Determinants of Skilled Delivery Assistance in a Rural Population: Findings from an HDSS Site of Rural West Bengal, India

Saswata Ghosh, Md. Zakaria Siddiqui, Anamitra Barik & Sunil Bhaumik

Maternal and Child Health Journal

ISSN 1092-7875

Matern Child Health J
DOI 10.1007/s10995-015-1768-0

Springer

Matern Child Health J
DOI 10.1007/s10995-015-1768-0

Determinants of Skilled Delivery Assistance in a Rural Population: Findings from an HDSS Site of Rural West Bengal, India

Saswata Ghosh[1] · Md. Zakaria Siddiqui[2] · Anamitra Barik[3] · Sunil Bhaumik[3]

Abstract
Objective This study examines the determinants of utilisation of skilled birth attendants (SBAs) amongst 2886 rural women in the state of West Bengal, India, using data from a survey of 2012–2013 conducted by the Birbhum Health and Demographic Surveillance System.
Method Multilevel logit regression models were estimated and qualitative investigations conducted to understand the determinants of utilisation of SBAs in rural West Bengal.
Results Among women who delivered their last child during the 3 years preceding the survey, 69.1 % of deliveries were assisted by SBAs, while 30.9 % were home deliveries without any SBA assistance. Multivariate analysis revealed that apart from socio-demographic and economic factors (such as household affluence, women's education, birth order, uptake of comprehensive ANC check-ups, advice regarding danger signs of pregnancy and household's socio-religious affiliation), supply side factors, such as availability of skilled birth attendants in the village and all-weather roads, have significant effect on seeking skilled assistance. Our findings also show that unobserved factors at village level independently influence uptake of SBA-assisted delivery.
Conclusions for Practice The present findings emphasise that both demand and supply side intervention strategies are essential prerequisites to enhance skilled birth attendance. Ample communication is observed at the individual level, but improving community level outreach and advocacy activities could generate further demand. SBAs can be better integrated by accommodating the socio-religious needs of local communities, such as providing female doctors and doctors with similar socio-religious backgrounds.

Keywords Skilled birth attendant · Birbhum HDSS · Supply side factors · Multilevel modelling · Unobserved heterogeneity

✉ Saswata Ghosh
ghosh.saswata@gmail.com

Md. Zakaria Siddiqui
zakaria.jnu@gmail.com

Anamitra Barik
anomitro2010@gmail.com

Sunil Bhaumik
sunilbhaumik.09@gmail.com

[1] Institute of Development Studies Kolkata (IDSK), DD-27/D, Sector-1, Near City Centre, Salt Lake City 700 064, Kolkata, India

[2] Crawford School of Public Policy, Australian National University, Acton, ACT, Australia

[3] Society for Health and Demographic Surveillance (SHDS), Suri, Birbhum, India

Significance

Both demand and supply-side intervention strategies are essential prerequisites to enhance skilled birth attendance among marginalised sections of rural Indian society.

Introduction

India's maternal mortality ratio (MMR) has declined from 398 to 167 per 100,000 live-births between 1997–1998 and 2011–2013 with an average annual reduction of 4.5 % [1, 2]; however, achieving the Millennium Development Goal

Published online: 30 June 2015

target of 109 per 100,000 live-births by 2015 remains a distant dream. The largest share (19 %) of the global burden of maternal deaths (2010) is occupied by India [3]. Studies have shown that the risk of maternal death is high during labour, delivery and up to 24 h of post-partum [4], and more than two-thirds of such deaths are directly related to obstetric conditions [5]. Adequate care, including skilled attendance during labour and delivery can prevent three-fourths of maternal deaths [6].

