NFHS-1, found that woman's education is a major factor affecting utilization of maternal health services in both north and south India (Govindasamy and Ramesh 1997).

A number of other studies have stressed the role of socioeconomic and demographic factors in influencing demand for and utilization of maternal and child health services (Ray et al. 1984; Kanitkar and Sinha 1989; Elo 1992; Swenson et al. 1993; Abdalla 1993; Govindasamy 1994; Khan et al. 1994; Barlow and Diop 1995; Ahmed and Mosley 1997; Regmi and Manandhar 1997). Many of these studies have also shown that utilization of maternal and child health services is strongly affected by woman's education. Other socioeconomic factors usually found to be important are urban-rural residence, woman's work status, woman's status relative to men, religion, caste/tribe membership, household standard of living (or economic status of the household), and community development.

Some studies have stressed the importance of access to health services as a factor affecting the utilization of services (Rao and Richard 1984; Sarita and Tuominen 1993; Kumar et al. 1997; Rohde and Viswanathan 1994). Historically, improving access to services has been a primary strategy for increasing health-service utilization in developing countries. In recent years, field experience and data from both qualitative and quantitative studies have indicated that improvements in the quality of services can further increase service utilization. Programmes that maximize quality as well as access to services enhance client satisfaction, leading to greater utilization (Shelton and Davis 1996; Levine et al. 1992). It is argued that access helps determine whether an individual makes contact with the provider, while quality of care influences a client's decision whether to accept and use the service or to continue using the service (Bertrand et al. 1995). Many of the above studies have stressed outreach programmes, including home visits, mobile clinics, and community-based delivery systems, as mechanisms to increase both the quantity and quality of services. Although quality of services is often mentioned as an important factor in the utilization of health services (Dennis et al. 1995; Shrestha and Ittiravivongs 1994; Phommasack 1995; Visaria 1999), much of the research on this subject refers to family planning services rather than institutional delivery (Levine et al. 1992; Koenig and Khan 1999; Koenig et al. 1999; Roy and Verma 1999; Khan et al. 1999; Gupte et al. 1999; UNECA 1989; Roberto 1993; Townsend et al. 1999; Patel et al. 1999; Satia and Sokhi 1999).

Some studies have presented evidence that the effects of inadequate access to services on utilization of services are greater than the effects of socioeconomic factors (Sawhney 1993; Elo 1992) and that as access to public health facilities improves, the effects of socioeconomic factors on utilization of services become less important (Rosenzweig and Schultz 1982; Govindasamy and Ramesh 1997). Other studies argue that lack of motivation is the major factor in nonutilization of services, and that provision of services alone cannot overcome lack of motivation or demand for services (Ray et al. 1984).

As this brief review of literature illustrates, previous research provides conflicting evidence on the relative importance of programmatic (supply) and nonprogrammatic (demand) factors affecting health-seeking behavior. Also, there is little research on how utilization of one type of health service might affect utilization of other types of health service. In particular, there is no research that we know of that examines how utilization of antenatal-care services affects the likelihood of giving birth in a medical institution, which is the topic of the present study.

In this report we attempt to measure the effect of utilization of antenatal-care services on the likelihood of institutional delivery, after controlling for the effects of a number of demand and supply factors discussed above. Antenatal care is hypothesized to have a positive effect on the likelihood of institutional delivery, inasmuch as

women receiving antenatal care come in contact with health-care providers who are likely to encourage them to give birth in a medical facility. A complicating factor is that women with pregnancy complications are more likely than other pregnant women both to receive antenatal check-ups and to deliver in a health facility because of the pregnancy complication. For these women the correlation between antenatal care and institutional delivery arises not because of a causal effect of antenatal care on the likelihood of institutional delivery but instead because a third, prior factor (pregnancy complication) influences both the likelihood of antenatal care and the likelihood of institutional delivery. As we shall see, however, statistically controlling for the presence or absence of pregnancy complications makes virtually no difference in the results.

The analysis covers the states of Andhra Pradesh, Gujarat, Rajasthan, and Bihar. Each of these states is from one of the four major regions of India—Rajasthan in the north, Andhra Pradesh in the south, Bihar in the east, and Gujarat in the west. Andhra Pradesh and Gujarat are states with relatively high utilization of maternal health services, while Bihar and Rajasthan are states with relatively low utilization.

DATA AND METHODS

Data for this study are from India's two National Family Health Surveys conducted in 1992–93 and 1998–99, respectively. NFHS-1 collected data from a nationally representative sample (except for Sikkim, the Kashmir region of Jammu and Kashmir state, and the small Union Territories, which were not included) of 89,777 ever-married women age 13–49 years residing in 88,562 households. NFHS-2 collected data from a nationally representative sample (except for the small Union Territories) of 90,303 ever-married women age 15–49 residing in 92,486 households. Data from both surveys are representative at the state level.

The analysis here is based on births during the three-year period before each survey to ever-married women in the four states of Andhra Pradesh, Gujarat, Bihar, and Rajasthan. The NFHS-1 and NFHS-2 samples include, respectively, 1,412 and 1,129 such births in Andhra Pradesh; 1,499 and 1,324 births in Gujarat; 2,660 and 2,912 births in Bihar; and 2,197 and 3,076 births in Rajasthan.

In both NFHS-1 and NFHS-2, the sample design was such that in some states certain categories of respondents (e.g., those from urban areas) were oversampled, so that weights are needed to restore the correct proportions. The weights are designed to preserve the total numbers of households and ever-married women interviewed in each state, so that the weighted state total equals the unweighted state total. Details of sample design, including sampling frame and sample implementation, are provided in the basic survey reports for the four states (PRC Visakhapatnam and

IIPS 1995; IIPS and ORC Macro 2000b; PRC Vadodara and IIPS 1995; IIPS and ORC Macro 2001a; PRC Patna and IIPS 1995; IIPS and ORC Macro 2001b; PRC Udaipur and IIPS 1995; IIPS and ORC Macro 2001c).

Three types of questionnaires were administered in both NFHS-1 and NFHS-2: a Household Questionnaire, a Woman's Questionnaire, and a Village Questionnaire. This report uses data from all three questionnaires. The Household Questionnaire provides basic demographic and socioeconomic information on households. The Woman's Questionnaire provides, for ever-married women of reproductive age, information on socioeconomic and demographic characteristics, reproductive history, contraceptive behavior, fertility preferences, and maternal and child health. The Village Questionnaire provides information on various amenities available in sampled villages, such as electricity, water, transportation, and various educational and health facilities.

In both NFHS-1 and NFHS-2, mothers who gave birth during the three years preceding the survey were asked if their delivery was assisted by a health professional, such as a doctor, auxiliary nurse midwife (ANM), lady health visitor (LHV), or other nurse/midwife. Mothers were also asked if they delivered at home or in a medical institution, such as a government or private hospital/clinic, primary health centre, or maternity home. Whether the mother delivered in a medical institution (yes or no) is the primary response variable in our analysis.

Each survey also collected information on utilization of specific antenatal-care services for each pregnancy that resulted in a live birth during the three years preceding the survey. Mothers were asked whether they had received any pregnancy-related check-up from a doctor or a health worker in a health facility or at home (yes or no). They were also asked whether they had received two or more doses of tetanus toxoid vaccine during the pregnancy (yes or no). These two antenatal-care variables are the primary predictor variables in our analysis.

