Utilization of Maternal Health Services in Uttar Pradesh: A Comparison between Simple Logistic and Multilevel Logistic Regression Analysis

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Introduction

Every year nearly 536,000 women die of complications related to pregnancy and child-birth; and 99 percent of these maternal deaths occur in developing countries (WHO, 2007). The tragedy is that these women die not from disease but during the normal, life-enhancing process of procreation. It is estimated that nearly one-fifth of the total maternal deaths occur in India (WHO, 2004). This is the highest burden for any single country in the world (Agarwal, 2005). The most recent statistics indicate an average maternal mortality ratio of 301 per 100,000 live births at the national level with the highest number of deaths occurring in the state of Uttar Pradesh (RGI, 2006).

Recognizing the challenge of adverse maternal health, Government of India (GOI) in the National Population Policy-2000 and the National Health Policy-2003 aims at achieving maternal mortality rate to below 100 per 100,000 live births (GOI, 2000 and 2003). Such commitments are not only internal political manifestations but are also international commitments. India, as a signatory of Millennium Development Goals envisages to reducing maternal mortality ratio by three quarters between 1990 and 2015.

In spite of the GOI's effort to improve maternal health not much progress has been achieved. A large proportion of the population lacks access to life saving maternal care (Maine, 2001). For India as a whole, mothers of only 15 percent of births received all of the required components of antenatal care and less than 40 percent of births take place in health facilities (IIPS and Macro International, 2007).

Previous studies suggest that utilization of maternal health care services depends on various demographic, socio-economic and community-level factors. (Obermeyer 1993; Bhatia and Cleland 1995; Addai 1998; Nuwaha and Amooti-kaguna 1999; Magadi et al., 2000 and Thaddeus and Maine, 1994). Many studies have examined the impact of these factors on the utilization of health services. By virtue of their observational design, these studies rely heavily on the use of traditional multivariate analyses to remove the effects of confounding variables (Rothman et al., 1998; Hosmer, 1989 and McCullagh, 1989). But the data

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in health research frequently exists in hierarchical fashion (Duncan et al., 1998 and Rice and Leyland, 1996). Applying traditional multivariate techniques has limitations.

Traditional epidemiologic methods, such as logistic regression, typically analyze data at the individual-level, where some variation might be due to individual characteristics (compositional effects), group characteristics (contextual effects), or the effects of omitted group-level variables on individual-level outcomes (Bardenheier et al., 2005). Logistic regression permits the simultaneous examination of how individual level and group-level variables relate to individual-level outcomes, thus allowing for contextual effects that likely impact quality of health care. However, it does not allow the examination of both between and within group variability, nor how group-level and individual-level variability relate (Diez-Roux, 2002). Traditional logistic regression requires the assumptions: 1) independence of observations conditional on the independent variables and 2) uncorrelated residual errors. These assumptions are not always met when analyzing nested data.

Multilevel analysis should be considered when variability between groups on individual-level outcomes exists. (Bardenheier et al., 2005). A multilevel modeling strategy accommodates the hierarchical nature of the data (DiPrete and Forrostal, 1994; Goldstein, 1995 and Duncan et al., 1998) and corrects the estimated standard errors to allow for the clustering of the observations within units (Goldstein, 1995). The use of multilevel models also allows the identification of clustering of the outcome at different levels. This clustering, known as the random intercept, represents the extent to which the outcome of interest varies between each higher-order units (community) after controlling for variables entered in the model. The random intercept can reflect factors influencing the outcomes that have been omitted from the model or factors that cannot be quantified in a large-scale social survey (for example, variations in beliefs concerning health).

In view of the above discussion the present paper provides a comparative scenario in identifying factors associated with the utilization of maternal health services in rural Uttar Pradesh under simple logistic regression analysis (often used in demographic analysis) and comparatively a lesser use technique of multilevel logistic analysis.

Data and Methods

The Reproductive and Child Health – District Level Household Survey Round (RCH-DLHS) II for Uttar Pradesh completed during 2002-04 is the basis of the present study. In each district, 40 Primary Sampling Units (PSUs – Villages/Urban Frame Size) were selected with probability proportional to size

(PPS) using 1991 Census data. All the villages were stratified according to population size, and female literacy was used for implicit arrangement within each strata. The number of PSUs in rural and urban was decided on the basis of percent of urban population in the district. The target sample size in each district was set at 1000 complete residential households from 40 selected PSUs. In the second stage, with in each PSU, 28 residential households were selected with Circular Systematic Random Sampling (CSRS) procedure after house listing. In order to take care of non-response due to various reasons, sample was inflated by 10 percent. The respondents of the RCH-DLHS were currently married women in the age group of 15-44 years. The main focus of the RCH-DLHS was on the coverage of ANC and immunization services, proportion of safe delivery, contraceptive prevalence rates, unmet need for family planning, awareness about RTI/STI and HIV/AIDS and utilization of government health services and user's satisfaction.

Composite index to measure the extent of antenatal care use has been created using different procedures that come under the umbrella of antenatal care giving appropriate weights to the different components. The weights for the different components are assigned on the basis of the available literature on the relative roles of different components in improving maternal health (Ram and Singh, 2005). The components, namely at least three antenatal visits, initial visit in first four months, and prescribed iron folic acid tablets were assigned a weight of three. At least two tetanus injections, advice regarding the danger signs of pregnancy, advice regarding delivery care, blood pressure measured, and abdomen examined were given a weight of two each. The rest of the items were assigned a weight of one each. This composite index (range 0–23) was further classified into three levels of antenatal care use, namely no antenatal use, moderate antenatal use (1–11) and high antenatal use (11–23).