Reducing MMR and maternal morbidity has been one of the key goals of the Indian government over the years [7, 8]. The Reproductive and Child Health Programme aimed to enhance skilled birth attendants (SBAs) [9, 10]. To build an efficient and skilled cadre of birth attendants in India, midwifery training, practices and regulatory standards underwent significant changes during the 1990s [11]. Since 1996, the term 'skilled' attendant was employed instead of 'trained' attendant, recognising that someone who has been trained is not necessarily skilled. Following the World Health Organization's definition, the Government of India defines a skilled birth attendant as an accredited health professional—such as a midwife, doctor or nurse—who has been educated and trained to handle common and major obstetric and neonatal emergencies, and recognises exigent cases that need attention from a First Referral Unit (FRU)/ Doctor [12]. Some national surveys revealed that in India only 47–53 % of deliveries were conducted by SBAs [13, 14]. A key constraint in the progress of SBA-assisted deliveries is the deficit in human resources and physical infrastructure, particularly among socioeconomically vulnerable sections [15].

Studies indicate that despite the ready availability of SBAs in developing countries, expectant mothers continue to use traditional birth attendants [16]. Adequate antenatal care (ANC) [13, 17], higher educational attainment [18], higher age at parity [13], and economic accessibility [19–21] are positive covariates of SBA utilisation. However, higher birth order [13], socially disadvantaged communities [13, 14], and lower economic status of households [22, 23] are negatively associated with SBA utilisation. A recent article revealed that in addition to the aforesaid correlates, factors influencing SBA use include obstetric complications, quality of care, and proximity to a health facility [22]. Moreover, the study criticised other studies for neglecting issues of accessibility and the perceived benefits/needs of SBAs.

Many studies on determinants of SBA utilisation in India have primarily focused on demand side factors, ignoring supply side and contextual variables [24–27]. The present paper attempts to bridge this gap by analysing data from a rural Health & Demographic Surveillance System (HDSS) in the state of West Bengal, which is comparable to the national average in human development indicators. The principal hypothesis is that the village level contextual and supply side factors independently influence utilisation rate of SBAs. In this study, physical accessibility and availability of both paramedical staff and SBAs, all-weather roads and transport at the village level are considered supply side variables. Information-education-counselling (IEC) activities in the village are taken as a contextual variable.

Materials and Methods

Data

The Birbhum HDSS, established in 2008 and recognised by INDEPTH,[1] follows 54,585 individuals belonging to 12,557 households located in 351 rural villages in four administrative blocks of Birbhum district in West Bengal, India [28, 29]. The HDSS was designed to study demographic changes, population health and epidemiology, and healthcare utilisation.[2]

A multi-stage sampling design was adopted to select sample households [28, 29]. Selection of administrative blocks depended on socio-demographic characteristics of the population.[3] Then, villages were selected from the administrative blocks using a probability proportional to size sampling method, followed by households within villages selected by a stratified sampling method. Thus, the sample households are self-weighted. In addition to collecting data on vital statistics, antenatal and postnatal tracking, and conducting verbal autopsies, periodic surveys also captured socio-demographic and economic conditions [29]. The population under surveillance experience economic hardship and are socially marginalised communities.[4] Basic socio-demographic, economic and maternal health indicators for the Birbhum HDSS and the state of West Bengal are compared in Table 1.

The present study uses data from the second wave of socio-economic surveys conducted in 2012–2013. This survey also collected information regarding utilisation of

[1] INDEPTH is a pioneer in health and population research through its global network of health and demographic surveillance system (HDSS) field sites in Africa, Asia and Oceania. INDEPTH produces reliable longitudinal data not only about the lives of people in developing and least developed countries, but about the impact of development policies and programs on those lives.

[2] The Department of Health (DoH), Government of West Bengal funds the HDSS.

[3] Socio-demographic characteristics include proportion of scheduled castes (SCs) and scheduled tribes (STs) population and proportion of urban population. SCs and STs are castes and tribes identified by the Government of India as socioeconomically disadvantaged.

[4] Other geo-physical characteristics of the area include undulating topography, drought and remoteness.