As mentioned earlier, estimation of the effects of the antenatal-care variables on the likelihood of institutional delivery requires statistical controls for other factors that may be correlated with the antenatal-care variables. Failure to control for these variables could bias the estimates of the effects of the antenatal-care variables. The following demographic, socioeconomic, and health-services variables are included as controls in the analysis: age of the mother at the time of survey (15–19, 20–24, 25–29, 30–49), birth order of child (1, 2, 3, 4+), religion of household head (Hindu, Muslim, other), caste/tribe of household head (scheduled caste or scheduled tribe, other)[1],

[1]Scheduled castes (SC) and scheduled tribes (ST) are castes and tribes identified by the Government of India as socially and economically backward and in need of special protection from social injustice and exploitation.

mother's education (illiterate, literate but less than middle school complete, middle school complete or higher), mother's work status at the time of the survey (working, not working), mother's exposure to electronic mass media (regularly exposed, not regularly exposed)[2], household standard of living (low, medium, high)[3,4], availability of a hospital within 5 km of the village (yes, no), and whether the village is connected to the outside by an all-weather road (yes, no). Two additional variables for which information was collected only in NFHS-2—decisionmaking about one's own health (self, jointly with others, not involved) and quality of health-care services in the primary sampling unit in which the mother resides (low, high)[5]—are also included in the bivariate analysis of variables that may be correlated with institutional delivery. But because the decisionmaking and quality-of-care variables show little correlation with institutional delivery, they are not included in the multivariate analysis.

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[2]Listens to radio at least once a week, watches television at least once a week, or goes to a cinema hall or theatre to see a movie at least once a month.

[3]In NFHS-1, standard of living is measured by an index defined in terms of ownership of household goods. The standard of living index (SLI) is calculated by adding the following scores: house type: 4 for *pucca*, 2 for semi-*pucca*, 0 for *kachha*; toilet facility: 4 for own flush toilet, 2 for public or shared flush toilet or own pit toilet, 1 for shared or public pit toilet, 0 for no facility; source of lighting: 2 for electricity, 1 for kerosene, gas, or oil, 0 for other source of lighting; main fuel for cooking: 2 for electricity, liquified natural gas, or biogas, 1 for coal, charcoal, or kerosene, 0 for other fuel; source of drinking water: 2 for pipe, hand pump, or well in residence/yard/plot, 1 for public tap, hand pump, or well, 0 for other water source; separate room for cooking: 1 for yes, 0 for no; ownership of house: 2 for yes, 0 for no; ownership of agricultural land: 4 for 5 acres or more, 3 for 2.0–4.9 acres, 2 for less than 2 acres or acreage not known, 0 for no agricultural land; ownership of irrigated land: 2 if household owns at least some irrigated land, 0 for no irrigated land; ownership of livestock: 2 if owns livestock, 0 if does not own livestock; durable goods ownership: 4 for a car or tractor, 3 each for a scooter/motorcycle or refrigerator, 2.5 for a television, 2 each for a bicycle, electric fan, radio/transistor, sewing machine, water pump, bullock cart, or thresher, 1 for a clock/watch. Index scores range from 0–10 for low SLI, 10.5–20 for medium SLI, and 20.5–45.5 for high SLI.

[4]In NFHS-2, standard of living is measured by an index calculated by adding the following scores: house type: 4 for *pucca*, 2 for semi-*pucca*, 0 for *kachha*; toilet facility: 4 for own flush toilet, 2 for public or shared flush toilet or own pit toilet, 1 for shared or public pit toilet, 0 for no facility; source of lighting: 2 for electricity, 1 for kerosene, gas, or oil, 0 for other source of lighting; main fuel for cooking: 2 for electricity, liquified natural gas, or biogas, 1 for coal, charcoal, or kerosene, 0 for other fuel; source of drinking water: 2 for pipe, hand pump, or well in residence/yard/plot, 1 for public tap, hand pump, or well, 0 for other water source; separate room for cooking: 1 for yes, 0 for no; ownership of house: 2 for yes, 0 for no; ownership of agricultural land: 4 for 5 acres or more, 3 for 2.0–4.9 acres, 2 for less than 2 acres or acreage not known, 0 for no agricultural land; ownership of irrigated land: 2 if household owns at least some irrigated land, 0 for no irrigated land; ownership of livestock: 2 if owns livestock, 0 if does not own livestock; durable goods ownership: 4 for a car or tractor, 3 each for a moped/scooter/motorcycle, telephone, refrigerator, or color television, 2 each for a bicycle, electric fan, radio/transistor, sewing machine, black and white television, water pump, bullock cart, or thresher, 1 each for a mattress, pressure cooker, chair, cot/bed, table, or clock/watch. Index scores range from 0–14 for low SLI, 15–24 for medium SLI, and 25–67 for high SLI.

Presence or absence of pregnancy complications is another variable for which information was collected only in NFHS-2. We defined two pregnancy-complications variables. The first specification defines pregnancy complications as 1 if the mother mentions any of the following and 0 if none are mentioned: night blindness; blurred vision; convulsions not from fever; swelling of the legs, body, or face; excessive fatigue; anaemia; or any vaginal bleeding. The second specification defines pregnancy complications more restrictively as 1 if the mother reports convulsions not from fever or any vaginal bleeding and 0 if neither of these complications is reported. As discussed earlier, the pregnancy-complications variable is considered because the correlation between antenatal care and institutional delivery may arise not because of a causal effect of antenatal care on the likelihood of institutional delivery but instead because pregnancy complications have positive effects on both the likelihood of antenatal care and the likelihood of institutional delivery. However, neither of the pregnancy-complications variables has a statistically significant effect on the likelihood of delivery in a medical institution, nor does its inclusion or exclusion in the statistical models alter the estimated effect of antenatal care on delivery in a medical institution. For this reason, and also because the question on pregnancy complications was not asked in NFHS-1, the models presented in the tables below do not include a variable for pregnancy complications.

Information on the three household-level variables is derived from the Household Questionnaire; information on the five woman-level variables, one child-level variable, and the quality-of-care index for each primary sampling unit is derived from the Woman's Questionnaire; and information on the two community-level variables is derived from the Village Questionnaire. A complete listing of variables and their definitions is shown in Table 1.

Each control variable has a rationale for inclusion. Mother's age and child's birth order are included because they are correlated with utilization of antenatal- and delivery-care services. Religion and caste/tribe variables help control for cultural

[5]NFHS-2 included several questions on quality of care for women who visited a health facility during the 12 months before the survey. Based on this information, an index of quality of care was constructed for each primarily sampling unit (PSU, consisting of a rural village or urban block). This index was constructed in several steps, as follows. First the following scores were added for each sampled woman in the PSU who went to a health facility or provider during the 12 months before the survey: spent enough time: 1 for yes , 0 for no; talked nicely: 2 for nicely, 1 for somewhat nicely, 0 for not nicely; need for privacy: 2 for respected privacy, 1 for privacy not needed, and 0 for not respected need for privacy; and cleanliness: 2 for very clean, 1 for somewhat clean, and 0 for not clean. This score ranges from 0 to 7. A PSU-level quality-of-care index was then calculated as the average score for these women. The average PSU-level score was then assigned to all women and births in a given PSU. The index score was then dichotomized as low if less than or equal to the median score for PSUs or high if greater than the median score for PSUs.