In the present paper six maternal service use variables for all the three components of maternal health care, that is, antenatal care, natal care and postnatal care has been modeled. Six dependent variables are as follows (1) whether the respondent received any component of antenatal care; (2) whether the respondent received high level of antenatal care. The analysis is restricted to those women who had used any component of ANC during their last pregnancy. If a woman scores 11-23 in the composite index of ANC then she is designated that she has received high extent of antenatal care (3) whether the respondent sought treatment for the complications during her last pregnancy. The analysis is restricted to those women who had faced problems during their last pregnancy; (4) whether the respondent delivered her child in an institution; (5) whether the respondent received any assistance from trained professionals when she delivered her baby at a place other than a medical institution (assisted delivery); (6) whether the respondent

sought advice for the complications during the post-delivery period. The analysis is restricted to those women who had faced problems during their post-delivery period.

In view of the dichotomous dependent variable (No/Yes), the choice of logistic regression analysis is obvious. Separate simple and multilevel logistic regression models have been fitted for each of the service utilization by the women. For multilevel regression, two level models are employed for fitting, with women (level 1), nested within the community/PSU (level 2). Accordingly, a two-level logistic regression analysis was applied. Since this procedure considers the variables at their own level, it helps in retaining the obvious hierarchical structure of the data in the analysis. Further, this procedure also accounts for the variability because of variables which could not be considered in the analysis.

The model fitted takes the form

$$\mathbf{\log [p_{ij}/ (1-p_{ij})] = x_{ij}a+w_jb+u_j+e_{ij}}$$

Where p_{ij} is the probability that a woman i in community j has used maternal health service, x_{ij} and w_j are vectors of individual and community level characteristics respectively; and a and b are vectors of estimated parameter coefficients. $U_j \sim N(0, \sigma_u^2)$ is an error term at the community level and $e_{ij} \sim N(0, \sigma^2)$ is an error term at the individual level. The main advantage of this approach is control for the correlation between women in a particular community (level 2). Let y_{ij} be the response variable for the i^{th} woman in the j^{th} village and y_{kj} be the same response variable for k^{th} woman in the same village j^{th}. Let **x** be the vector of explanatory variable, then

$$\mathbf{Cov (y_{ij},y_{kj}/x) = Cov (a_0+ax_{ij}+u_j+bw_j+e_{ij}, a_0+ax_{kj}+bw_j+u_j+e_{kj}) \Rightarrow Cov (y_{ij},y_{kj}/x) = \sigma_u^2}$$

Where a_0 is the constant intercept, Cov stands for covariance. The community error term (U_j) in the model gives indication of the variation after controlling for the individual level characteristics.

The models have been fitted in order to provide a comparative scenario in identifying factors associated with utilization of antenatal, natal and postnatal services in Uttar Pradesh under simple logistic and technique of multilevel logistic regression analysis. The demographic variables used are age, age at marriage and children ever born. Socio-economic factors considered are religion, caste, women's and husband's year of schooling and standard of living. Health status is represented by pregnancy wastage. The community level variables considered in the analysis are: availability of sub-centre in the PSU, availability of middle school in the PSU, distance of the PSU from nearest town, distance of primary health centre from the PSU and PSU connected by road to other places The variables are divided into appropriate categories so that there are sufficient numbers of respondents in each category to facilitate multivariate analysis.

Conceptualization of Relationship

Based on the findings of several studies, the relationship between background characteristics of the women and the utilization of various components of maternal health service has been discussed.

Socio-Economic Factors:

Although pregnancy is recognized as a biological process, its socio-economic dimensions are equally important. The whole process of childbearing is governed by social, cultural and economic factors (Mondol, 2003). Socio-economic factors have been shown to be of greater importance than demographic factors in influencing maternal health-service use (Obermeyer and Potter, 1991). Although demographic factors may shape a woman's desire to make use of services (for example, younger women may have more modern attitudes towards health care), socio-economic status of an individual and her household determines her ability to do so (Stephenson and Tsui, 2002).

Religion affects the use of professional maternal services through cultural practices and rituals (Wall, 1998; Haque et al., 1998). Religious tradition and culture are important determinants for non-use of hospital facilities for delivery in many developing countries (Paul and Rumsey, 2002). Paul (2000) observed that the vast majority of people in rural Bangladesh believe that childbirth is an act of God and is a 'natural event.' For this reason, they do not expect delivery complications and therefore use TBAs for childbirth. Villagers also select TBAs because of tradition, convenience and TBAs are invariably known and trusted members of the community (Paul and Rumsey, 2002). Unlike TBAs, doctors, nurses, and staff at hospitals are most likely to be from outside the locality. Rural women, particularly in Muslim countries do not usually converse with unknown persons, particularly males (Paul and Rumsey, 2002). This situation acts as an important social and religious barrier to the use of health centers for delivery purposes. However, this does not follow a stereotypical pattern. According to Pallikadavath et al. (2004) religion shows unique state specific features. For example, whilst among all the religious groups Muslims in the state of Madhya Pradesh in India are most likely to access antenatal care through visits to a health facility while Muslims in the other states taken in the study (that is, Bihar, Uttar Pradesh and Rajasthan) had the lowest visits.

The effect of caste on use of maternal care is not direct, but is mediated by the interplay of such factors as social status, accessibility and perception for health services. Grover et al. (2001), in their RCH survey of Faridabad, Haryana, have shown that the higher caste women have received the antenatal care, tetanus toxoid and iron folic acid packages more frequently than women of the scheduled caste (SC) and other backward classes (OBC). Similar finding can be seen in a study conducted by Pallikadavath et al.