Table 1 Selected socio-demographic and health care indicators of Birbhum HDSS vis-à-vis West Bengal

Socio-demographic indicators	Birbhum HDSS	West Bengal
Population	54,585	91,276,115[a]
Overall sex ratio	970	950[a]
Child sex ratio (0–6 years)	970	956[a]
% of SC to total population	33.3	23.5[a]
% of ST to total population	10.5	5.8[a]
% of Muslim to total population	29.1	25.2[b]
Male literacy (%)	68.5	72.2[a]
Female literacy (%)	56.6	62.3[a]
Literacy among SC (%)	50.8	59.1[b]
Literacy among ST (%)	40.8	43.4[b]
Male agricultural labourer to male main workers in rural areas (%)	30.3	33.8[a]
Female agricultural labourer to female main workers in rural areas (%)	36.6	36.4[a]
Institutional delivery (%)	68.9	49.1[c]
Current contraceptive use (%)	75.7	72.0[c]

Sources: Estimates for Birbhum HDSS are based on authors' own calculations from socio-economic survey of 2012–2013

[a] Primary Census Abstract, 2011

[b] Census, 2001

[c] District Level Household and Facility Survey (DLHS)—3, 2007–2008

maternal healthcare services from 2918 women who delivered a live birth within 3 years preceding the survey.

It should be noted that deliveries generally take place at the maternal home while data regarding household and village level characteristics for this analysis were collected from the in-laws' residence where females live on a regular basis. Focused group discussions (FGDs) reveal that the closest health facility was roughly equidistant from both the maternal and marital home. Therefore, this issue should not significantly affect our analysis. In this study we considered only 2886 women for whom complete information was available.

Variables

Predictor variables used in the analysis primarily fall into three categories: individual level (including variables related to pregnancy care); household level; and supply side variables. Logarithm of per capita household expenditure is used as the proxy for household economic status. The 'comprehensive ANC' variable has been created from eight separate variables related to ANC. These variables are: received at least three ANC visits (no, yes); registration of pregnancy within first 3 months (no, yes); received at least two tetanus-toxoid injections (no, yes); consumed at least 100 IFA tablets (no, yes); blood tested (no, yes); blood pressure checked (no, yes); urine tested (no, yes); and weight measured (no, yes). Further, availability of any paramedical staff in the village was constructed from three variables, namely, the availability of any multipurpose health worker, *Anganwadi* worker[5] (AWW), or accredited social health activist (ASHA).[6] Availability of any SBA in the village was computed using variables such as availability of a public or private doctor (including doctors from Indian Systems of Medicines), nurse, or auxiliary midwife (ANM). Degree of participation in information-education-counselling (IEC) activities in health related matters at the community level during 1 year preceding the survey were obtained by adding the following binary variables: organisation of any cinema/theatre, visual display, drama/song/performance, puppet show or group meeting.

The response variable for analysis is binary coded; one if the woman reported utilisation of an SBA during delivery and zero otherwise. SBA utilisation has been defined as a delivery assisted by a qualified public or private doctor, nurse or ANM.

Analytical Model

Due to a multi-stage sampling design the HDSS dataset has a hierarchical structure. Thus, some unobserved characteristics of villages might influence the likelihood of the

[5] *Anganwadi* translates to "courtyard shelter" in English. *Anganwadi* workers are government sponsored health workers chosen from the community and given 4 months training in health, nutrition and child-care. Each *Anganwadi* worker is expected to cater to a population of 1000 people.

[6] ASHAs are community health workers recruited under the aegis of the National Rural Health Mission (NRHM) implemented by the Ministry of Health and Family Welfare, Government of India.

outcome. A multilevel modelling technique not only accounts for the hierarchical nature of the data and corrects standard errors to allow for clustering of observations within villages, but also treats them as an additional source of information in the model [30].

A two-level binomial logit regression model was used to estimate a binary outcome in terms of a log likelihood ratio of SBA utilisation. The model is written as follows:

$$\ln\left(\frac{\phi_{ij}}{1-\phi_{ij}}\right) = \beta_0 + \sum_{m=1}^{M} \beta^m X_{ij}^m + u_j + e_{ij}$$

ϕ_{ij}—Probability of using SBA for individual female i nested in jth village
X_{ij}^m—Covariates where m represents number of covariate
u_j—Random intercept effect of jth village
e_{ij}—Residual error of individual i nested in jth village

