

## Extended Abstract

### **Maternal Death and Extent of Utilization of Maternity Care Services in India**

Chandan Kumar<sup>1</sup>, Prashant Kumar Singh<sup>2</sup>, Rajesh Kumar Rai<sup>3</sup>

#### **Introduction**

Standing at the crossroads of the Millennium Development Goals, endorsed by the representatives of 189 countries in 2000 to reduce the maternal mortality ratio (MMR) by three quarters between 1990 and 2015, India appreciates its 65% reduction in MMR between 1990 (560/100000 live births) and 2013 (190/100000 live births) [1]. Despite this remarkable progress, India still accounts for the highest number (50000 in 2013) of maternal deaths globally [1]. Direct causes of maternal mortality such as hemorrhage, hypertensive disorders and sepsis are responsible for more than 50% of maternal deaths worldwide [3]. In India, a survey conducted during 2001- 2003 on the causes of maternal deaths found hemorrhage to be the leading (38%) cause of maternal mortality [4]. Maternal deaths due to direct causes could be prevented through effective intervention comprising antenatal, delivery and postnatal care.

Program and policy makers as well as leaders from the public health community are advocating for the implementation of the continuum of care framework, which has two dimensions - time and place [5]. The time dimension refers to linking care from adolescence and pre-pregnancy, through childbirth to the immediate postnatal period and childhood; the place dimension refers to linking care that is provided across different levels, such as the home and community, clinical care at primary and tertiary health centers, and outpatient and outreach services [5]. With regard to maternity care, the continuum of care suggests that every mother or prospective mother should receive the required antenatal, delivery, and postnatal care in a continuum [6].

---

<sup>1</sup>*Assistant Professor*, Department of Geography, School of Earth Sciences, Central University of Karnataka, Gulbarga, India; email: c.kumar803@gmail.com

<sup>2</sup>*Associate Fellow*, Population, Health & Nutrition Research Programme, Institute of Human Development, New Delhi, India; email: prashant\_iips@yahoo.co.in

<sup>3</sup>*Senior Research Associate*, Tata Institute of Social Sciences, Mumbai, Maharashtra, India; email: rajesh.iips28@gmail.com

There are several factors associated with the utilization of maternity care services and are complex. Thaddeus and Maine (1994) grouped various factors that cause maternal mortality into the “three delays” model, which maintains that pregnancy related mortality is due to delays in seeking required medical help, seeking a medical facility in time, and receiving adequate care [7]. However, it may further be realized that the “three delays” model is probably an oversimplification and that, at each level of care, there may be a complex series of factors affecting care [8]. As this study’s central focus is on the factors influencing the utilization of maternal healthcare services, it is appropriate to rely on the health behavior model proposed by Aday and Anderson [9, 10, 11, 12], which has been successfully applied in the study of healthcare services utilization in a developing country. This model [9] proposes that healthcare seeking behavior is a function of three sets of variables: 1) predisposing factors, such as age, gender, marital status, family size, social status, education and race; 2) enabling factors, such as family income, health insurance, service availability and health level symptoms or perceived sickness; and 3) the need to use services available, perhaps the most powerful predictor of utilization. The need is defined into two categories - the perceived need, and evaluative need [11]. This study has taken into account the ‘perceived need’- defined as “how people view their own general health and functional state, as well as how they experience symptoms of illness, pain, and worries about their health and whether or not they judge their problems to be of sufficient importance and magnitude to seek professional help [11].” The “need” to access or use maternity care is expected to be stronger among women who lived in a household that experienced maternal death as compared to women who resided in a household that did not experience any maternal death because if a woman witnesses a death related to pregnancy in the same household she is living in is more likely to seek healthcare services during her pregnancy to avoid her death. While performing the analysis, this study takes into account of the predisposing as well as enabling factors responsible for the healthcare service utilization, need to use the services available deemed to be the most important factor could encourage women use maternal healthcare services. Conversely, women belonged to households that did not experience any maternal death are less likely to feel the need to seek proper healthcare to avoid maternal death. In addition, a plethora of studies have documented the socioeconomic, demographic program and policy related determinants of maternal healthcare service utilization in India [13, 14, 15, 16, 17, 18, 19, 20, 21].

Against this background, this study hypothesizes that the utilization of maternal healthcare services by women belonging to households that experienced any maternal death will be significantly different from that by women who belong to households that did not experience any maternal death, and aimed to analyze it. To our knowledge, earlier studies on the utilization of maternal healthcare services in India have paid limited attention to the dynamics of maternal death and maternity care. This article seeks to assess the difference in the utilization of maternal healthcare services by women who belong to households that experienced at least one maternal death and that by women who belong to households that did not experience any maternal death, and place these in the context of existing policy and practice. This may help develop strategies to improve the provision and use of maternal healthcare services to achieve the targeted Reproductive, Maternal, Newborn, Child, and Adolescent Healthcare, (RMNCH+A) launched by the Ministry of Health and Family Welfare, Government of India in February, 2013 [22]. Three key maternity care components are measured: women who had full antenatal care (ANC), those who had skilled birth attendance (SBA), and those who received postnatal care (PNC) within six weeks of delivery.

## **Materials and Methods**

### *Data*

To accomplish the objective of this study, we used the third wave of the District Level Household and Facility Survey, 2007-08 (DLHS-3) [23]. The DLHS-3, conducted under the aegis of the Ministry of Health and Family Welfare, Government of India, covered a total sample of 643944 ever married women aged 15-49 years from 720320 households covering 27 states and 7 union territories, and 601 districts in India. A multi-stage stratified systematic sampling design was adopted for the DLHS-3. The survey was designed to collect data on various aspects of healthcare utilization for Reproductive and Child Health and accessibility of health facilities. In DLHS-3, the data were collected using different interview questionnaires, including household questionnaire, ever married women questionnaire, unmarried women questionnaire, village questionnaire and health facility questionnaire. The household response rate in DLHS-3 was 94%. A detailed description of the sampling procedures is given in the DLHS-3 report [23].