(2004). According to Pallikadavath et al. (2004), with regard to caste, members of OBC had a higher usage of antenatal care compared with SC and scheduled tribe (ST) women.

In terms of socio-economic factors, maternal education, is considered one of the strongest factors associated with receiving maternal health service use (Basu, 1990; Mitra et al., 1994 and 1997 and Prince, 1999). Some other studies also show that the determinant of health service use found most consistently is a woman's educational attainment (Obermeyer, 1993; Bhatia and Cleland, 1995; Addai, 1998; Nuwaha and Amooti-kaguna, 1999; Maggadi et al., 2000). Higher levels of educational attainment result in greater use of services (Stephenson and Tsui, 2002). Caldwell et al (1989) argue that education can have an empowering effect on women by broadening their horizons and making them aware of available opportunities. Education enables women to take personal responsibility for their health (Paul and Rumsey, 2002). The 1996–1997 Bangladesh Demographic Health Survey shows a higher proportion of births assisted by medical personnel to women with at least some education compared with births among women with no education (Mitra et al., 1997).

Similarly family's level of education, especially husband's, also has an influence on the utilization of maternal health services. Educated families are more knowledgeable of health practices that may influence the use of safer and more comfortable child-birthing procedures in hospital settings (Paul and Rumsey, 2002). India is primarily a patriarchal society. Husband is the ultimate decision maker in most families, including decisions on maternal health care, number of children to have, contraceptive use and health seeking behavior. As the reproductive behavior of a woman is usually determined by her husband, husband's education also plays a significant role in influencing the use of reproductive health service by their wife (Khan et.al., 1997). The findings of the Uttar Pradesh Male Reproductive Health Survey (MRHS) suggests that married men in the northern Indian state of Uttar Pradesh who were better educated are significantly more knowledgeable about serious problems a woman may experience during pregnancy and they also understand the importance of service utilization (Mahler, 2000). Thus, husband's high level of education increases the likelihood of health service use (Nwakoby, 1994; Nuwaha and Amootikaguna, 1999). Pallikadavath et al. (2004) found that use of antenatal check-ups through visits to a health facility increases with husband's education.

Household standard of living is a proxy variable for household income. Usually families belonging to a higher economic class are more aware of the existing health resources and have easier access to them (Feldman, 1983). Moncler and Foelix (1990) in their study of rural health services found that increase in household income also increases the probability of service utilization at primary health centers

(PHCs). In a study of maternal health care utilization in Jordan, Obermeyer and Potter (1991) shows that a high standard of living is positively associated with intensity of utilization of prenatal care. Similarly, Mondal (1997) in the study of utilization of ante-natal care services in Rajasthan observed that women's standard of living index is positively associated with service utilization. Pallikadavath et al. (2004) in their study in four states in India found that association of higher standard of living with greater likelihood of receiving antenatal check-ups is because health workers prefer to visit households with a higher standard of living and they are more reluctant to visit the homes of poor women in some settings. As regard to the utilization of delivery services, according to Mills and Bertrand (2005), main reason for not delivering at health-care facilities is cost. Cost has often been shown to be a barrier to service use (Bloom et al., 1999; Griffiths and Stephenson, 2001). In focus group discussions conducted by Stekelenburg et al. (2004) to determine the level of use of maternal health services and assess factors that influence the women's choice where to deliver, participants mentioned that apart from the payment of medical fees, health personnel sometimes instruct women to come with certain equipment, such as new baby gear, clothes, leather blades, candles, paraffin and maternity pads. Women who failed to produce these items often decided to deliver at home.

Demographic Factors :

Maternal age is an important demographic factor which may influence the use of maternal health services (Mitra et al., 1997 and Bhatia and Cleland, 1995). Women under 18 or over 34 years of age are considered at greater obstetric risk (Amini et al., 1996). In such cases, the probability of using medically- trained childbirth assistants is high (Paul and Rumsey, 2002).

Early marriage and pregnancy soon after marriage is a serious problems in many countries posing complications to the health of mother. As a women has to bear the whole brunt of motherhood, her body has to be strong and all her organs fully developed before she can bear the great physical and mental stress that a pregnancy brings about. Precisely this is the reason that a girl should not be married before the age of 18 years (Singh, 2001). The Child Marriage Restraint Act of India prohibits marriage of girls below the age of 18. In India, cultural norms and values promote early marriage and pregnancy, and it is generally believed as a way of gaining status within the peer group and a link between maternity and feminine identity (Mondol, 2003). When marriage occurs at an early age it is not surprising that an early pregnancy will occur. A newly married young woman has no say in the reproductive decision making and they are not able to negotiate about sex, contraception, child bearing and use of reproductive services with their husbands (AGI, 1996). Thus, lack of autonomy in the household influences a women's decision to seek maternal

health care (Ravindran and Sundari, 1999). A study of adolescent reproductive health in Bangladesh recorded that most of the married adolescent girls were not able to seek ante-natal care during pregnancy and had to face adverse pregnancy outcomes as well as complications during delivery (CWFP, 1998). Similarly, according to Pallikadavath et al., (2004) antenatal check-ups through visits to a health facility were more likely among women who married at the age of 19 or above compared with women married at a younger age.

Parity affects the utilization of maternal health services. In Jordan and Kenya less use of antenatal care was found among women having larger numbers of children (Obermeyer and Potter, 1991 and Magadi et al., 2000). Similarly, in India utilization of antenatal care was low among women with higher order pregnancies (Neilsen et al., 2001). Pallikadavath et al. (2004) observed that the likelihood of an antenatal check-up through visits to a health facility is lower among women with two or more children compared with women having one child. Regarding use of delivery services, Kowalewski et al. (2002) in their study found that the time spent for institutional delivery is hard on multiparous women. They showed that women with more than four children and women older than 35 years avoided actively hospital delivery and report following as reason: the mother is urgently needed to help with the farm work and their is no additional person free from farm work to care for the children during hospital admission.