Table 1 Definitions of the variables included in the analysis of births during the 3-year periods preceding NFHS-1 and NFHS-2

Variable	Definition
Age (in years)	
15–19	Mother's age at the time of the survey is 15–19 years
20–24	Mother's age at the time of the survey is 20–24 years
25–29	Mother's age at the time of the survey is 25–29 years
30–49	Mother's age at the time of the survey is 30–49 years
Birth order	
1	First birth
2	Second birth
3	Third birth
4+	Fourth or higher-order birth
Religion	
Hindu	Mother lives in a household whose head is Hindu
Muslim	Mother lives in a household whose head is Muslim
Other	Mother lives in a household whose head is neither Hindu nor Muslim
Caste/tribe	
Scheduled caste/scheduled tribe	Mother lives in a household whose head belongs to a scheduled caste (SC) or scheduled tribe (ST)
Other	Mother lives in a household whose head does not belong to a scheduled caste (SC) or scheduled tribe (ST)
Woman's education	
Illiterate	Mother is illiterate
Literate, < middle complete	Mother is literate with less than a middle school education
Middle complete or higher	Mother is literate with at least middle school education
Current work status	
Not working	Mother is currently not working, aside from own household work
Working	Mother is currently working, aside from own household work
Media exposure	
Exposed	Mother watches television or listens to radio at least once a week or visits a cinema at least once a month
Not exposed	Mother is not regularly exposed to any electronic mass media
Decisionmaking about own health care[a]	
Self	Mother herself makes the decision about obtaining health care for herself
Jointly with others	Mother makes the decision about obtaining health care for herself jointly with husband or others in household
Not involved	Mother not involved in decisionmaking for obtaining health care for herself; husband or others in household make the decision
Standard of living[b,c]	
Low	Mother lives in a household with a low standard of living
Medium	Mother lives in a household with a medium standard of living
High	Mother lives in a household with a high standard of living
Received antenatal check-up	
Yes	Mother received at least one antenatal check-up while pregnant with the specified child
No	Mother did not receive any antenatal check-up while pregnant with the specified child
Received two or more tetanus toxoid injections	
Yes	Mother received two or more tetanus toxoid injections while pregnant with the specified child
No	Mother received less than two tetanus toxoid injections while pregnant with the specified child
Received professional assistance at delivery	
Yes	Mother received assistance of a doctor, ANM/LHV, or nurse/midwife for delivery of the specified child[d]
No	Mother did not receive assistance of a doctor, ANM/LHV, or nurse/midwife for delivery of the specified child
Delivered in a medical institution	
Yes	Mother delivered the specified child in a medical institution
No	Mother did not deliver the specified child in a medical institution

cont.

Table 1, cont. Definitions of the variables included in the analysis of births during the 3-year periods preceding NFHS-1 and NFHS-2

Variable	Definition
Availability of a hospital within 5 km	
Yes	Mother lives in a village that has a government hospital, a community health centre/rural hospital, or a private hospital within a distance of 5 km
No	Mother lives in a village that does not have any government hospital, community health centre/rural hospital, or private hospital within a distance of 5 km
Village has all-weather road	
Yes	Mother lives in a village that has an all-weather road within a distance of 1 km that connects the village to other places
No	Mother lives in a village that does not have an all-weather road within a distance of 1 km that connects the village to other places
Quality of health care services[a,e]	
Low	Mother lives in a village with low-quality health care services
High	Mother lives in a village with high-quality health care services

[a]Available only for NFHS-2.

[b]See text footnote 3 for explanation of how the standard of living index (SLI) is defined using NFHS-1 data.

[c]See text footnote 4 for explanation of how the standard of living index (SLI) is defined using NFHS-2 data.

[d]ANM denotes auxiliary nurse midwife. LHV denotes lady health visitor.

[e]See text footnote 5 for explanation of how the quality-of-care index is constructed using NFHS-2 data.

variation in health-seeking practices. The various socioeconomic variables are included because they also tend to be correlated with utilization of antenatal- and delivery-care services. Distance to a hospital and availability of an all-weather road affect access to health services, which can influence utilization of antenatal- and delivery-care services.

The multivariate statistical method used in the analysis is logistic regression, with institutional delivery (yes or no) as the response variable, the two antenatal-care variables discussed above as the primary predictor variables, and the ten demographic, socioeconomic, and community-access variables discussed above as controls. The twelve predictor variables are divided into four groups: background factors, demand factors (socioeconomic), demand factors (antenatal care), and supply factors. For each state and each survey, five alternative logistic regression models are estimated using different combinations of these groups of variables. Background factors include age, birth order, religion, and caste/tribe. These are factors that affect the likelihood of institutional delivery but are not easily amenable to change, and they are included as controls in all five models. Demand factors (socioeconomic) include the mother's education, current work status, media exposure, and standard of living. Demand factors (antenatal care) include whether the mother received at least one antenatal check-up and whether the mother received two or more tetanus toxoid injections during the pregnancy. Supply factors include availability of a hospital within 5 km of the village and availability of an all-weather road connecting the village to the outside. The results of the multivariate analysis are presented in the form of odds ratios.

Table 2 Selected background characteristics of Andhra Pradesh, Gujarat, Bihar, Rajasthan, and all India

Characteristic	Andhra Pradesh	Gujarat	Bihar	Rajasthan	All India
Population 2001 (millions)[a]	75.7	50.6	109.8	56.5	1,027.0
Per capita net State Domestic Product, 1997–98 (Rs. at current prices)	10,590	16,251	4,654	9,256	12,729
Percent below poverty line, 1993–94	22	24	55	27	36
Percent literate, 2001[b]	61	70	49	61	65
Percent of females literate, 2001[b]	51	59	35	44	54
Total fertility rate (per woman), 1998	2.4	3.0	4.3	4.1	3.2
Infant mortality rate (per 1,000), 1998	66	64	67	83	72
Maternal mortality rate (per 100,000), 1998	436	389	470	550	453
Average rural population served by a sub centre[c]	5,038	4,230	6,156	4,203	NA
Average rural population served by a primary health centre (PHC)[c]	32,545	31,821	41,241	24,911	NA
Average population served by an allopathic hospital[d]	23,288	17,810	270,475	240,790	NA
Average distance to a primary health centre (km)[c]	7.3	7.9	5.0	8.0	6.6

NA: Not calculated because the reference years for states are not the same.

Notes:

[a]Figures for Bihar include Jharkhand state. In 2000, the state of Jharkhand was created from part of Bihar.

[b]Literacy rates for Bihar are population-weighted averages of Bihar (post-2000) and Jharkhand states. Literacy rates pertain to ages 7 and above.

[c]Figures for Andhra Pradesh refer to 1998, and figures for Gujarat, Bihar, and Rajasthan refer to 1999.

[d]Not including community health centres (CHCs) and TB sanatoriums/clinics. Figures for Andhra Pradesh and Rajasthan refer to 1998, figures for Bihar refer to 1992, and figures for Rajasthan refer to 1995.

Sources:

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RESULTS

Background Characteristics of the Study States

Table 2 shows selected socioeconomic and demographic indicators and indicators of availability of health facilities for the four states of Andhra Pradesh, Gujarat, Bihar, and Rajasthan and all India. The four states account for 28 percent of India's population. Bihar and Rajasthan are more backward than Andhra Pradesh and Gujarat on most indicators. For example, levels of literacy—especially female literacy—are much

Table 3 Percentage utilization of selected antenatal- and delivery-care services for births during the three years preceding NFHS-1 and NFHS-2 by residence: Andhra Pradesh, Gujarat, Bihar, and Rajasthan

	Andhra Pradesh		Gujarat		Bihar		Rajasthan	
Indicator	**NFHS-1**	**NFHS-2**	**NFHS-1**	**NFHS-2**	**NFHS-1**	**NFHS-2**	**NFHS-1**	**NFHS-2**
Received antenatal check-up								
Total	89	93	78	86	40	37	33	48
Rural	87	91	75	84	35	34	29	42
Urban	95	99	87	91	68	69	51	70
Received two or more tetanus toxoid injections								
Total	76	83	64	73	33	59	29	52
Rural	73	80	58	67	28	57	25	48
Urban	86	90	78	83	62	80	53	71
Received professional assistance at delivery								
Total	52	64	44	53	20	21	23	36
Rural	43	57	33	42	15	18	18	29
Urban	79	85	69	74	53	48	45	62
Delivered in a medical institution								
Total	35	50	37	46	13	15	12	22
Rural	23	40	24	33	8	12	8	15
Urban	69	79	64	69	42	41	34	48
Number of births	1,412	1,129	1,499	1,324	2,660	2,912	2,197	3,076

lower in Bihar and Rajasthan than in Andhra Pradesh and Gujarat. Fertility is much higher in Bihar (4.3 children per woman) and Rajasthan (4.1) than in Andhra Pradesh (2.4) and Gujarat (3.0). Per capita net state domestic product is about four times higher in Gujarat than in Bihar. Although availability of government-sponsored primary health centres does not vary much among the four states, availability of hospitals is much lower in Bihar and Rajasthan than in Andhra Pradesh and Gujarat. Population served per hospital is 270,475 in Bihar, 240,790 in Rajasthan, 23,288 in Andhra Pradesh, and 17,810 in Gujarat.