### *Defining Maternal Mortality*

In the household questionnaire of DLHS-3 [23], nine questions (from question number 142 to 150) were posed to survey respondents about the name and date of any person who died in the household, since January 1, 2004. If the respondents were affirmative about the death in the household, the next question was ‘whether the deceased was female in the age group 15-49 at the time of death’. If the response was positive, another four questions were posed: 1) “was (deceased female person’s name) pregnant when she died”; 2) “did (name) die at the time of abortion or within six weeks of abortion”; 3) “did (name) die during childbirth”; and 4) did (name) die within six weeks of pregnancy or childbirth”. If any of the four questions was marked positive, it was recorded as maternal mortality in DLHS-3. Of 720320 households covered in DLHS-3, 1319 households (unweighted sample) experienced maternal deaths, 913 women (unweighted sample) aged 15-49 belonged to those households, and 321 women (unweighted sample) experienced pregnancy/childbirth since January 1, 2004 (**Figure 1**). The spatial variation in number of sample households that experienced at least one maternal death during the stipulated period ranged from 286 in Uttar Pradesh to 1 in Kerala (**Figure 2**).

### *Outcome Events*

The study measured three outcome variables, namely, full ANC, SBA, and PNC. The ANC policy in India follows the WHO approach to promote safe pregnancies as early detection of problems during pregnancy leads to timely treatment [24]. The DLHS-3 defines full ANC as “at least three visits of ANC check-up, at least one tetanus toxoid (TT) injection received and 100 IFA tablets or equivalent syrup consumed” [23]. A delivery conducted either in a medical institution or home delivery, but assisted/attended by a doctor/auxiliary nurse midwife/nurse is considered to have skilled birth attendance [25]. The postnatal check-up within six weeks after the childbirth is considered as a potential maternal healthcare indicator [26], and, thus, used by this study as pertinent outcome variable. The analysis was restricted to 321 women (who experienced pregnancy/childbirth between January 1, 2004 and the date of interview i.e. during 2007-08 and belonged to households that experienced at least one maternal death), and 217737 women (who experienced pregnancy/childbirth between January 1, 2004 and the date of interview and belonged to households that did not experience any maternal death). The women from the households experiencing any maternal death in this study were considered utilizing

particular maternal healthcare services only after the maternal death was experienced in the household. The information on the timing of maternal death in the household and subsequent delivery was extracted from the household roster of the survey.

### *Covariates*

Notable socioeconomic and demographic variables such as maternal age at childbirth (below 19, and 19 and above), birth order (1, 2, and 3+), women's education (illiterate, and literate), husband's education (illiterate, and literate), whether women had heard of or seen messages on antenatal care (yes, and no), whether women had heard of or seen messages on delivery care (yes, and no), caste (general/others, and Scheduled Castes (SC)/Scheduled Tribes(ST)), religion (Hindu, Muslim, and others), household wealth quintile (bottom two, middle, and upper two), place of residence (rural, and urban), and region of residence (high focus states, and non-high focus states) were included in the analyses. Household wealth quintile, a relative index of household wealth, was calculated from a standard set of assets owned by the household, including ownership of consumer items and dwelling characteristics [27]. Individuals were ranked on the basis of their household score and divided into five quintiles, each representing 20% of the score. In this study, the upper two quintiles (40%) and lower two quintiles (40%) are merged in order to provide sufficient sample households to each classified group for robust statistical analyses. Because of the regional variation in the utilization of healthcare services in India, the analyses in this study have adjusted the estimates for region of residence. For this purpose, the sample households/individuals were classified to be the part of two groups: high focus states and non-high focus states. On account of the unacceptably high fertility and mortality indicators, the nine states (Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttarakhand, Uttar Pradesh and Assam), which account for about 48% of India's population, were designated as 'High Focus States' by the Government of India [28], and the remaining 18 states and seven union territories were recorded as non-high focus states.

### *Statistical Analyses*

Both the bivariate and multivariate analyses were performed to fulfill the study objective. Bivariate analyses included the estimation of weighted percentage with 95% confidence interval as well as the Chi-squared ( $\chi^2$ ) tests to determine significant differences in proportions. To

reiterate, the three key maternity care components were assessed as outcome variables: women who had received full antenatal care, those who had skilled birth attendance, and those who received postnatal care within six weeks of delivery. To understand the difference between utilization of maternal healthcare services between women from households that experienced any maternal death and women from households that did not experience any maternal death, a binary logistic regression was deployed. Instead of a linear probability model, a binary logistic regression function proves preferable to fit some kind of sigmoid curve when response variable is dichotomous (binary or 0-1) and that reasonably portrays the reality about outcome events [29]. The logistic function takes an input that might be any value from negative infinity to positive infinity, whereas the output is confined to values between 0 and 1. In this study, the binomial response ( $y$ , had full ANC or not; delivery conducted by the skilled birth attendants or not; received postnatal care within six weeks of delivery or not) for each individual was related to a set of categorical predictors,  $X$ , and a fixed effect by a logit link function:

$$\text{logit}(\pi_i) = \log[\pi_i/1 - \pi_i] = \beta_0 + \beta(X) + \varepsilon$$

The probability that an individual had full ANC, or had delivery conducted by skilled birth attendants, or received postnatal care within six weeks of delivery is  $\pi_i$ . The parameter  $\beta_0$  estimates the log odds of the three outcome variables for the reference group, and the parameter  $\beta$  estimates with maximum likelihood, the differential log odds of full ANC, skilled birth attendance, postnatal care associated with the predictor  $X$ , as compared to the reference group. The term  $\varepsilon$  represents the error term or residual in the model. The appropriate sampling weight has been supplemented to perform the whole analyses. The analyses were conducted using Stata version 10 [30].

## Results

### *Sample Characteristics*

**Table 1** presents the distribution of households by the status of maternal death in the household since January 1, 2004. The statistics show that 2240 households (weighted sample) experienced at least one maternal death. Out of the total households experiencing maternal deaths, 56% of the

households (1256 households) reported that the woman's death incurred during pregnancy, which excludes the deaths that took place within six weeks of pregnancy (about 24%). Nearly 7% of those households (163 households) reported that the woman in the household died at the time of abortion or within six weeks of abortion, while around 13% of households (290 households) reported the death of the woman during childbirth.

### *Differentials in Maternity Care Services by Status of Maternal Death in the Household*

**Table 2** presents the proportion of women receiving full antenatal care (ANC) by selected socioeconomic, demographic and regional characteristics across households that experienced any maternal death and those that did not. In total, there were 8% and 19% of women who recorded receiving full ANC, respectively in households that experienced any maternal death and those that did not. The study sample indicates that the proportion of older women (age 19 and above) receiving full antenatal care was higher (10%) among households that experienced any maternal death compared to younger women (age below 19). The higher proportion of women receiving full ANC was also recorded along the following parameters: in the case of first birth (birth order 1) to women, if the women and their husbands were literate/educated, if the women had heard the messages related to ANC and delivery care, if the women belonged to non-SC/ST households and were affiliated to religions other than Hindu and Muslim. There was little difference in the proportion of women who received full ANC across households at different economic levels (wealth quintile). Although the pattern of proportional distribution of women receiving full ANC was almost similar across background characteristics of women in households that experienced maternal death and those that did not, the estimates showed an interesting inversion while they were compared across rural and urban areas. The proportion of women receiving full ANC was higher in urban areas (30%) in the case of households that did not experience any maternal death, while the proportion was higher in rural areas (9%) in the case of households that experienced any maternal death. The proportion was lower in a group of high focus states compared to other states.