Health Status:

Maternal health status such as previous history of pregnancy wastage influences the utilization of maternal services. Mondol (2003) in his study found that obstetric history like pregnancy wastage widely affect outcome of subsequent pregnancies. On the basis of his study he suggests that bleeding during the later period of pregnancy occurs to those women who have previous adverse obstetric history. So, women's personal health status prior to pregnancy can have an important influence on her chances of utilizing maternal services. So, omen with adverse pregnancy wastage would not like take any chance with their present pregnancy and will be more probable to use maternal health care . The Kasonga Team (1984) found that a bad obstetric history, compared to a good, had a relative risk of 9.2 of producing an obstructed labour and therefore they have more likelihood of using professional maternal health care.

Community-Level Factors:

Recently, interest has grown in examining community influences on individual health outcomes, so as to place health seeking behaviour in its socio-economic context (Manda, 1998; Magadi et

al., 2000 and Chacko 2001). These studies relate individual health out-comes and health care seeking behaviour to characteristics of community, including community's health infrastructure. Characteristics of community's health-service infrastructure influence individual behaviour through access to services (Stephenson and Tsui, 2002). Many studies have demonstrated a relationship between measures to access to services (for example, traveling distance to services) and individual health care seeking behaviors (Jahn et al., 1998). Distance to the nearest health resources and lack of transport are associated with the use of health facilities for childbirth (Rahaman et al., 1982; Paul, 1992; NoorAli et al., 1999). Long travel distances to facilities discourage the use of professional services (Thaddeus and Maine 1994). Available evidence suggests that women who live closer to health-care facilities are more likely to use professional obstetric services (Rose et al. 2001). The distance separating potential patients from the nearest health facility and transportation difficulties have been shown to be important barriers to seeking health care, particularly in rural areas (Stock, 1983; Lennox, 1984). In addition, the effect of distance becomes stronger when combined with lack of transportation and poor roads. Poor conditions of road act as barrier in timely reaching an adequate obstetric facility (Thaddeus and Maine 1994). According to Orji et al. (2002) roads from the villages or remote homes may be rough or even impossible to use at certain times of the year; transport may be non-existent or unreliable because there are no spare parts or fuel to keep the vehicle on the road and people may even be too poor to pay the fares. As one study in Kenya's Meru district illustrates, road improvements significantly reduced travel distance and time to health centers in the district (Thaddeus and Maine, 1994).

Results:

Table 1 presents the percentage distribution of no ANC, moderate ANC, high ANC, advice for pregnancy complications, institutional delivery, assisted delivery and advice for post-delivery complications by socio-economic, demographic and community characteristics of the respondents. It is clear that considerable variation exists in the utilization of the six health care services according to the background characteristics of the women. With the exception of advice for the complications during the pregnancy and post-delivery, utilization of health services was found to be higher or almost equal among Hindus. Utilization of antenatal, delivery and post-delivery services is higher in the general caste than other backward caste and the scheduled caste and scheduled tribes. Utilization of maternal health services rapidly increases with the increase in the women's and husband's year of schooling. The percentage of women with 11+ years of schooling going for high ANC, advice for pregnancy complications, institutional delivery,

assisted delivery and advice for post-delivery complications are 48 percent, 60.2 percent, 51.8 percent, 20.7 percent and 64.2 percent respectively. On the other hand the corresponding percentages for the illiterate women are 5.6 percent, 31.4 percent, 10.7 percent, 4 percent and 47.4 percent respectively. Utilization of maternal health services considerably increases with the standard of living index. High use of ANC varies from 5.9 percent for women from low standard of living to 33.2 percent with a high standard of living. Similarly, advice for pregnancy complications vary from 31.8 percent to 52.4 percent, institutional delivery varies from 10.5 percent to 41.8 percent, assisted delivery varies from 4.4 percent to 10.4 percent and sought treatment for the complications during post-delivery varies from 47.7 percent to 58.5 percent. Utilization of all services is highest in the age group 20-24. With the exception of advice for pregnancy complications utilization all other maternal health services is lowest in the age group of 30+. Utilization of all health services are highest among women who married above the minimum legal age at marriage than women marrying below 18 years of age. Use of health care is highest among women with 1-2 CEB and lowest among high parity women of 5+ CEB. Service utilization is higher among women who had experienced pregnancy wastage compared with women who had not experienced any such wastage.

The percentages of women living in PSU with sub-center, going for moderate ANC (56.4 percent), high ANC (11.8 percent), consult/sought treatment for pregnancy complications (35.7 percent), institutional delivery (15.7 percent), assisted delivery (5.8 percent) and consult/sought treatment for post-delivery complications (53.1 percent) are higher than those living in PSU with no sub-center. The utilization of all the services is higher among women living in PSU with a middle school. The percentages of women living in PSU connected by a road, going for moderate ANC (55.2 percent), high ANC (10.6 percent), consult/sought treatment for pregnancy complications (36.5 percent), institutional delivery (16 percent), assisted delivery (6.1 percent) and consult/sought treatment for post-delivery complications (51.9 percent) are higher than those living in PSU not connected by road. Distance of PSU from the nearest town also makes a difference to service utilization. The utilization of all the services are higher among women residing in PSU that are within the radius of 5 kms from their respective PHC. The percentages of women living in PSU that are within 5 kms of the PHC opting for moderate ANC, high ANC, consult/sought treatment for pregnancy complications, institutional delivery, assisted delivery and consult/sought treatment for post-delivery complications are 56 percent, 9.6 percent, 36.9 percent, 14.8%, 7.6 percent and 49.5 percent respectively. The corresponding percentages of women residing in PSU that are more than 10 kms from the PHC are 50.5 percent, 8.4 percent, 29.6 percent, 12.4 percent, 3.3 percent and 46.7 percent.