Patterns of Antenatal and Delivery Care

Table 3 presents rates of utilization of selected antenatal- and delivery-care services for births in the three years preceding NFHS-1 and NFHS-2 in the four states by urban/rural residence. In both NFHS-1 and NFHS-2, the proportions of mothers receiving antenatal care and delivery care are much lower in Bihar and Rajasthan than in Andhra Pradesh and Gujarat. In all four states, the proportions receiving each of the antenatal- and delivery-care services are higher in urban areas than in rural areas, especially in Bihar and Rajasthan. Utilization of antenatal- and delivery-care services

Table 4 Percentage distribution of births by place of delivery for births during the three years preceding NFHS-1 and NFHS-2 by residence: Andhra Pradesh, Gujarat, Bihar, and Rajasthan

	Andhra Pradesh		Gujarat		Bihar		Rajasthan	
Source	NFHS-1	NFHS-2	NFHS-1	NFHS-2	NFHS-1	NFHS-2	NFHS-1	NFHS-2
RURAL								
Home	77	60	76	67	92	88	92	85
Public-sector facility	12	11	11	10	4	3	7	11
Private-sector facility	11	30	13	24	4	9	1	4
Other	0	0	0	0	0	0	0	0
URBAN								
Home	31	21	36	31	58	59	66	52
Public-sector facility	25	19	25	14	17	12	27	34
Private-sector facility	45	60	39	55	25	29	8	14
Other	0	0	1	0	0	0	0	0
TOTAL								
Home	65	50	63	54	87	85	88	78
Public-sector facility	15	13	15	11	6	4	10	16
Private-sector facility	20	37	21	35	7	11	2	6
Other	0	0	0	0	0	0	0	0

improved in each state between NFHS-1 and NFHS-2, with the partial exception of Bihar, where the proportion of mothers receiving an antenatal check-up declined slightly between the two surveys. The proportion giving birth in medical institutions increased considerably in Andhra Pradesh, Gujarat, and Rajasthan between NFHS-1 and NFHS-2. In Bihar, however, it increased only marginally, from 13 percent to 15 percent.

Table 4 shows place of delivery for births in the three years preceding NFHS-1 and NFHS-2 in the four states by urban/rural residence. In all four states, the majority of deliveries take place at home (either own home or parents' home). In NFHS-2, the proportion delivering in medical institutions is highest in Andhra Pradesh (50 percent), followed by Gujarat (46 percent), Rajasthan (22 percent), and Bihar (15 percent). In Andhra Pradesh, Gujarat, and Bihar, about three out of four deliveries in health facilities take place in private-sector health facilities. But the situation is reversed in Rajasthan, where about three out of four deliveries in health facilities take place in public-sector health facilities. The proportion delivering in public-sector facilities declined between the two surveys in Andhra Pradesh, Gujarat, and Bihar but increased in Rajasthan. The proportion delivering in private medical institutions increased in all four states. Use of private-sector facilities for delivery increased in both rural and urban areas in all four states.

Correlates of Institutional Delivery

The likelihood of giving birth in a medical institution depends on many factors, including urban/rural residence, mother's demographic and socioeconomic characteristics, and availability and quality of health services. Table 5 presents the proportion of rural mothers giving birth in a medical institution during the three years preceding NFHS-1 and NFHS-2 by selected characteristics for each of the four states. The table shows that older mothers are somewhat less likely to give birth in a medical institution than younger mothers. It also shows that first-order births to rural mothers are much more likely to take place in a medical institution than second or higher-order births. In NFHS-2 in Andhra Pradesh, for example, 53 percent of first-order births but only 24 percent of fourth or higher-order births took place in medical institutions. In NFHS-2, Hindu mothers are somewhat more likely than Muslim mothers to deliver in a medical institution in Bihar and Rajasthan, but somewhat less likely to do so in Andhra Pradesh and Gujarat. In all four states, rural mothers belonging to scheduled castes or scheduled tribes are much less likely to give birth in a medical institution than mothers not belonging to a scheduled caste or scheduled tribe.

Institutional delivery is positively associated with mother's education, exposure to mass media, and household standard of living. Among rural mothers, literate mothers are much more likely to give birth in a medical institution than illiterate mothers in all four states in both surveys. In NFHS-2 in Bihar, for example, only 7 percent of illiterate mothers delivered in a medical institution, compared with 39 percent of mothers with middle school complete or more education. In all four states, rural mothers who are regularly exposed to electronic mass media are several times more likely to give birth in a medical institution than mothers not so exposed. Mothers belonging to households with a low standard of living are much less likely to give birth in a medical institution than mothers belonging to households with a medium or high standard of living. For example, in NFHS-2 in Andhra Pradesh and Gujarat, mothers living in households with a high standard of living are about three times as likely to deliver in a medical institution as mothers living in households with a low standard of living. Currently working rural mothers are much less likely than nonworking rural mothers to give birth in a medical institution. Surprisingly, woman's autonomy, as measured by decisionmaking about her own health care, shows little association with institutional delivery.

In all four states, rural mothers who received antenatal care are several times more likely to deliver in a medical institution than mothers who did not receive such care. Rural mothers who received at least one antenatal check-up are six to nine times as likely to give birth in a medical institution as mothers who did not receive an antenatal check-up in NFHS-1 and three to seven times as likely in NFHS-2. Similarly, rural mothers who received two or more tetanus toxoid injections are three to

Table 5 Percentage of rural women giving birth in a medical institution during the three years preceding NFHS-1 and NFHS-2 by selected characteristics: Andhra Pradesh, Gujarat, Bihar, and Rajasthan

Characteristic	Andhra Pradesh		Gujarat		Bihar		Rajasthan	
	NFHS-1	NFHS-2	NFHS-1	NFHS-2	NFHS-1	NFHS-2	NFHS-1	NFHS-2
BACKGROUND FACTORS								
Age (in years)								
15–19	22	40	25	27	7	10	10	24
20–24	26	42	27	37	11	16	9	16
25–29	22	40	23	32	8	13	7	15
30–49	18	32	19	29	5	7	7	12
Birth order								
1	34	53	35	47	14	20	12	27
2	24	37	27	34	10	16	6	14
3	18	35	19	28	8	11	5	10
4+	12	24	14	21	4	7	7	11
Religion								
Hindu	23	40	25	32	9	14	7	15
Muslim	33	(58)	18	(48)	5	6	9	10
Other	(19)	34	0	0	*	(10)	(24)	0
Caste/tribe								
Scheduled caste/scheduled tribe	14	31	12	25	3	7	6	13
Other	26	45	29	39	9	15	9	16
DEMAND FACTORS – SOCIOECONOMIC								
Woman's education								
Illiterate	16	29	12	22	4	7	6	12
Literate, < middle complete	43	53	30	43	20	25	18	27
Middle complete or higher	62	67	66	57	37	39	30	37
Current work status								
Not working	33	55	33	42	10	15	10	17
Working	17	29	15	24	3	4	4	13
Media exposure								
Exposed	29	47	38	43	17	28	15	26
Not exposed	10	23	15	25	6	8	6	12
Decisionmaking about own health care								
Self	NA	44	NA	36	NA	10	NA	13
Jointly with others	NA	42	NA	37	NA	16	NA	15
Not involved	NA	38	NA	27	NA	11	NA	15
Standard of living								
Low	17	26	14	19	5	6	5	11
Medium	27	47	24	35	9	17	6	15
High	55	75	55	58	37	46	17	27
DEMAND FACTORS – ANTENATAL CARE								
Received antenatal check-up								
Yes	26	44	31	37	17	27	19	25
No	3	6	5	13	3	5	3	8
Received two or more tetanus toxoid injections								
Yes	28	45	36	38	18	18	18	24
No	9	20	9	23	4	6	5	8
SUPPLY FACTORS								
Availability of a hospital within 5 km								
Yes	30	40	27	42	7	15	8	18
No	20	41	24	30	8	10	7	14
Village has all-weather road								
Yes	29	43	30	38	10	15	11	18
No	17	37	13	24	6	11	5	14
Quality of health-care services								
Low	NA	35	NA	33	NA	10	NA	12
High	NA	45	NA	33	NA	16	NA	20
Number of births	1,056	846	1,025	841	2,312	2,657	1,837	2,446

NA Not available

*Not shown; <25 unweighted cases in the denominator

( ) 25–49 unweighted cases in the denominator

four times as likely to give birth in a medical institution as mothers who received only one or no tetanus injection in NFHS-1 and two to three times as likely in NFHS-2.