**Table 3** presents the proportion of women receiving skilled birth attendance (SBA) by selected socioeconomic, demographic and regional characteristics (including service utilization) across households that experienced any maternal death and those that did not. In total, there were 49% and 53% women who received SBA, respectively in households that experienced any

maternal death and those that did not, which implies that there was no profound difference between these two types of households. There was no considerable difference in the proportion of older and younger women receiving SBA in both types of households. The higher proportion of women receiving SBA was recorded in the case of first birth (birth order 1) to women; if the women and their husbands were literate/educated, if the women had heard the messages related to ANC and delivery care, if the women belonged to non-SC/ST households and were affiliated to religions other than Hindu and Muslim. However, there was no significant difference in the proportion of women receiving SBA across caste groups. Women who belonged to the upper two wealth quintiles and were residing in urban areas and non-high focus states, received a higher proportion of SBA compared to their counterparts in the lower wealth quintile residing in rural areas and in high focus states in both types of households. Similarly, women who received full ANC were higher in proportion in receiving SBA compared to women who did not receive full ANC in both types of households.

**Table 4** presents the proportion of women receiving postnatal care (PNC) by selected socioeconomic, demographic and regional characteristics (including service utilization) across households that experienced any maternal death and those that did not. In total, there were 40% and 48% women recorded receiving PNC respectively in households that experienced any maternal death and those that did not. There was no significant difference in the proportion of older and younger women receiving PNC among the households that experienced any maternal death. Similarly, the proportion of women receiving PNC was also not significantly different for selected birth orders, caste and religious groups. The proportion of women receiving PNC was recorded higher if the women and their husbands were literate/educated, if the women had heard the messages related to ANC and delivery care, if the women belonged to the upper two wealth quintiles, and if the women were residing in urban areas and non-high focus states. In both types of households, the women who received PNC were in higher proportion if they had received the full ANC and SBA earlier.

#### *Influence of Maternal Death in the Household on the Use of Maternity Care Services*

In order to examine the influence of maternal death that occurred in the household on the women's utilization (or attitude towards utilizing) of maternity care services, we analyzed the three maternity care services separately. **Table 5** presents the unadjusted and adjusted odds ratios



(OR)with 95% CI (Confidence Interval) depicting the association between women belonging to households that experienced any maternal death and women belonging to households that did not experience any maternal death. The result indicates that after controlling for potential confounders, the women belonging to the households that experienced any maternal death had 44% less likelihood of receiving full ANC (OR: 0.557; 95% CI: 0.353 – 0.876). However, comparatively, the likelihood of women receiving SBA was estimated to be 31% higher(OR: 1.311; 95% CI: 1.030-1.730) among households that experienced any maternal death. Women from households that experienced any maternal death were found to have less probability (OR: 0.825; 95%CI: 0.606 - 0.912) for receiving PNC compared to women from households that did not experience any maternal death.

## **Discussion**

This study aimed to understand whether there is any significant difference in maternity care use between women living in households that experienced any maternal death and women living in households that did not experience any maternal death.

The study findings indicate that women who lived in households that experienced at least one maternal death were less likely to use full antenatal care, and to receive postnatal care within six weeks of delivery, as compared to women living in households that did not experience any maternal death. This difference could be explained by a host of factors. Maternal death is a rare event, and it is concentrated in rural areas of underserved states in India among the deprived sections of population where proper availability, accessibility and utilization of maternal healthcare services are highly questionable. To reiterate, full antenatal care includes “at least three visits of ANC check-up, at least one tetanus toxoid (TT) injection received and 100 IFA tablets or equivalent syrup consumed”. Women belonging to households that experienced maternal deaths could have access to some form of antenatal care, but the full ANC remained beyond their reach. Therefore, households that experienced maternal deaths are characterized by suboptimum utilization of maternity care services that results in maternal death. Second, if the delivery of the child were conducted in the healthcare facility, the likelihood of getting postnatal care would be higher for women. In India, nearly 38% of rural Indian women had their delivery in a healthcare facility [23]. Since most of the households that experienced maternal deaths belonged to rural areas and the poorer sections of society, one could expect that most of the

deliveries were conducted at home, because lack of functional healthcare facilities at the village level. Therefore, most of the women could not receive any postnatal care even within six weeks of delivery.

The findings also suggest that women who lived in households that experienced at least one maternal death were more likely to have skilled birth attendance as compared to women who were living in households that did not experience any maternal death. The explanation has to do with the need factors as explained in the Aday and Anderson's framework [11]. In this case, most of the maternal mortality could be the result of avoiding proper health facilities for delivery, therefore women living in those households are more likely to feel the need for institutional delivery to avoid any maternal death that could occur. In addition, this result could be attributed to the incentive attached to skilled birth attendance [31]. Under the ambit of the National Rural Health Mission launched by the Government of India in 2005, the broad conditional cash transfer scheme called *Janani Suraksha Yojana* (JSY) was planned to encourage women of low socioeconomic status to give birth in health facilities [31]. According to JSY's guidelines, after delivery in one of these facilities, the eligible woman would receive Rs. 600 (US\$ 11.30) in urban areas and Rs. 700 (US\$ 13.18) in rural areas [31]. The cash incentive was higher in the ten high focus states (Assam, Bihar, Chhattisgarh, Jammu and Kashmir, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttarakhand, and Uttar Pradesh) – Rs. 1000 (US\$ 18.83) in urban areas and Rs. 1400 (US\$ 26.36) in rural areas [31]. Although the effect of JSY in reducing maternal mortality through institutional delivery is debatable [32], perhaps, women who lived in households that experienced maternal death belonged to low socioeconomic group and opted for skilled birth attendance since they would have an incentive if they underwent the delivery conducted by a skilled birth attendant. However, this finding requires further investigation.