Table 1: Percentage distribution of utilization of various maternal health services by selected background characteristics.

Variables	No ANC	Moderate ANC	High ANC	Advice for Pregnancy Complication	Institutional Delivery	Assisted Delivery	Advice for Post-Delivery Complication
Religion							
Hindu	34.8	55.1	10.1	34.8	15.5	5.5	49.3
Non-Hindu	44.1	47.3	8.6	37	12.7	4.3	50.9
Caste							
OBC	37.8	53	9.1	35.3	15.1	5.2	50.1
SC/ST	38.6	55	6.4	32.6	10.1	4	47.2
Others	28.5	55	16.6	38.3	21.9	7.8	51.5
Woman's Year of Schooling							
Illiterate	42.8	51.6	5.6	31.4	10.7	4	47.4
1-5.	23.9	63.1	13	38.8	17.8	8.4	52.9
6-10.	16.3	62.6	21.1	44.8	27.5	8.8	54.8
11+	6.6	45.4	48	60.2	51.8	20.7	64.2
Husband's Year of Schooling							
Illiterate	49	46.9	4.2	28	8.2	3.7	45.9
1-5.	41.4	53	5.6	31.6	11.2	4.6	52
6-10.	30	59.3	10.7	36.9	16.8	5.8	50.5
11+	19.3	57	23.7	49.1	29	9.1	54.1
Standard of Living							
Low	41.8	52.3	5.9	31.8	10.5	4.4	47.7
Medium	26.9	58.4	14.8	40.1	20.5	7.3	52.7
High	11.6	55.2	33.2	52.4	41.8	10.4	58.5
Age							
15-19	29.7	59.9	10.3	35	17.6	7.7	52
20-24	30.2	56.9	12.9	35.4	18.5	6.5	51.8
25-29	35.8	53.6	10.6	35	14.9	5.1	48.2
30+	44.9	49.3	5.8	35.1	10.8	3.6	47.8
Age at Marriage							
<15	42.1	52.1	5.8	30.9	10.4	5.1	49.1
15-17	38.5	54.1	7.4	34.7	12.5	4.8	49.1
18+	28.1	55.1	16.8	38.9	22.6	6.3	50.7
Children Ever Born							
<2	26.5	57.8	15.7	38.1	22.5	7.7	52.2
3-4.	36	55.7	8.2	34	12.2	4.7	48.1
5+	48.1	47.6	4.4	32.5	8.7	3.4	48
Pregnancy Wastage							
No	36.5	54	9.5	34.4	14.6	5.2	48.5
Yes	34.1	54	11.9	38	17.6	5.7	54.2
Sub-center in PSU							
No	38	53	9	34.8	14.8	5.1	48.1
Yes	31.7	56.4	11.8	35.7	15.7	5.8	53.1
Middle School in PSU							
No	38.2	53.5	8.3	33	14.4	5.2	46
Yes	33.6	54.6	11.7	37.6	15.9	5.4	54.1

PSU connected by road							
No	40.5	51.3	8.2	31.8	13.1	3.7	44.7
Yes	34.1	55.2	10.6	36.5	16	6.1	51.9
Distance of PSU from nearest town							
Less than 5	34.9	55.4	9.6	36.9	14.8	7.6	49.5
5_10	36.1	54	9.9	35.2	16.3	4.6	50.3
More than 10	37.3	52.7	10	32.8	13.6	4.3	48.4
Distance of Primary Health Center from PSU							
Less than 5	34.6	56	9.4	38.4	15.5	6.6	51
5_10	36	54.4	9.6	35.1	15.5	5	49.2
More than 10	41.1	50.5	8.4	29.6	12.4	3.3	46.7
TOTAL	36.1	54	9.9	35.2	15.1	5.3	49.6
N	5471	8174	1496	2283	1963	684	2413

Table 2 presents likelihood ratio along with standard error for utilization of antenatal care (ANC) and high level of ANC separately for simple logistic regression analysis (SLRA) and multilevel analysis (MLRA). It is clear that all variables included in the model, except age, middle school in the PSU and PSU connected by road are statistically significant in explaining the use of ANC. Compared with Hindus, Non-Hindus are 21 percent less likely to use ANC. The odds of using ANC are higher among general caste with reference to the other backward caste. Woman's and husband's years of schooling have a significant relationship with ANC: as the number of years of schooling increases (for both woman and husband) a woman's likelihood of using ANC also increases. In contrast to women from low standard of living, woman from medium and high standard of living are more likely to undergo antenatal care. The odds of using ANC are higher among women marrying at the age of 18+ with reference to women marrying below the age of 15 years. Number of children ever born to a woman has a significant influence on service utilization. Women with 3-4 or 5+ CEB have 21 percent and 41 percent lower odds of utilizing antenatal service than women with less than 2 CEB. Women with a previous record of pregnancy wastage are 22 percent more likely to use ANC than women who do not have any such pregnancy wastage. Availability of sub-center in the PSU increases the probability of utilizing antenatal service. A PSU connected by road displays a positive significant relationship with the utilization of antenatal care. Religion, caste, woman's and husband's years of schooling, standard of living, children ever born, pregnancy wastage and sub-center in the PSU are found to be significantly associated with the likelihood of utilizing high level of ANC. The relationships are in the expected direction.