The availability and quality of health services are correlated with institutional delivery, but the relationships are rather weak. In NFHS-2, rural mothers living in villages within 5 km of a hospital facility are more likely to give birth in a medical institution than mothers living farther away in Gujarat, Bihar, and Rajasthan but not in Andhra Pradesh. In all states, mothers living in villages with an all-weather road are more likely to deliver in a medical institution than mothers living in villages without an all-weather road. Rural mothers living in villages with higher-quality health services are more likely to deliver in medical institutions than mothers living in villages with lower-quality health services in all states except Gujarat.

By way of comparison with Table 5, Table 6 presents correlates of institutional delivery for urban mothers of births in the three years preceding each survey. Among urban mothers, older mothers and mothers of higher-order births are less likely to give birth in a medical institution. Muslim mothers are more likely than Hindu mothers to give birth in a medical institution in Andhra Pradesh and Gujarat, but Muslim mothers are much less likely than Hindu mothers to do so in Bihar and Rajasthan. Scheduled-caste and scheduled-tribe mothers in urban areas in all four states are much less likely than other mothers to deliver in a medical institution. More-educated mothers, mothers regularly exposed to electronic mass media, and mothers living in households with a high standard of living are much more likely to give birth in a medical institution than other mothers. Working urban mothers are less likely to deliver in a medical institution than nonworking mothers in all four states. As in the case of rural mothers, decisionmaking about one's own health care is weakly associated with institutional delivery. In Andhra Pradesh and Gujarat, urban mothers who are not involved in decisionmaking about their own health care are less likely to deliver in medical institutions than mothers who are involved, but in Bihar and Rajasthan involvement in this decisionmaking has no effect on institutional delivery.

As in the case of rural mothers, antenatal care is strongly associated with institutional delivery for urban mothers. In all four states and in both surveys, urban mothers who received an antenatal check-up are several times more likely to deliver in a medical institution than those who did not. Mothers who received two or more tetanus toxoid injections are also more likely to deliver in a medical institution than mothers who received one or no injection. The quality of health-care services, as perceived by respondents, is positively associated with institutional delivery in Gujarat and Bihar but not in Andhra Pradesh and Rajasthan.

Table 6 Percentage of urban women giving birth in a medical institution during the three years preceding NFHS-1 and NFHS-2 by selected characteristics: Andhra Pradesh, Gujarat, Bihar, and Rajasthan

	Andhra Pradesh		Gujarat		Bihar		Rajasthan	
Characteristic	**NFHS-1**	**NFHS-2**	**NFHS-1**	**NFHS-2**	**NFHS-1**	**NFHS-2**	**NFHS-1**	**NFHS-2**
BACKGROUND FACTORS								
Age (in years)								
15–19	(60)	(64)	(68)	(59)	23	(38)	0	(34)
20–24	71	79	65	70	47	45	37	48
25–29	74	84	64	71	47	40	43	52
30–49	65	(80)	64	69	37	36	25	47
Birth order								
1	73	82	75	83	50	62	45	62
2	75	79	66	66	56	42	41	50
3	69	(65)	65	52	52	(28)	33	47
4+	55	(80)	40	62	21	24	21	32
Religion								
Hindu	69	76	65	68	46	46	37	52
Muslim	71	90	56	73	17	25	(11)	33
Other	0	0	0	0	(48)	0	0	0
Caste/tribe								
Scheduled caste/scheduled tribe	(68)	(66)	(60)	59	36	24	15	33
Other	70	79	65	74	43	45	42	51
DEMAND FACTORS – SOCIOECONOMIC								
Woman's education								
Illiterate	49	62	41	50	16	20	13	28
Literate, < middle complete	(68)	81	73	65	55	(49)	43	47
Middle complete or higher	87	90	84	87	73	63	72	85
Current work status								
Not working	72	80	67	70	44	42	34	51
Working	58	72	49	66	(22)	0	(38)	34
Media exposure								
Exposed	71	79	72	73	57	53	48	58
Not exposed	(41)	0	45	57	16	22	15	28
Decisionmaking about own health care								
Self	NA	(81)	NA	82	NA	(38)	NA	45
Jointly with others	NA	74	NA	67	NA	47	NA	52
Not involved	NA	81	NA	60	NA	37	NA	47
Standard of living								
Low	39	53	40	34	16	17	9	21
Medium	73	79	57	64	31	38	21	34
High	86	93	84	89	71	75	52	72
DEMAND FACTORS – ANTENATAL CARE								
Received antenatal check-up								
Yes	71	79	72	73	57	54	60	58
No	0	0	16	(35)	11	10	7	25
Received two or more tetanus toxoid injections								
Yes	73	80	74	74	60	48	57	56
No	(49)	(69)	30	47	14	(12)	8	28
SUPPLY FACTORS								
Quality of health-care services								
Low	NA	79	NA	59	NA	27	NA	47
High	NA	77	NA	76	NA	53	NA	48
Number of births	353	283	474	483	346	254	360	628

NA Not available

( ) 25–49 unweighted cases in the denominator

Determinants of Institutional Delivery

This section presents adjusted effects (odds ratios) of selected background, socioeconomic, antenatal care, and community-access variables on the likelihood of giving birth in a medical institution. The analysis is limited to rural areas of each of the four states because information on community access to health facilities was collected only for rural areas in NFHS-1 and NFHS-2. Effects are "adjusted" by statistically controlling for potentially confounding variables by holding them constant at their mean values in the underlying logistic regressions (see Retherford and Choe 1993 for methodological details). For each survey and for each state, five alternative models are estimated using alternative sets of predictor variables. Adjusted effects of antenatal care on institutional delivery are discussed first, followed by discussion of the effects of the other predictor variables included in the analysis.

Effects of antenatal care on institutional delivery

The bivariate relationships presented in the previous section reveal a strong positive correlation between antenatal care and institutional delivery. Tables 7–10 present adjusted effects of antenatal care on the likelihood of institutional delivery for Andhra Pradesh, Gujarat, Bihar, and Rajasthan, based on five alternative models. The two antenatal care variables—antenatal check-up and two or more tetanus toxoid injections—are included in Models 2, 3, and 5.

Table 7 shows that in rural Andhra Pradesh, mothers who received an antenatal check-up are several times more likely to give birth in a medical institution than mothers who did not receive any antenatal check-up, even after controlling for a number of potentially confounding variables. In NFHS-1 in Model 2, with age, birth order, religion, and caste/tribe controlled by holding them constant at their mean values in the underlying logistic regression, the odds of giving birth in a medical institution (as predicted by the underlying logistic regression) is 5.4 times higher for mothers who received an antenatal check-up than for mothers who did not receive any antenatal check-up. This effect of antenatal care is reduced to 4.2 when mother's education, work status, exposure to electronic mass media, and household living standard are additionally controlled in Model 3, and further to 3.8 when availability of a hospital within 5 km and availability of an all-weather road are additionally controlled in Model 5, which is the full model that includes all of the predictor variables. In NFHS-2 the comparable value from Model 5 is 4.5, somewhat higher than the value of 3.8 in NFHS-1. Overall, the results indicate that receiving an antenatal check-up has a large effect on the likelihood of giving birth in a medical institution, independent of the mother's demographic and socioeconomic characteristics and her access to health services.