In order to take corrective action that can overcome systematic and programmatic gaps in service provision to avert maternal deaths, the Maternal Death Review (MDR) has been institutionalized by the Government of India [33]. Under this process, reporting and analysis on the causes of maternal deaths have to be collected through a Community Based Maternal Death Review (CBMDR) or a Facility Based Maternal Death Review (FBMDR). The guidelines for MDR suggest that the CBMDR must be taken up for all deaths that occur in the specified geographical area, irrespective of the place of death, be it at home, a facility or in transit, whereas the FBMDR will be taken up for all government teaching hospitals, referral hospitals and other hospitals

(District, Sub district, CHCs) where more than 500 deliveries are conducted in a year [34]. The MDR was expected to investigate the reason for the occurrence of maternal death in the household retrospectively, but the progress of this scheme is not known. Similarly, the Government of India launched the program, 'Mother and Child Tracking System (MCTS), where it was proposed that all the mothers and children will be tracked to make sure that they were receiving required care [35]. However, it was very hard to maintain this system because it required a huge database of prospective mothers. In February, 2013, the Minister of Health and Family Welfare, Government of India launched the RMNCH+A scheme under which mothers must receive full ANC, delivery and postnatal care as proposed [22]. However, the scheme has yet to be implemented in earnest across all states in India. This study would draw the attention of program and policy makers and advocates for wider propagation of the need of antenatal and postnatal care services, which is evidenced to be considered as less important compared to institutional delivery even by households that have already experienced maternal death. The findings of this study are an important contribution in the literature investigating aspects of maternal mortality and maternity care services, and in aid of better implementation of the reproductive, maternal, newborn, child, and adolescent healthcare (RMNCH+A), recently initiated by the federal Indian government.

## References

1. WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division (2014) Trends in maternal mortality: 1990 to 2013. Geneva: World Health Organization.
2. Office of the Registrar General and Census Commissioner (2011) Census of India, 2011. New Delhi: Ministry of Home Affairs, Government of India.
3. Say L, Chou D, Gemmill A, Tunçalp O, Moller A, Daniels J, Gulmezoglu AM, Temmerman M, Alkema L (2014) Global causes of maternal death: a WHO systematic analysis. *Lancet Global Health* doi:10.1016/S2214-109X(14)70227-X
4. Registrar General of India (2006) Maternal mortality in India: 1997-2003, trend causes and risk factors. New Delhi: Ministry of Home Affairs, Government of India.
5. The Partnership for Maternal, Newborn and Child Health (2012) The PMNCH, report-analyzing progress on commitments to the global strategy for women's and children's health. Geneva: World Health Organization.

6. Rai RK (2014) Tracking women and children in a Continuum of Reproductive, Maternal, Newborn, and Child Healthcare (RMNCH) in India. *Journal of Epidemiology and Global Health* <http://dx.doi.org/10.1016/j.jegh.2013.12.006>.
7. Thaddeus S, Maine D (1994) Too far to walk: maternal mortality in context. *Social Science & Medicine* 38(8): 1091-110.
8. Bhutta ZA (2011) Seeing the unseen: targeting neonatal mortality in rural Vietnam. *Global Health Action*. 4: 6360.
9. Aday LA, Andersen RM (1974) A framework for the study of access to medical care. *Health Services Research* 9(3): 208–20.
10. Andersen RM (1968) *A behavioral model of families' use of health services*. Chicago: Center for Health Administration Studies, University of Chicago.
11. Andersen RM (1995) Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior* 36(1): 1–10.
12. Andersen RM, Newman JF (2005) Societal and individual determinants of medical care utilization in the United States. *The Milbank Memorial Fund Quarterly Health and Society* 51(1): 95–124.
13. Singh L, Rai RK, Singh PK (2012) Assessing the utilization of maternal and child health care among married adolescent women: evidence from India. *Journal of Biosocial Science* 44(1): 1-26.
14. Rai RK, Tulchinsky TH (2012). Addressing sluggish progress in reducing maternal mortality in India. *Asia Pacific Journal of Public Health* doi: 10.1177/1010539512436883.
15. Singh PK, Rai RK, Alagarajan M, Singh L (2012) Determinants of maternity care services utilization among married adolescents in rural India. *PLoS ONE* 7(2): e31666.
16. Singh PK, Rai RK, Singh L (2012) Examining the Effect of Household Wealth and Migration Status on Safe Delivery Care in Urban India, 1992–2006. *PLoS ONE* 7(9): e44901.
17. Rai RK, Kumar C, Singh PK (2012) District level coverage gap in Maternal, Newborn and Child Health care services in India. *Journal of Epidemiology and Global Health* 2(4): 221-4.

18. Kumar C, Singh PK, Rai RK (2013) Coverage gap in maternal and child health services in India: assessing trends and regional deprivation during 1992–2006. *Journal of Public Health* (Oxford) 35(4): 598-606.
19. Singh PK, Kumar C, Rai RK, Singh L (2013) Factors associated with maternal healthcare services utilization in nine high focus states in India: a multilevel analysis based on 14 385 communities in 292 districts. *Health Policy and Planning* doi:10.1093/heapol/czt039.
20. Kumar C, Rai RK, Singh PK, Singh L (2013) Socioeconomic Disparities in Maternity Care among Indian Adolescents, 1990–2006. *PLoS ONE* 8(7): e69094.
21. Singh PK, Rai RK, Kumar C (2013) Equity in maternal, newborn, and child health care coverage in India. *Global Health Action* 6: 22217.
22. Ministry of Health and Family Welfare (2013) *A strategic approach to Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+A) in India*. New Delhi: Government of India.
23. International Institute for Population Sciences (2010) *District Level Household and Facility Survey, 2007-08 (DLHS-3)*. Mumbai: International Institute for Population Sciences.
24. Villar J, Baaqeal H, Piaggio G, Lumbiganon P, Miguel BJ, Farnot U, Al-Mazrou Y, Carroli G, Pinol A, Donner A, Langer A, Nigenda G, Mugford M, Fox-Rushby J, Hutton G, Bergsjø P, Bakketeig L, Berendes H, Garcia J, WHO Antenatal Care Trial Research Group (2001) WHO antenatal care randomized trial for the evaluation of a new model of routine antenatal care. *The Lancet* 357(9268): 1551-64.
25. World Health Organization (2004) *Making Pregnancy Safer. The critical roles of the skilled attendant: a joint statement by WHO, ICM and FIGO*. Geneva: World Health Organization.
26. World Health Organization (2013) *WHO recommendations on postnatal care of the mothers and newborn*. Geneva: World Health Organization.
27. Vyas S, Kumaranayake L (2006) Constructing socio-economic status indices: how to use principal components analysis. *Health Policy and Planning* 21(6): 459-68.
28. Kumar C, Singh PK, Rai RK (2012) Under-Five Mortality in High Focus States in India: A District Level Geospatial Analysis. *PLoS ONE* 7(5): e37515.