Any multilevel model has both a fixed and a random component. The fixed component provides coefficients with respect to each of the covariates as is given in normal logit regressions. The random component of the model provides two variances with respect to each of the random intercept terms in the model representing the village (σ_j^2), and the individual (σ_i^2) level measures of independent impact of unobserved factors on the utilisation of SBA, thus making it a two level model. The Variance Partition Coefficient (VPC) was calculated to measure the share of variance between-the-villages in the total unexplained variance, that is, $\sigma_j^2/\left(\sigma_j^2+\sigma_i^2\right)$. A cumulative model building process was used; Model 1 includes only the individual level variables to understand the effect of individual level factors on use of SBA. Models 2 and 3 add sequentially household level and village level variables to examine how each of these groups of variables explains the variations in use of SBA. We also track changes in σ_j^2 to appreciate the role of household and village level variables in controlling contextual factors at the village level.

Data were analysed using Stata12. To obtain the basic socioeconomic characteristics of the samples, descriptive statistics were produced. Then bivariate and multivariate analyses were conducted to identify association of SBA utilisation with individual and village level determinants.

Qualitative Analysis

To supplement information obtained from the quantitative survey, we conducted 12 focus group discussions (FGDs) during October–November, 2013 (three in each administrative block) among three separate homogeneous groups having 8–10 participants each, namely, Hindu, Muslim and Tribal mothers. Mothers were mostly between 18 and 30 years of age. Each group had both, mothers who had an SBA-assisted delivery and mothers who had not. Participants were requested to use their last delivery as the reference to discuss reasons for their decision to seek delivery assistance or not. Discussions were on the training status of persons who assisted the delivery, awareness of facilities available for institutional delivery, out of pocket expenditure (OOP) for delivery, experiences and satisfaction with services in delivery places, and exchange of ideas and knowledge between communities regarding assistance from SBAs. All FGDs were recorded and transcribed verbatim.

Ethics Statement

The study was conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975 (in its most recently amended version). An independent Ethical Review Board appointed by the Chairman of the Birbhum HDSS, Government of West Bengal approved the study. Informed consent from the participants was taken prior to the survey. The information was anonymized. Further information on ethical committee can be obtained from the official website http://www.shds.in.

Results

Sample Characteristics

Sample characteristics of the surveyed women who delivered a live birth during the 3 years preceding the survey are reported in Table 2. More than two-thirds of the women were between 20 and 29 years of age. Over 30 % of the surveyed women were non-literate, while nearly 40 % had at least a secondary education. Two out of five children delivered were of first birth order, while nearly one-fourth of children were of higher birth order. Although majority of the women received comprehensive ANC, only about half received advice on pregnancy complications. Majority of the respondents belonged to the Scheduled Caste (SC) Hindu community, followed by Muslims and other minorities. Nearly one-third of the villages do not have all-weather roads and although more than 80 % of respondents reported having access to paramedics, just over 60 % of them reported having availability of an SBA.

Multivariate Analysis

Table 3 depicts the results obtained from multilevel logit analysis. After individual level variables were controlled

Table 2 Sample distribution of respondents aged 15–49, who have delivered a live-birth during the 3 years preceding the survey and selected village level characteristics, Birbhum HDSS, 2012–2013 (N = 2886 Nested within 324 Villages)

Variables	Number	Percentage (mean)
SBA-assisted delivery		
No SBA assistance	893	30.9
Assistance from SBA	1993	69.1
Individual level variables		
Age of respondents		
15–19	329	11.4
20–24	1227	42.5
25–29	868	30.1
30 or more	462	16.0
Birth order of children		
1	1182	41.0
2	1020	35.3
3 or more	684	23.7
Educational attainment		
Non-literate	1032	35.8
Primary	712	24.7
Secondary or more	1142	39.6
Work status		
Not-working	2515	87.1
Working	371	12.9
Variables related to comprehensive ANC check-ups		
Mean number of comprehensive ANC check-ups[2]	2886	6.25 (0.86) [0,8]
Knowledge of pregnancy complications		
No	1451	50.3
Yes	1435	49.7
Household level variables		
Religion/caste		
High caste Hindu	530	18.4
Scheduled caste (SC) Hindu	1017	35.2
Scheduled tribe (ST) Hindu	383	13.3
Muslim/others	956	33.1
Village level supply side variables		
Proportion of women living in a village which has an all-weather road		
No	888	30.8
Yes	1998	69.2
Proportion of women living in a village which has at least one paramedical staff		
No	530	18.4
Yes	2356	81.6
Proportion of women living in a village which has at least one SBA		
No	1671	57.9
Yes	1215	42.1