Table 7 Adjusted effects (odds ratios) of selected predictor variables on the likelihood of giving birth in a medical institution in rural areas of Andhra Pradesh: NFHS-1 and NFHS-2

	NFHS-1					NFHS-2				
Characteristic	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BACKGROUND FACTORS										
Age (in years)										
15–19†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20–24	1.84*	1.98**	1.84*	1.94**	1.84*	1.61	1.87*	1.63*	1.89**	1.68*
25–29	2.37*	2.59**	2.36*	2.50**	2.29*	3.02**	2.86**	2.95**	3.17**	3.22**
30–49	3.96**	3.16**	4.05**	3.09**	4.07**	2.55*	2.58*	2.70*	2.45*	2.75*
Birth order										
1†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	0.57**	0.45**	0.55**	0.44**	0.54**	0.45**	0.43**	0.46**	0.42**	0.45**
3	0.37**	0.28**	0.38**	0.26**	0.37**	0.42**	0.35**	0.43**	0.32**	0.43**
4+	0.22**	0.16**	0.25**	0.15**	0.25**	0.26**	0.26**	0.33**	0.17**	0.32**
Religion										
Hindu†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Muslim	1.46	1.56	1.43	1.55	1.42	1.57	2.99*	2.07*	2.29	2.21*
Other	1.07	1.06	1.05	0.92	0.90	0.91	0.91	0.83	1.15	0.93
Caste/tribe										
Scheduled caste/scheduled tribe	0.66	0.53*	0.67	0.55*	0.71	0.82	0.63*	0.83	0.58*	0.81
Other†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DEMAND FACTORS – SOCIOECONOMIC										
Woman's education										
Illiterate†	1.00		1.00		1.00	1.00		1.00		1.00
Literate, < middle complete	2.73**		2.53**		2.51**	1.74*		1.65*		1.73*
Middle complete or higher	3.94**		3.50**		3.23**	1.98*		1.86*		1.83*
Current work status										
Not working†	1.00		1.00		1.00	1.00		1.00		1.00
Working	0.66*		0.71		0.75	0.51**		0.54**		0.53**
Media exposure										
Exposed	2.27**		2.10**		2.07**	1.57*		1.41		1.39
Not exposed†	1.00		1.00		1.00	1.00		1.00		1.00

cont.

Table 7, cont. Adjusted effects (odds ratios) of selected predictor variables on the likelihood of giving birth in a medical institution in rural areas of Andhra Pradesh: NFHS-1 and NFHS-2

	NFHS-1					NFHS-2				
Characteristic	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
DEMAND FACTORS – SOCIOECONOMIC, cont.										
Standard of living										
Low†	1.00		1.00		1.00	1.00		1.00		1.00
Medium	1.24		1.24		1.35	1.72*		1.67*		1.66*
High	1.80		1.79		1.80	3.25**		3.11**		3.21**
DEMAND FACTORS – ANTENATAL CARE										
Received antenatal check-up										
Yes		5.36**	4.18**		3.75*		6.64**	4.56**		4.50**
No†		1.00	1.00		1.00		1.00	1.00		1.00
Received two or more tetanus toxoid injections										
Yes		2.17**	1.85*		1.77*		2.04**	1.66		1.67
No†		1.00	1.00		1.00		1.00	1.00		1.00
SUPPLY FACTORS										
Availability of a hospital within 5 km										
Yes				1.43	1.26				0.89	0.79
No†				1.00	1.00				1.00	1.00
Village has all-weather road										
Yes				1.92*	1.61				1.38	1.40
No†				1.00	1.00				1.00	1.00
Number of births	1,036	1,046	1,027	1,019	991	815	808	804	819	804

†Reference category

*p<.05

**p<.01

Having received two or more tetanus toxoid injections during pregnancy also has a positive effect on institutional delivery, but this effect is much smaller than the effect of having had an antenatal check-up and, in NFHS-2, not statistically significant in the full model. The principal mechanism by which the two antenatal-care variables affect institutional delivery is presumably that the health professionals who provide the antenatal care tend to encourage mothers to deliver in a medical institution.

The adjusted effects of antenatal check-ups on institutional delivery are also large and highly statistically significant in the rural areas of Gujarat, Bihar, and Rajasthan (Tables 8–10). In NFHS-1, after controlling for the various background, socioeconomic, and supply factors (Model 5), the odds of institutional delivery are 2.8 times higher in Gujarat, 3.5 times higher in Bihar, and 4.7 times higher in Rajasthan among mothers who received antenatal check-ups than among mothers who did not. The corresponding odds ratios in NFHS-2 are 2.6 in Gujarat, 3.7 in Bihar, and 2.2 in Rajasthan. As in the case of Andhra Pradesh, the adjusted effects of receiving two or more tetanus toxoid injections during pregnancy are weaker than the effects of antenatal check-ups in Gujarat, Bihar, and Rajasthan, and the effects are mostly in the expected direction.

Effects of other factors on institutional delivery

Tables 7–10 also present adjusted effects (odds ratios) of the selected background, socioeconomic, and supply factors on the likelihood of institutional delivery. Here we focus on findings from Model 5 in each table. In Table 7 for Andhra Pradesh in both NFHS-1 and NFHS-2, mother's age has a large positive effect on the odds of institutional delivery when other variables, including birth order, are controlled. Child's birth order, on the other hand, has a strong negative effect when other variables, including mother's age, are controlled. The odds of institutional delivery are three to four times as high for first-order births as for fourth or higher-order births. The opposite effects of maternal age and child's birth order indicate that women who delay childbearing are more likely to deliver in a medical institution.

The odds of institutional delivery are considerably higher for Muslim mothers than for Hindu mothers, especially in NFHS-2. In NFHS-1, however, this effect of religion is not statistically significant. The effect of caste/tribe membership is reduced considerably and becomes statistically nonsignificant when the other variables are controlled.

Mother's level of education has a large positive effect on the odds of institutional delivery in Andhra Pradesh in both NFHS-1 and NFHS-2. With all of the other predictor variables controlled, the odds of institutional delivery are two to three times higher for mothers with middle school or higher education than for illiterate mothers.

The effect of education is not much affected by inclusion or exclusion of the antenatal-care and supply variables, as indicated by comparison of Models 1, 3, and 5.

The adjusted effect of mother working is to reduce the odds of institutional delivery in both NFHS-1 and NFHS-2, although the effect is not statistically significant in NFHS-1. The reasons for this negative effect are not clear. Mother's exposure to electronic mass media has a positive effect on the odds of institutional delivery, but the effect is not statistically significant in NFHS-2. Household standard of living has a positive effect on the odds of institutional delivery, but the effect is not statistically significant in NFHS-1. In NFHS-2, the odds of institutional delivery are 3.2 times higher if the mother resides in a household with a high standard of living than if she resides in a household with a low standard of living.

Comparison of Models 1 and 3 indicates that the effects of the socioeconomic demand factors do not change much when the antenatal-care variables are added to the model, indicating that the effects of the two sets of variables on the likelihood of institutional delivery are mostly independent of each other.

Neither availability of a hospital within 5 km of mother's village nor availability of an all-weather road connecting the village to the outside world has a statistically significant effect on the odds of institutional delivery in Andhra Pradesh in either NFHS-1 or NFHS-2 in Model 5. Comparison of Models 4 and 5 indicates that the effects of availability of a hospital and availability of an all-weather road on the odds of institutional delivery are about the same whether or not the two sets of demand variables are included in the model.