29. Retherford RD, Choe MK (1993) *Statistical Models for Causal Analysis*. New York: John Wiley and Sons. Inc.
30. Statacorp (2007) *Stata statistical software: Release 10*. College Station, Texas, USA: Statacorp LP.
31. Lim SS, Dandona L, Hoisington JA, James SL, Hogan MC (2010) India's Janani Suraksha Yojana, a conditional cash transfer program to increase births in health facilities: an impact evaluation. *The Lancet* 375(9730): 2009-23.
32. Rai RK, Singh PK (2012) *Janani Suraksha Yojana: the conditional cash transfer scheme to reduce maternal mortality in India – a need for reassessment*. WHO South-East Asia Journal of Public Health 1(4):359-494.
33. Ministry of Health and Family Welfare (2013) *Annual Report, 2012–2013*. New Delhi: Department of Health and Family Welfare, Government of India.
34. Ministry of Health and Family Welfare (2013) *Maternal Death Review Guidebook*. New Delhi, India: Maternal Health Division, Government of India.
35. Ministry of Health and Family Welfare (2014) *Maternal and Child Tracking System*. New Delhi, India: Maternal Health Division, Government of India.

**Table 1.** Number of Households by the Status of Maternal Death since January 1, 2004, India, DLHS- 2007-08

	Unweighted sample	Weighted sample
Household did not experience any maternal death	718990	1303969
Household experienced at least one maternal death	1319	2240
Woman was pregnant when she died	738	1256
Woman died at the time of abortion/ within 6 weeks of abortion	96	163
Woman died during childbirth	172	290
Woman died within 6 weeks of pregnancy	313	531

**Table 2.** Proportion (%) of Women receiving Full Antenatal Care by Background Variables across Households experiencing no Maternal Death (no death) and at least one Maternal Death (any death), India, DLHS 2007-08

Background variables	No death	95% CI	Any death	95% CI
<b>Mother's age at childbirth</b>	[ $\chi^2=175.32$ ; $p<0.001$ ]		[ $\chi^2=5.53$ ; $p=0.018$ ]	
Below 19	15.5	[15.0-16.0]	1.3	[0.2-8.8]
19 and above	19.2	[19.0-19.4]	9.6	[6.5-13.8]
<b>Birth order</b>	[ $\chi^2=2823.2$ ; $p<0.001$ ]		[ $\chi^2=2.45$ ; $p=0.086$ ]	
1	25.6	[25.2-26.0]	10.8	[6.5-17.1]
2	23.4	[22.9-23.7]	9.8	[4.6-19.3]
3+	10.2	[9.91-10.3]	3.4	[1.2-8.7]
<b>Women's education</b>	[ $\chi^2=1060.00$ ; $p<0.001$ ]		[ $\chi^2=11.92$ ; $P<0.001$ ]	
Illiterate	6.9	[6.7-7.1]	3.2	[1.4-6.9]
Literate	27.5	[27.2-27.8]	13.3	[8.7-19.8]
<b>Husband's education</b>	[ $\chi^2=4010.27$ ; $p<0.001$ ]		[ $\chi^2=4.47$ ; $p=0.034$ ]	
Illiterate	7.9	[7.5-8.1]	3.0	[0.9-8.9]
Literate	22.2	[21.9-22.4]	9.8	[6.5-14.4]
<b>Heard/seen message of ANC</b>	[ $\chi^2=2972.72$ ; $p<0.001$ ]		[ $\chi^2=3.83$ ; $p=0.050$ ]	
Yes	20.9	[20.6-21.1]	9.3	[6.2-13.5]
No	4.4	[4.0-4.6]	2.6	[0.6-9.6]
<b>Heard/seen message of delivery care</b>	[ $\chi^2=3375.40$ ; $p<0.001$ ]		[ $\chi^2=1.44$ ; $p=0.229$ ]	
Yes	22.0	[21.7-22.2]	9.0	[5.9-13.4]
No	7.4	[7.1-7.7]	5.1	[2.1-11.7]
<b>Caste</b>	[ $\chi^2=657.53$ ; $p<0.001$ ]		[ $\chi^2=1.2387$ ; $p=0.625$ ]	
General/Others	20.9	[20.6-21.2]	8.4	[5.3-13.0]
SC/ST	15.0	[14.6-15.3]	6.9	[3.4-13.1]
<b>Religion</b>	[ $\chi^2=8.5757$ ; $p<0.001$ ]		[ $\chi^2=1.66$ ; $p=0.188$ ]	
Hindu	18.8	[18.5-19.0]	7.7	[5.0-11.7]
Muslim	18.1	[17.4-18.8]	4.1	[1.0-14.9]
Others	20.2	[19.4-20.8]	15.6	[6.2-33.7]
<b>Household wealth quintile</b>	[ $\chi^2=5148.92$ ; $p<0.001$ ]		[ $\chi^2=1.1924$ ; $p=0.824$ ]	
Bottom two	7.6	[7.3-7.7]	6.9	[3.8-12.0]
Middle	16.0	[15.5-16.3]	8.6	[4.1-16.9]
Upper two	30.0	[29.5-30.4]	8.9	[4.4-17.1]
<b>Place of residence</b>	[ $\chi^2=1881.28$ ; $p<0.001$ ]		[ $\chi^2=1.59$ ; $p=0.206$ ]	
Rural	14.7	[14.4-14.8]	8.9	[6.0-12.8]
Urban	29.5	[28.8-30.1]	2.7	[0.3-17.2]
<b>Region of residence</b>	[ $\chi^2=1070.0$ ; $p<0.001$ ]		[ $\chi^2=2.52$ ; $p=0.112$ ]	
High focus states	8.2	[8.0-8.4]	6.5	[4.0-10.1]
Non-high focus states	32.1	[31.6-32.4]	12.1	[6.3-21.6]
<b>Total</b>	18.8	[18.5-19.0]	7.9	[5.4-11.3]
Sample size (unweighted n)	217737		321	

SC = Scheduled Castes; ST = Scheduled Tribes

Note: High-focus states refer to a group of nine states comprising the states of Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttarakhand, and Uttar Pradesh. Figures in parentheses are the  $\chi^2$  statistics and corresponding  $p$  values.