Table 3 depicts results of SLRA and MLRA for advice for pregnancy complication and institutional delivery. Non-Hindu women are more likely to consult for pregnancy complication than Hindu

women. Woman's and husband's years of schooling have a significant positive relationship with seeking advice for pregnancy complications. Women belonging to high standard of living are 39 percent more likely to opt for advice regarding pregnancy complication than those from low standard of living. Compared with women of 15-19 years, women of the ages of 30+ are 35 percent have more likelihood of having advice for pregnancy complication. Women having 5+ children ever born are less likely to sought advice for pregnancy problems than women with <2 CEB. Experience of pregnancy wastage increases the likelihood of taking advice for complications. With regard to institutional delivery, it may be noticed that variables such as woman's and husband's years of schooling, standard of living, age at marriage and pregnancy wastage are found to be positive predictors of delivering in an institution. Contrary to this, increase in the number of children ever born reduces the likelihood of delivering in an institution. Distance of PHC from PSU is the only variable at the PSU level that emerged as a statistically significant predictor of the institutional delivery in the SLRA. However, the same variable looses its significance in MLRA. This could be the result of the fact that in the MLRA controls for the correlation between different variables, which is not taken into consideration in the SLRA.

Table 4 shows comparative analysis for SLRA and MLRA for advice for assisted delivery and post-delivery complications. Likelihood ratio reveals that all variables included in the model, except religion, standard of living, age and availability of sub-center in the PSU are statistically significant in defining the use of assisted delivery. Most of the results are in expected direction. One interesting finding is that women marrying above the minimum legal age at marriage (18 years) are less likely to opt for assisted delivery. Regression analysis conducted for examining advice regarding post-delivery complications shows that years of schooling, pregnancy wastage, middle school in the PSU and PSU connected by road have significant relationship with seeking advice for post-delivery complications. Distance of PHC from PSU emerged as a statistically significant predictor in the SLRA. But it looses its significance in MLRA.

Broadly speaking, the results of both the techniques used in the present analysis reveal quite similar scenario. The odds ratio reveal that though the direction of the association between the independent and dependent variables remain same in both the techniques, there are some variations in the significance levels and the strength of the associations. Further, the standard errors too reveal somewhat different picture, as the standard errors are comparatively smaller in the SLRA as compared to the MLRA. This may intuitively lead to more number of variables as significant predictors under SLRA.

The PSU level random intercept terms for each of the maternal service outcome is significant. The likelihood that women will use each of these services thus varies across communities, even after controlling for various variables. Community (PSU) level variance explains the variation of individual communities' lines around the average line predicted by the fixed part of the model.

Table 2: Simple logistic and multilevel logistic regression results of the standard error and likelihood of using ANC and high level of ANC by the respondents

	ANC				High Level of ANC			
	Simple Logistic Regression		Multilevel Logistic Regression		Simple Logistic Regression		Multilevel Logistic Regression	
Variables	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**
Religion								
Hindu (Ref.)								
Non-Hindu	0.06	0.79***	0.05	0.78***	0.11	1.20*	0.14	1.19
Caste								
OBC (Ref.)								
SC/ST	0.05	1.10**	0.06	1.08	0.09	0.95	0.09	0.94
Others	0.05	1.21***	0.08	1.28***	0.08	1.30***	0.11	1.35***
Woman's Year of Schooling								
Illiterate (Ref.)								
1-5.	0.07	1.66***	0.13	1.69***	0.10	1.37***	0.15	1.37***
6-10.	0.07	2.11***	0.17	2.13***	0.09	1.67***	0.16	1.70***
11+	0.21	4.37***	1.01	4.55***	0.13	3.68***	0.57	3.94***
Husband's Year of Schooling								
Illiterate (Ref.)								
1-5.	0.06	1.23***	0.08	1.17**	0.14	1.06	0.15	1.04
6-10.	0.05	1.52***	0.08	1.50***	0.10	1.32***	0.14	1.33***
11+	0.07	1.78***	0.14	1.80***	0.12	1.78***	0.22	1.80***
Standard of Living								
Low (Ref.)								
Medium	0.05	1.39***	0.07	1.35***	0.08	1.45***	0.12	1.46***
High	0.12	2.15***	0.26	2.06***	0.11	2.01***	0.24	2.05***
Age								
15-19 (Ref.)								
20-24	0.08	0.94	0.08	0.93	0.12	1.09	0.14	1.13
25-29	0.09	0.93	0.09	0.91	0.14	1.13	0.17	1.17
30+	0.10	0.88	0.09	0.85	0.17	0.98	0.18	1.00
Age at Marriage								
<15 (Ref.)								
15-17	0.05	1.00	0.06	1.02	0.10	0.91	0.10	0.89
18+	0.06	1.13**	0.08	1.13*	0.11	1.16	0.13	1.13
Children Ever Born								
<2 (Ref.)								
3-4.	0.06	0.79***	0.05	0.76***	0.09	0.69***	0.07	0.68***
5+	0.07	0.59***	0.05	0.57***	0.13	0.59***	0.08	0.58***