The adjusted effects of the various demographic, socioeconomic, and supply factors for Gujarat, Bihar, and Rajasthan (Tables 8–10) are broadly similar to those in Andhra Pradesh. There are some differences, however. Again we focus on results from Model 5. In rural Gujarat, with other factors controlled, the odds of institutional delivery are higher for Hindu mothers than for Muslim mothers in NFHS-1, but lower in NFHS-2. The reasons for this reversal are not clear. In Bihar, on the other hand, the odds of institutional delivery are higher for Hindus than for Muslims in both NFHS-1 and NFHS-2. As in the case of Andhra Pradesh, the odds of institutional delivery are lower for scheduled-caste and scheduled-tribe mothers than for mothers not belonging to scheduled castes or scheduled tribes in Gujarat and Bihar, but this is not so in Rajasthan.

Mother's education has a large positive effect on the odds of institutional delivery in Gujarat, Bihar, and Rajasthan. The effect of education is much stronger in NFHS-1 than in NFHS-2 in each of these states, perhaps indicating that the practice of institutional delivery is spreading from the more educated classes to the less educated classes, with the result that differences in the likelihood of institutional delivery by education are becoming smaller. The adjusted effect of media exposure is positive

Table 8 Adjusted effects (odds ratios) of selected predictor variables on the likelihood of giving birth in a medical institution in rural areas of Gujarat: NFHS-1 and NFHS-2

	NFHS-1					NFHS-2				
Characteristic	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BACKGROUND FACTORS										
Age (in years)										
15–19†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20–24	1.13	1.33	1.07	1.38	0.95	1.41	1.93*	1.44	1.78*	1.26
25–29	0.94	1.48	0.86	1.86	0.80	1.54	2.41*	1.59	2.24*	1.46
30–49	1.29	1.84	1.18	2.17	1.06	1.81	3.01**	1.90	2.91**	1.81
Birth order										
1†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	0.72	0.67*	0.74	0.59*	0.71	0.55**	0.48**	0.54**	0.47**	0.52**
3	0.61	0.40**	0.61	0.33**	0.57	0.53*	0.33**	0.51*	0.32**	0.50*
4+	0.60	0.31**	0.68	0.21**	0.64	0.37**	0.18**	0.35**	0.17**	0.33**
Religion										
Hindu†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Muslim	0.53	0.55	0.51	0.58	0.52	1.84	2.54	1.72	2.83	1.62
Other	0.47	2.00	0.52	1.74	0.55	2.06	2.52	2.24*	3.47*	3.03**
Caste/tribe										
Scheduled caste/scheduled tribe	0.49*	0.33**	0.46*	0.36**	0.46*	0.76	0.66	0.78	0.59*	0.71
Other†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DEMAND FACTORS – SOCIOECONOMIC										
Woman's education										
Illiterate†	1.00		1.00		1.00	1.00		1.00		1.00
Literate, < middle complete	2.29**		1.73*		1.58	1.94**		1.81**		1.84**
Middle complete or higher	8.14**		5.66**		5.49**	2.30**		2.03*		1.84
Current work status										
Not working†	1.00		1.00		1.00	1.00		1.00		1.00
Working	0.58**		0.58**		0.56**	0.56**		0.56**		0.58**
Media exposure										
Exposed	1.47		1.32		1.27	1.21		1.20		1.19
Not exposed†	1.00		1.00		1.00	1.00		1.00		1.00

cont.

Table 8, cont. Adjusted effects (odds ratios) of selected predictor variables on the likelihood of giving birth in a medical institution in rural areas of Gujarat: NFHS-1 and NFHS-2

	NFHS-1					NFHS-2				
Characteristic	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
DEMAND FACTORS – SOCIOECONOMIC, cont.										
Standard of living										
Low†	1.00		1.00		1.00	1.00		1.00		1.00
Medium	0.94		0.96		0.97	1.34		1.28		1.31
High	1.18		1.12		1.10	2.22*		2.07*		1.88
DEMAND FACTORS – ANTENATAL CARE										
Received antenatal check-up										
Yes		3.68**	2.72**		2.81**		3.25**	2.49**		2.60**
No†		1.00	1.00		1.00		1.00	1.00		1.00
Received two or more tetanus toxoid injections										
Yes		2.75**	1.98**		1.95**		1.12	0.90		0.90
No†		1.00	1.00		1.00		1.00	1.00		1.00
SUPPLY FACTORS										
Availability of a hospital within 5 km										
Yes				0.92	0.73				1.61	1.54
No†				1.00	1.00				1.00	1.00
Village has all-weather road										
Yes				2.75*	1.98*				1.97*	1.67
No†				1.00	1.00				1.00	1.00
Number of births	1,016	1,022	1,014	987	977	801	803	800	752	748

†Reference category

*$p<.05$

**$p<.01$

Table 9 Adjusted effects (odds ratios) of selected predictor variables on the likelihood of giving birth in a medical institution in rural areas of Bihar: NFHS-1 and NFHS-2

	NFHS-1					NFHS-2				
Characteristic	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BACKGROUND FACTORS										
Age (in years)										
15–19†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20–24	2.16*	2.30**	2.05*	1.93*	1.67	2.17**	2.74**	2.38**	2.42**	2.30**
25–29	2.08	2.65*	2.06	2.65*	1.96	3.06**	4.17**	3.31**	3.84**	3.17**
30–49	3.35*	3.41*	3.27*	2.47	2.36	3.08**	3.94**	3.42**	3.37**	3.35**
Birth order										
1†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	0.48**	0.58*	0.50*	0.63*	0.60	0.50**	0.51**	0.51**	0.52**	0.51**
3	0.44*	0.37**	0.43*	0.37**	0.45*	0.35**	0.32**	0.38**	0.30**	0.39**
4+	0.26**	0.24**	0.30**	0.18**	0.31*	0.25**	0.20**	0.28**	0.14**	0.26*
Religion										
Hindu†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Muslim	0.56	0.44*	0.56	0.47*	0.60	0.52*	0.43**	0.54*	0.35**	0.49*
Other	NE	NE	NE	NE	NE	0.74	0.81	0.58	1.32	0.57
Caste/tribe										
Scheduled caste/scheduled tribe	0.49	0.34*	0.52	0.28**	0.49	0.68*	0.49**	0.74	0.38**	0.76
Other†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DEMAND FACTORS – SOCIOECONOMIC										
Woman's education										
Illiterate†	1.00		1.00		1.00	1.00		1.00		1.00
Literate, < middle complete	3.10**		2.53**		2.66**	2.15**		1.85**		1.60*
Middle complete or higher	5.42**		3.98**		3.54**	2.65**		2.04**		1.89**
Current work status										
Not working†	1.00		1.00		1.00	1.00		1.00		1.00
Working	0.59		0.65		0.68	0.49**		0.51**		0.46**
Media exposure										
Exposed	1.13		1.00		1.20	1.34		1.12		1.09
Not exposed†	1.00		1.00		1.00	1.00		1.00		1.00

cont.