**Table 3.** Proportion (%) of Women receiving Skilled Birth Attendance by Background Variables across Households experiencing no Maternal Death (no death) and at least one Maternal Death (any death), India, DLHS 2007-08

Background Variables	No death	95% CI	Any death	95% CI
<b>Mother's age at childbirth</b>	[ $\chi^2=11.44$ ; $p< 0.001$ ]		[ $\chi^2=1.00$ ; $p= 0.992$ ]	
Below 19	51.5	[50.8-52.1]	49.1	[37.2-61.0]
19 and above	52.7	[52.3-52.9]	49.1	[42.6-55.4]
<b>Birth order</b>	[ $\chi^2=7500.44$ ; $p< 0.001$ ]		[ $\chi^2=3.80$ ; $p= 0.022$ ]	
1	68.0	[67.6-68.4]	58.5	[49.6-66.9]
2	58.6	[58.1-59.0]	46.0	[34.6-57.8]
3+	35.3	[34.8-35.7]	40.3	[31.0-50.3]
<b>Women's education</b>	[ $\chi^2=1970.0$ ; $p< 0.001$ ]		[ $\chi^2=17.69$ ; $p< 0.001$ ]	
Illiterate	31.2	[30.8-31.6]	37.4	[30.0-45.3]
Literate	68.1	[67.7-68.4]	62.6	[54.1-70.3]
<b>Husband's education</b>	[ $\chi^2=1050.0$ ; $p< 0.001$ ]		[ $\chi^2=8.83$ ; $p= 0.003$ ]	
Illiterate	29.7	[29.2-30.2]	35.1	[25.3-46.2]
Literate	59.5	[59.1-59.8]	54.6	[47.9-61.1]
<b>Heard/seen message of ANC</b>	[ $\chi^2=6021.52$ ; $p< 0.001$ ]		[ $\chi^2=10.31$ ; $p< 0.001$ ]	
Yes	56.6	[56.2-56.9]	53.8	[47.5-60.0]
No	24.3	[23.6-24.9]	31.2	[20.9-43.7]
<b>Heard/seen message of delivery care</b>	[ $\chi^2=7370.77$ ; $p< 0.001$ ]		[ $\chi^2=25.52$ ; $p< 0.001$ ]	
Yes	59.1	[58.7-59.4]	58.4	[51.6-64.8]
No	29.2	[28.6-29.7]	26.0	[17.8-36.1]
<b>Caste</b>	[ $\chi^2=2126.09$ ; $p< 0.001$ ]		[ $\chi^2=1.50$ ; $p= 0.220$ ]	
General/Others	57.7	[57.2-58.0]	51.6	[44.4-58.6]
SC/ST	43.1	[42.6-43.6]	44.2	[35.1-53.6]
<b>Religion</b>	[ $\chi^2=50.38$ ; $p< 0.001$ ]		[ $\chi^2=4.22$ ; $p= 0.014$ ]	
Hindu	52.9	[52.5-53.2]	50.1	[43.7-56.4]
Muslim	48.7	[47.7-49.6]	32.5	[20.1-47.8]
Others	55.3	[54.2-56.2]	67.6	[48.0-82.5]
<b>Household wealth quintile</b>	[ $\chi^2=1250.0$ ; $p< 0.001$ ]		[ $\chi^2=11.96$ ; $p< 0.001$ ]	
Bottom two	29.1	[28.7-29.4]	35.1	[28.0-43.0]
Middle	48.5	[47.9-49.0]	52.6	[41.1-63.8]
Upper two	74.9	[74.5-75.3]	69.2	[57.5-78.7]
<b>Place of residence</b>	[ $\chi^2=3997.01$ ; $p< 0.001$ ]		[ $\chi^2=3.56$ ; $p= 0.059$ ]	
Rural	43.5	[43.1-43.7]	46.3	[40.5-52.1]
Urban	75.9	[75.1-76.6]	63.7	[46.3-78.0]
<b>Region of residence</b>	[ $\chi^2=7541.53$ ; $p< 0.001$ ]		[ $\chi^2=18.52$ ; $p< 0.001$ ]	
High focus states	39.5	[39.0-39.9]	41.5	[35.3-47.9]
Non-high focus states	68.8	[68.3-69.2]	71.6	[59.5-81.1]
<b>Full antenatal care</b>	[ $\chi^2=1410.0$ ; $p< 0.001$ ]		[ $\chi^2=13.06$ ; $p< 0.001$ ]	
No	45.3	[44.9-45.6]	46.2	[40.3-52.2]
Yes	83.5	[83.0-83.9]	82.3	[63.5-92.5]
<b>Total</b>	52.5	[52.2-52.8]	49.1	[43.4-54.7]
Sample size ( unweighted n)	217737		321	

SC = Scheduled Castes; ST = Scheduled Tribes

Note: High-focus states refer to a group of nine states comprising the states of Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttarakhand, and Uttar Pradesh. Figures in parentheses are the  $\chi^2$  statistics and corresponding  $p$  values.

**Table 4.** Proportion (%) of Women receiving Postnatal Care by Background Variables across Households experiencing no Maternal Death (no death) and at least one Maternal Death (any death), India, DLHS 2007-08