Pregnancy Wastage								
No (Ref.)								
Yes	0.05	1.22***	0.07	1.21***	0.08	1.50***	0.13	1.49***
Sub-center in PSU								
No (Ref.)								
Yes	0.05	1.28***	0.10	1.32***	0.08	1.17**	0.11	1.17*
Middle School in PSU								
No (Ref.)								
Yes	0.04	1.04	0.07	1.04	0.07	1.12	0.09	1.13
PSU connected by road								
No (Ref.)								
Yes	0.04	1.16***	0.08	1.19***	0.07	1.00	0.09	1.01
Distance of PSU from nearest town								
Less than 5 (Ref.)								
5_10	0.05	0.97	0.08	0.99	0.09	1.04	0.11	1.04
More than 10	0.06	0.98	0.09	0.99	0.10	1.12	0.13	1.14
Distance of PHC from PSU								
Less than 5 (Ref.)								
5_10	0.05	0.96	0.07	0.96	0.08	1.06	0.11	1.07
More than 10	0.06	0.80***	0.07	0.78***	0.10	1.00	0.12	0.99
Random Part: PSU level (level 2)			0.09	0.67**			0.22	0.98**

Level of significance: *** $p<0.01$; ** $p<0.05$; * $p<010$

Table 3: Simple logistic and multilevel logistic regression results of the standard error and likelihood of having advice for pregnancy complication and institutional delivery by the respondents

	Advise for pregnancy complications				Institutional Delivery			
	Simple Logistic Regression		Multilevel Logistic Regression		Simple Logistic Regression		Multilevel Logistic Regression	
Variables	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**
Religion								
Hindu (Ref.)								
Non-Hindu	0.11	1.31***	0.15	1.35***	0.08	0.96	0.09	0.95
Caste								
OBC (Ref.)								
SC/ST	0.09	0.98	0.09	0.98	0.07	0.78***	0.06	0.76***
Others	0.09	0.94	0.09	0.94	0.06	1.12*	0.08	1.17**
Woman's Year of Schooling								
Illiterate (Ref.)								
1-5.	0.12	1.12	0.14	1.13	0.09	1.25***	0.11	1.21**
6-10.	0.11	1.52***	0.18	1.54***	0.07	1.57***	0.13	1.57***
11+	0.21	2.23***	0.52	2.35***	0.12	2.88***	0.43	3.21***
Husband's Year of Schooling								

Illiterate (Ref.)								
1-5.	0.12	1.14	0.14	1.14	0.10	1.18	0.12	1.17
6-10.	0.09	1.43***	0.14	1.44***	0.07	1.47***	0.11	1.46***
11+	0.13	1.82***	0.25	1.87***	0.09	1.81***	0.17	1.79***
Standard of Living								
Low (Ref.)								
Medium	0.09	1.13	0.10	1.14	0.06	1.46***	0.09	1.42***
High	0.16	1.39**	0.23	1.39**	0.09	2.34***	0.23	2.26***
Age								
15-19 (Ref.)								
20-24	0.14	0.99	0.14	0.99	0.09	0.89	0.09	0.89
25-29	0.16	1.11	0.18	1.11	0.11	0.94	0.11	0.93
30+	0.18	1.35*	0.25	1.36*	0.13	1.04	0.14	1.03
Age at Marriage								
<15 (Ref.)								
15-17	0.10	1.07	0.11	1.07	0.08	0.90	0.08	0.94
18+	0.11	0.95	0.11	0.94	0.09	1.17**	0.11	1.21**
Children Ever Born								
<2 (Ref.)								
3-4.	0.11	0.89	0.10	0.89	0.07	0.57***	0.04	0.55***
5+	0.14	0.79*	0.11	0.79*	0.10	0.49***	0.05	0.48***
Pregnancy Wastage								
No (Ref.)								
Yes	0.09	1.19**	0.11	1.19**	0.07	1.47***	0.10	1.48***
Sub-center in PSU								
No (Ref.)								
Yes	0.08	0.99	0.09	0.99	0.06	1.01	0.08	1.00
Middle School in PSU								
No (Ref.)								
Yes	0.08	1.20**	0.10	1.21**	0.06	0.98	0.07	0.98
PSU connected by road								
No (Ref.)								
Yes	0.08	1.10	0.09	1.10	0.06	1.06	0.08	1.07
Distance of PSU from nearest town								
Less than 5 (Ref.)								
5_10	0.09	0.99	0.10	0.99	0.07	1.12	0.10	1.10
More than 10	0.11	0.90	0.11	0.90	0.08	0.96	0.10	0.93
Distance of PHC from PSU								
Less than 5 (Ref.)								
5_10	0.09	0.87	0.09	0.86	0.07	1.00	0.09	1.00
More than 10	0.11	0.76**	0.09	0.74**	0.08	0.84**	0.09	0.85
Random Part: PSU level (level 2)			0.38	0.70**			0.12	0.77**

Level of significance: *** $p<0.01$; ** $p<0.05$; * $p<010$

Table 4: Simple logistic and multilevel logistic regression results of the standard error and likelihood of having assisted delivery and advice for post-delivery complication by the respondents