Table 9, cont. Adjusted effects (odds ratios) of selected predictor variables on the likelihood of giving birth in a medical institution in rural areas of Bihar: NFHS-1 and NFHS-2

	NFHS-1					NFHS-2				
Characteristic	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
DEMAND FACTORS – SOCIOECONOMIC, cont.										
Standard of living										
Low†	1.00		1.00		1.00	1.00		1.00		1.00
Medium	0.96		0.93		0.85	1.68**		1.51*		1.54*
High	2.72*		2.36*		2.23	3.70**		2.93**		3.17**
DEMAND FACTORS – ANTENATAL CARE										
Received antenatal check-up										
Yes		3.73**	3.10**		3.54**		4.94**	3.73**		3.66**
No†		1.00	1.00		1.00		1.00	1.00		1.00
Received two or more tetanus toxoid injections										
Yes		1.60	1.06		0.98		1.53	1.21		1.34
No†		1.00	1.00		1.00		1.00	1.00		1.00
SUPPLY FACTORS										
Availability of a hospital within 5 km										
Yes				0.90	0.90				1.39	1.43
No†				1.00	1.00				1.00	1.00
Village has all-weather road										
Yes				1.82*	1.08				1.30	1.19
No†				1.00	1.00				1.00	1.00
Number of births	2,036	2,093	2,030	1,950	1,884	2,668	2,662	2,658	2,534	2,520

†Reference category

*p<.05

**p<.01

NE: Not estimated due to insufficient number of cases

Table 10 Adjusted effects (odds ratios) of selected predictor variables on the likelihood of giving birth in a medical institution in rural areas of Rajasthan: NFHS-1 and NFHS-2

	NFHS-1					NFHS-2				
Characteristic	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BACKGROUND FACTORS										
Age (in years)										
15–19†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20–24	0.70	0.80	0.65	0.93	0.62	0.82	0.77	0.72	0.88	0.72
25–29	0.86	0.78	0.73	0.95	0.68	1.40	1.31	1.25	1.40	1.24
30– 49	1.23	0.92	1.14	0.88	0.89	1.62	1.30	1.35	1.41	1.32
Birth order										
1†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	0.52*	0.54*	0.55*	0.44**	0.47*	0.41**	0.39**	0.40**	0.42**	0.40**
3	0.47*	0.48*	0.51	0.29**	0.37*	0.26**	0.25**	0.26**	0.25**	0.27**
4+	0.55	0.70	0.65	0.52	0.66	0.26**	0.27**	0.29**	0.23**	0.29**
Religion										
Hindu†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Muslim	1.23	0.93	1.05	1.26	1.14	0.68	0.61	0.65	0.57	0.63
Other	2.26	3.56	2.72	2.06	1.61	1.38	1.55	1.40	1.70	1.60
Caste/tribe										
Scheduled caste/scheduled tribe	0.95	0.70	0.96	0.74	1.09	0.98	0.79	0.92	0.85	0.98
Other†	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DEMAND FACTORS – SOCIOECONOMIC										
Woman's education										
Illiterate†	1.00		1.00		1.00	1.00		1.00		1.00
Literate, < middle complete	2.27*		1.91*		2.05*	1.87**		1.43		1.52
Middle complete or higher	3.45**		2.33*		2.22	2.09**		1.50		1.50
Current work status										
Not working†	1.00		1.00		1.00	1.00		1.00		1.00
Working	0.53*		0.51*		0.63	0.98		0.95		1.00
Media exposure										
Exposed	1.43		1.11		1.19	1.73**		1.49*		1.53**
Not exposed†	1.00		1.00		1.00	1.00		1.00		1.00

cont.

Table 10, cont. Adjusted effects (odds ratios) of selected predictor variables on the likelihood of giving birth in a medical institution in rural areas of Rajasthan: NFHS-1 and NFHS-2

	NFHS-1					NFHS-2				
Characteristic	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
DEMAND FACTORS – SOCIOECONOMIC, cont.										
Standard of living										
Low†	1.00		1.00		1.00	1.00		1.00		1.00
Medium	1.14		1.08		0.83	1.14		1.01		1.04
High	1.88		1.45		1.27	1.42		1.09		1.06
DEMAND FACTORS – ANTENATAL CARE										
Received antenatal check-up										
Yes		5.69**	5.19**		4.67**		2.43**	2.21**		2.24**
No†		1.00	1.00		1.00		1.00	1.00		1.00
Received two or more tetanus toxoid injections										
Yes		1.59*	1.36		1.40		2.32**	2.11**		2.04**
No†		1.00	1.00		1.00		1.00	1.00		1.00
SUPPLY FACTORS										
Availability of a hospital within 5 km										
Yes				1.09	0.78				1.36	1.48*
No†				1.00	1.00				1.00	1.00
Village has all-weather road										
Yes				2.06**	1.88*				1.24	0.95
No†				1.00	1.00				1.00	1.00
Number of births	1,779	1,819	1,763	1,639	1,574	2,438	2,438	2,427	2,352	2,331

†Reference category

*$p<.05$

**$p<.01$

in each state, but it is small and not statistically significant, except in Rajasthan in NFHS-2. The adjusted effect of household standard of living on the odds of institutional delivery is generally positive but small and not statistically significant, except in Bihar in NFHS-2.

In Gujarat, Bihar, and Rajasthan (unlike Andhra Pradesh), comparison of Models 1 and 3, which differ only in the inclusion or exclusion of the antenatal-care variables, suggests that some of the effect of education on the likelihood of institutional delivery is indirect via antenatal care, inasmuch as the effect of education is reduced when the antenatal care variables are included in the model. This tends not be so, however, in the case of the other socioeconomic demand variables (current work status, media exposure, and standard of living), the effects of which do not change much between Models 1 and 3 in any of the four states.

In contrast to Andhra Pradesh, availability of a hospital within 5 km has a positive effect on the odds of institutional delivery in NFHS-2 in Gujarat, Bihar, and Rajasthan, but the effect is not statistically significant in Gujarat and Bihar. Availability of an all-weather road has a positive and statistically significant effect in Gujarat and Rajasthan in NFHS-1, but this effect is small and not statistically significant in Andhra Pradesh and Bihar in NFHS-1 and in all four states in NFHS-2.

CONCLUSIONS

The analysis indicates that, among rural mothers in Andhra Pradesh, Gujarat, Bihar, and Rajasthan who gave birth during the 3-year periods before NFHS-1 and NFHS-2, the odds of giving birth in a medical institution are two to five times higher for mothers who received at least one antenatal check-up than for mothers who did not receive any antenatal check-up, after a number of potentially confounding variables are controlled by holding them constant. The effect of tetanus toxoid vaccination on institutional delivery is usually positive but smaller and not always statistically significant when other variables are controlled.

Among the other predictor variables considered, mother's education has a strong positive effect on the odds of institutional delivery in each of the four states in both surveys. Mother's age also has a strong positive effect, but child's birth order has a strong negative effect in most cases. Together, the opposite effects of mother's age and child's birth order indicate that women who delay childbearing are more likely to deliver in a medical institution. The effects of religion are mixed. In some cases, the odds of institutional delivery are higher for Muslims than for Hindus, but in other cases the direction of the effect is reversed. The odds of institutional delivery are lower for scheduled-caste and scheduled-tribe mothers than for other mothers. They are also lower for working mothers than for nonworking mothers. The odds of insti-

tutional delivery are higher for mothers who are regularly exposed to the electronic mass media than mothers who are not regularly exposed, and higher for mothers in households with a high standard of living than for mothers in households with a low standard of living.

Contrary to expectation, availability of a hospital within 5 km of the village does not have a statistically significant effect on the odds of giving birth in a medical institution in most cases, after other potentially confounding variables are controlled. The effect of availability of an all-weather road on institutional delivery is usually positive, but again not statistically significant in most cases.

Overall, the analysis indicates that receiving one or more antenatal check-ups is the strongest predictor of institutional delivery. This finding has important programme implications. It suggests that it is possible to promote institutional delivery by expanding antenatal-care coverage and associated counseling. Given that distance to a hospital does not have a significant effect on institutional delivery, it may not be necessary to create new hospitals (at least not for the purpose of encouraging institutional delivery), but rather to focus on expanding the availability and quality of services at existing facilities, in addition to counseling and educating mothers about the importance of giving birth in a medical institution under the supervision of trained professionals. Because a much higher proportion of institutional deliveries take place in private-sector facilities than in public-sector facilities in three of the four states, efforts should also be made to strengthen private-sector health facilities to make them more accessible to rural mothers, in terms of availability and quality of services and cost. Since half or more of deliveries in all four states still occur at home, efforts to train traditional birth attendants, increase the availability of trained midwives, promote home visits by paramedics for antenatal check-ups, distribute iron and folic acid tablets, and vaccinate against tetanus should continue.

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