Background variables	No death	95% CI	Any death	95% CI
<b>Mother's age at childbirth</b>	[ $\chi^2=33.51$ ; $p < 0.001$ ]		[ $\chi^2=1.01$ ; $p = 0.892$ ]	
Below 19	45.7	[44.9-46.3]	40.2	[29.0-52.5]
19 and above	47.7	[47.3-48.0]	39.3	[32.9-45.9]
<b>Birth order</b>	[ $\chi^2=4196.77$ ; $p < 0.001$ ]		[ $\chi^2=2.66$ ; $p = 0.069$ ]	
1	58.6	[58.2-59.0]	47.5	[38.5-56.6]
2	53.3	[52.8-53.7]	36.3	[25.7-48.4]
3+	34.2	[33.7-34.5]	33.1	[24.8-42.6]
<b>Women's education</b>	[ $\chi^2=1280.0$ ; $p < 0.001$ ]		[ $\chi^2=16.67$ ; $p < 0.001$ ]	
Illiterate	29.7	[29.3-30.1]	28.7	[22.0-36.3]
Literate	60.4	[60.0-60.7]	52.0	[43.3-60.4]
<b>Husband's education</b>	[ $\chi^2=6616.94$ ; $p < 0.001$ ]		[ $\chi^2=4.50$ ; $p = 0.0338$ ]	
Illiterate	28.8	[28.3-29.3]	29.8	[20.8-40.5]
Literate	53.2	[52.8-53.5]	43.3	[36.5-50.3]
<b>Heard/seen message of ANC</b>	[ $\chi^2=4405.24$ ; $p < 0.001$ ]		[ $\chi^2=14.90$ ; $p < 0.001$ ]	
Yes	51.1	[50.8-51.4]	45.4	[38.8-52.1]
No	22.0	[21.3-22.6]	17.3	[9.5-29.2]
<b>Heard/seen message of delivery care</b>	[ $\chi^2=5539.27$ ; $p < 0.001$ ]		[ $\chi^2=15.50$ ; $p < 0.001$ ]	
Yes	53.2	[52.8-53.5]	46.4	[39.5-53.4]
No	27.1	[26.5-27.6]	22.2	[14.7-32.0]
<b>Caste</b>	[ $\chi^2=1952.92$ ; $p < 0.001$ ]		[ $\chi^2=1.023$ ; $p = 0.961$ ]	
General/Others	52.3	[51.9-52.7]	39.6	[32.7-46.8]
SC/ST	38.6	[38.1-39.0]	39.3	[29.7-49.6]
<b>Religion</b>	[ $\chi^2=6.46$ ; $P = 0.001$ ]		[ $\chi^2=1.616$ ; $p = 0.505$ ]	
Hindu	47.1	[46.7-47.4]	38.5	[32.1-45.2]
Muslim	48.4	[47.4-49.3]	37.9	[24.0-53.9]
Others	48.7	[47.7-49.6]	50.6	[31.7-69.2]
<b>Household wealth quintile</b>	[ $\chi^2=9482.52$ ; $p < 0.001$ ]		[ $\chi^2=12.25$ ; $p < 0.001$ ]	
Bottom two	27.0	[26.6-27.4]	24.8	[18.3-32.7]
Middle	43.0	[42.4-43.5]	45.1	[34.2-56.3]
Upper two	67.4	[66.9-67.8]	59.0	[46.5-70.4]
<b>Place of residence</b>	[ $\chi^2=3239.22$ ; $p < 0.001$ ]		[ $\chi^2=5.37$ ; $p = 0.020$ ]	
Rural	39.5	[39.1-39.8]	36.1	[30.4-42.1]
Urban	67.9	[67.1-68.7]	57.2	[39.9-72.9]
<b>Region of residence</b>	[ $\chi^2=9061.15$ ; $p < 0.001$ ]		[ $\chi^2=19.07$ ; $p < 0.001$ ]	
High focus states	33.6	[33.1-33.9]	31.9	[25.8-38.5]
Non-high focus states	64.8	[64.3-65.2]	62.0	[49.8-72.8]
<b>Full antenatal care</b>	[ $\chi^2=1340.0$ ; $p < 0.001$ ]		[ $\chi^2=3.89$ ; $p = 0.048$ ]	
No	40.4	[40.0-40.7]	37.9	[32.0-44.1]
Yes	77.9	[77.4-78.3]	57.9	[38.5-75.0]
<b>Safe delivery</b>	[ $\chi^2=4290.0$ ; $p < 0.001$ ]		[ $\chi^2=95.79$ ; $p < 0.001$ ]	
No	15.1	[14.8-15.4]	12.5	[7.9-18.9]
Yes	76.7	[76.3-77.0]	67.5	[59.3-74.7]
<b>Total</b>	47.5	[47.1-47.7]	39.5	[33.8-45.4]
Sample size (unweighted <i>n</i> )	217737		321	

SC = Scheduled Castes; ST = Scheduled Tribes

Note: High-focus states refer to a group of nine states comprising the states of Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttarakhand, and Uttar Pradesh. Figures in parentheses are the  $\chi^2$  statistics and corresponding *p* values.

**Table 5.** Odds Ratios (OR) estimated from Logistic Regression Models showing the likelihood of receiving Maternity Care Services among Women from Households experiencing at least one Maternal Death with reference to Women from Households experiencing no Maternal Death, India, DLHS 2007-08

	<b>Full Antenatal Care</b>			
	Unadjusted OR	95% CI	Adjusted <sup>†</sup> OR	95% CI
Women from households experienced no maternal death (Ref.)	1.000		1.000	
Women from households experienced at least one maternal death	0.369**	(0.247, 0.553)	0.557***	(0.353, 0.876)
	<b>Skilled Birth Attendance</b>			
	Unadjusted OR	95% CI	Adjusted <sup>†</sup> OR	95% CI
Women from households experienced no maternal death (Ref.)	1.000		1.000	
Women from households experienced at least one maternal death	0.871ns	(0.693, 1.093)	1.311*	(1.030, 1.730)
	<b>Postnatal care</b>			
	Unadjusted OR	95% CI	Adjusted <sup>†</sup> OR	95% CI
Women from households experienced no maternal death (Ref.)	1.000		1.000	
Women from households experienced at least one maternal death	0.722**	(0.566, 0.820)	0.825**	(0.606, 0.912)