	Assisted Delivery				Advise for post-delivery complications			
	Simple Logistic Regression		Multilevel Logistic Regression		Simple Logistic Regression		Multilevel Logistic Regression	
Variables	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**	**S.E.**	**Exp(B)**
Religion								
Hindu (Ref.)								
Non-Hindu	0.14	0.95	0.15	0.98	0.09	0.99	0.11	0.99
Caste								
OBC (Ref.)								
SC/ST	0.11	0.77**	0.09	0.73**	0.08	0.93	0.08	0.91
Others	0.11	1.27**	0.16	1.31**	0.08	1.03	0.11	1.07
Woman's Year of Schooling								
Illiterate (Ref.)								
1-5.	0.14	1.79***	0.27	1.80***	0.11	1.19	0.15	1.17
6-10.	0.13	1.74***	0.26	1.83***	0.10	1.31***	0.16	1.38***
11+	0.21	3.60***	0.93	3.92***	0.21	1.76***	0.45	1.90***
Husband's Year of Schooling								
Illiterate (Ref.)								
1-5.	0.15	1.20	0.18	1.08	0.10	1.26**	0.15	1.23
6-10.	0.12	1.07	0.13	1.04	0.08	1.07*	0.09	1.06*
11+	0.15	1.34*	0.20	1.23	0.12	1.04	0.13	0.98
Standard of Living								
Low (Ref.)								
Medium	0.10	1.19	0.13	1.18	0.08	1.07	0.10	1.13
High	0.18	1.28	0.28	1.37	0.15	1.18	0.21	1.23
Age								
15-19 (Ref.)								
20-24	0.15	0.83	0.14	0.85	0.12	1.12	0.17	1.25
25-29	0.18	0.91	0.19	0.96	0.14	0.99	0.18	1.13
30+	0.22	0.83	0.20	0.87	0.16	1.00	0.21	1.14
Age at Marriage								
<15 (Ref.)								
15-17	0.12	0.78	0.10	0.81	0.08	0.93	0.09	0.98
18+	0.14	0.81**	0.13	0.83	0.10	0.90	0.11	0.93
Children Ever Born								
<2 (Ref.)								
3-4.	0.12	0.67***	0.09	0.65***	0.09	0.93	0.10	0.93
5+	0.17	0.56***	0.10	0.53***	0.12	1.05	0.14	1.01
Pregnancy Wastage								
No (Ref.)								
Yes	0.11	1.31**	0.16	1.26**	0.08	1.29***	0.11	1.23**
Sub-center in PSU								
No (Ref.)								
Yes	0.10	1.12	0.16	1.13	0.08	1.13	0.13	1.18
Middle School in PSU								

No (Ref.)								
Yes	0.09	0.85*	0.12	0.88	0.07	1.31***	0.13	1.35***
PSU connected by road								
No (Ref.)								
Yes	0.10	1.43***	0.19	1.39**	0.07	1.28***	0.13	1.26**
Distance of PSU from nearest town								
Less than 5 (Ref.)								
5_10	0.11	0.72***	0.11	0.69**	0.08	1.10	0.14	1.09
More than 10	0.13	0.69***	0.12	0.67**	0.09	1.04	0.14	1.02
Distance of PHC from PSU								
Less than 5 (Ref.)								
5_10	0.11	0.90	0.13	0.89	0.08	0.89	0.10	0.84
More than 10	0.14	0.60***	0.11	0.58***	0.10	0.85*	0.11	0.80
Random Part: PSU level (level 2)			0.14	0.19**			0.13	0.20**

Level of significance: *** $p<0.01$; ** $p<0.05$; * $p<010$

Conclusion

The above analysis clearly suggests that women's and husband's year of schooling has a positive significant relationship with all the maternal health service indicators taken in the study. Pregnancy wastage has also emerged as a significant predictor for all the components of maternal care. Women belonging to general category of caste are more likely to opt for antenatal and natal care. Analysis suggest that as the standard of living increases probability of a woman utilizing antenatal care, high level of antenatal care, institutional delivery and advice for pregnancy complication also increases. Women who have 1-2 children ever born are more likely to use maternal care as compared with high parity women. This may be because women during their initial pregnancy are much more worried and excited about their pregnancy and therefore, they become more likely to use health services (Bloom et al., 1999). Similar behaviour has been observed in some other studies (Chandrasekhar at al., 1998 and Ram and Singh, 2005).

The analysis shows that community level factors play an important role in explaining the service use. The availability of sub-center in the PSU positively affects the utilization of antenatal care. Women residing in PSUs with a middle school are more likely to seek advice for pregnancy and post-delivery complication than women belonging to PSUs without a middle school. Except for the use of high level of antenatal care, distance of the PSU to the nearest primary health center is found to be significantly associated with the likelihood of women opting for all other services.

When the random effects between PSU variance has not been taken into consideration (simple logistic regression), certain variables which appeared to have significant relationship with maternal health services looses their significance under MLRA. The variables found to be significant in SLRA and

not under MLRA are distance of PHC from PSU (in case of institutional delivery and advice regarding post-delivery complications), husband's year of schooling (for assisted delivery and advise regarding post-delivery complications), age at marriage and middle school in PSU (in case of advise regarding post-delivery complications). Further, some predictors of maternal health service utilization appeared to be more significant when logistic regression has been used and they become less significant under multilevel model. Such factors which are less significant in MLRA are sub-center in the PSU (in case of utilization of high level of ANC), women's 1-5 years of schooling (in case of institutional delivery), distance of PSU from nearest town (for assisted delivery) and such associates in case of seeking advise for post-delivery complications are pregnancy wastage, PSU connected by road and distance of PHC from PSU (more than 10 kms). Conversely, other caste and age at marriage (in case of institutional delivery) and pregnancy wastage (for advise regarding post-delivery complications) are significant or more significant associates of the use of maternal care in the multilevel model but not in the logistic model, possibly due to increased power from using the proper covariance structure.

A public health data that includes a hierarchical structure requires multilevel analysis or other methods that account for correlated or nested data. In such data sets, standard error under SLRA is generally underestimated. This results in more number of factors being reported as significantly associated. Thus, failure to account for the structure of the data may lead to erroneous inferences. Similar findings have been reported in some other studies (Bryk and Raudenbush, 1992; Goldstein 1995). Therefore, it is suggested that hierarchical methods of multivariate analyses be routinely incorporated into the statistical analyses, in order to account for the hierarchical structure of the data. This would yield more focused variables, which would facilitate in ensuring effective public health programs and policies.

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