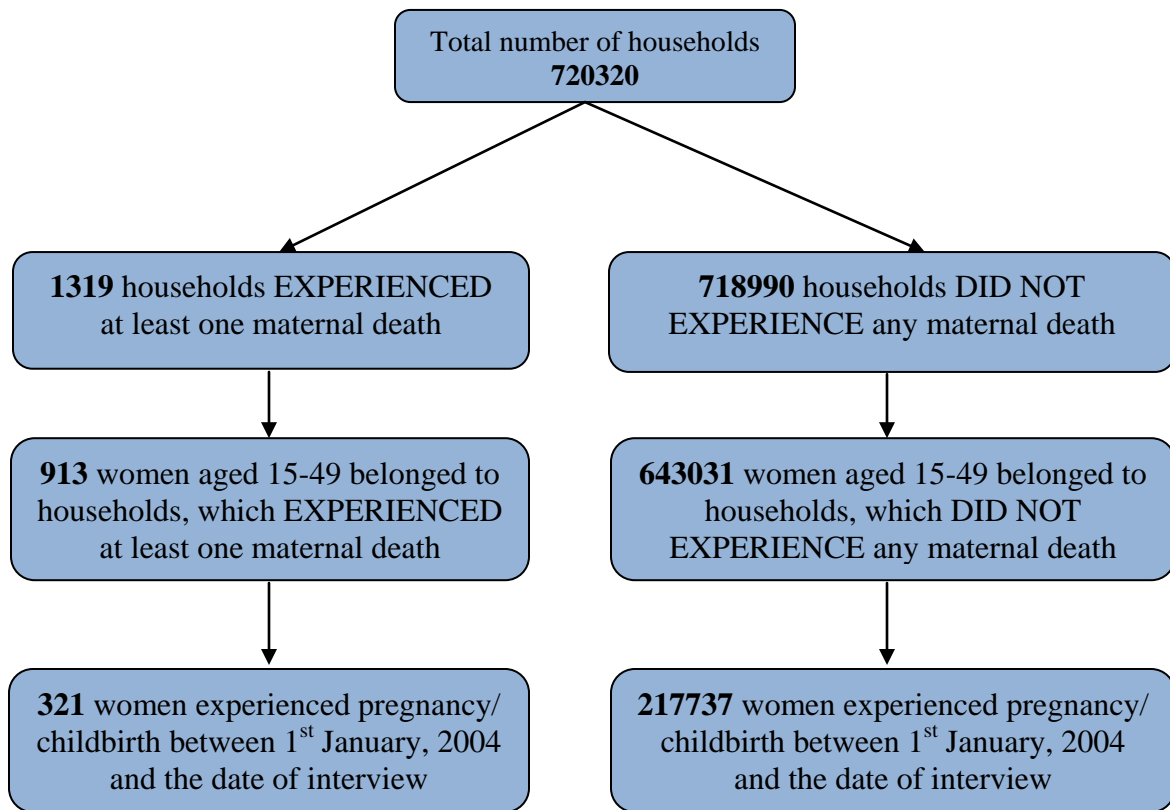
*Note*

The response variables are dichotomous: Full antenatal care (yes/no); Skilled Birth Attendance (yes/no); Postnatal care (yes/no).

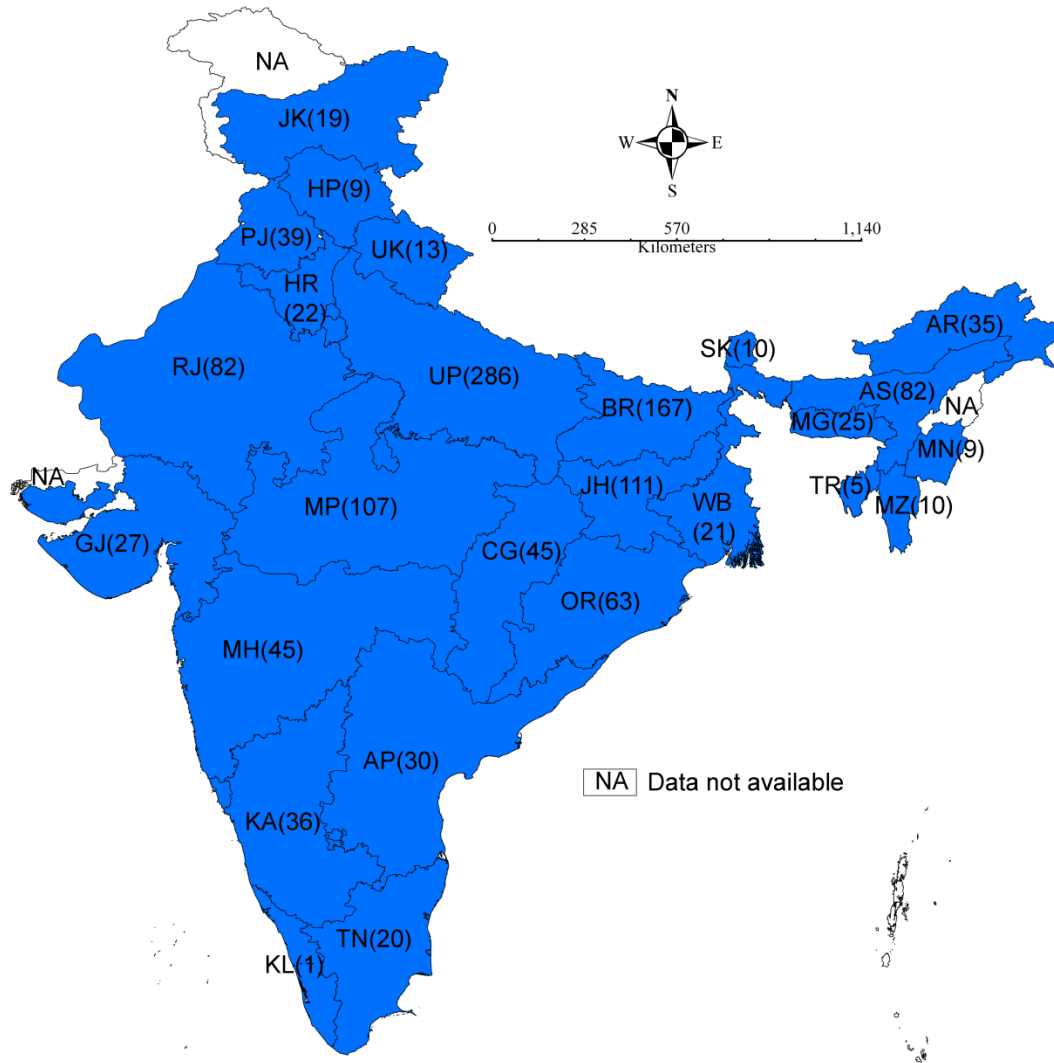
(Ref.), Reference category

Level of significance: \*\*\*  $p < 0.001$ ; \*\*  $p < 0.05$ ; \*  $p < 0.01$ ; ns: Not significant

<sup>†</sup>Adjusted for women's age at childbirth, birth order, women's education, husband's education, exposure to ANC messages, exposure to safe delivery care messages, castes, religion, household wealth quintile, place of residence, and region of residence. The model for the skilled birth attendance controls for the utilization of full ANC, and that for the postnatal care controls for the utilization of full ANC and SBA in addition to the variables mentioned above.



**Figure 1.** Derivation of sample size (unweighted) included in the analysis, DLHS 2007-08



**Figure 2.** State-wise Distribution of 1319 Households (unweighted) that experienced Maternal Death, DLHS 2007-08

*Note:* Abbreviations shown for the states are as follows: AP (Andhra Pradesh); AR (Arunachal Pradesh); AS (Assam); BR (Bihar); CG (Chhattisgarh); GJ (Gujarat); HR (Haryana); HP (Himachal Pradesh); JK (Jammu and Kashmir); JH (Jharkhand); KA (Karnataka); KL (Kerala); MG (Meghalaya); MH (Maharashtra); MN (Manipur); MP (Madhya Pradesh); MZ (Mizoram); OR (Orissa); PB (Punjab); RJ (Rajasthan); SK (Sikkim); TN (Tamil Nadu); TR (Tripura); UK (Uttarakhand); UP (Uttar Pradesh); and WB (West Bengal).

The figures presented in the parentheses are the number of sample households that experienced at least one maternal death since January 1, 2004.