Parenthesis represents standard deviation and square bracket represents range of the respective variables

Source: Authors' own calculation

for (Model 1), women who had delivered two or more births were significantly less likely to utilise assistance from an SBA than those who delivered their first child (OR 0.30 for second birth and OR 0.15 for third of higher order birth). Although women's work status did not significantly affect utilisation of an SBA, females with primary and secondary education had higher odds of SBA utilisation compared to their non-literate counterparts (OR 1.88 and 3.22 respectively). Model 1 also suggests that ever use of contraception, comprehensive ANC and knowledge of

Table 3 Odds ratios of multilevel logit model$^{\Omega}$ for use of SBA respondents aged 15–49, who have delivered a live-birth during the 3 years preceding the survey, Birbhum HDSS, 2012–2013

Variables (fixed components)	Model 1 Odds ratios (standard error)	Model 2	Model 3
Individual level			
Women's age			
15–19 (ref.)	1.00	1.00	1.00
20–24	1.05 (0.213)	1.05 (0.213)	1.05 (0.213)
25–29	1.24 (0.278)	1.28 (0.290)	1.28 (0.288)
30 or more	1.36 (0.341)	1.45 (0.369)	1.45 (0.368)
Birth order			
1 (ref.)	1.00	1.00	1.00
2	0.30*** (0.044)	0.30*** (0.044)	0.30*** (0.044)
3 or more	0.15*** (0.026)	0.16*** (0.029)	0.17*** (0.030)
Educational attainment			
Non-literate (ref.)	1.00	1.00	1.00
Primary	1.88*** (0.254)	1.77*** (0.242)	1.76*** (0.241)
Secondary or more	3.22*** (0.443)	2.71*** (0.393)	2.64*** (0.385)
Work status			
Not-working (ref.)	1.00	1.00	1.00
Working	0.814 (0.131)	0.94 (0.155)	0.94 (0.155)
Ever use of contraception			
No (ref.)	1.00	1.00	1.00
Yes	1.47** (0.195)	1.26* (0.168)	1.23 (0.158)
Extent of comprehensive ANC check-ups	1.43*** (0.095)	1.36*** (0.089)	1.37*** (0.090)
Knowledge of pregnancy complications			
No (ref.)	1.00	1.00	1.00
Yes	1.86*** (0.246)	1.71*** (0.217)	1.68*** (0.214)
Household level			
Per capita household expenditure (logarithm)		1.32* (0.181)	1.31* (0.180)
Religion/caste			
Upper caste Hindu (ref.)	Na	1.00	1.00
Scheduled caste (SC) Hindu	Na	0.59* (0.140)	0.57* (0.138)
Scheduled tribe (ST) Hindu	Na	0.11*** (0.030)	0.12*** (0.035)
Muslim/others	Na	0.18*** (0.045)	0.18*** (0.043)
Village level			
Village is connected to an all-weather road			
No	Na	Na	1.00
Yes	Na	Na	1.66** (0.278)
Village has at least one paramedical staff			
No	Na	Na	1.00
Yes	Na	Na	1.15 (0.217)
Village has at least one SBA			
No	Na	Na	1.00
Yes	Na	Na	1.41* (0.253)
Degree of exposure to IEC activities in village	Na	Na	1.06 (0.149)
Random components			
Village level variance (σ_j^2)	1.54*** (0.273)	0.856*** (0.185)	0.786*** (0.172)
Village level VPC $\left[\sigma_j^2/\left(\sigma_j^2+\sigma_i^2\right)\right]$	0.319 (0.039)	0.206 (0.036)	0.193 (0.034)

Table 3 continued

Variables (fixed components)	Model 1 Odds ratios (standard error)	Model 2	Model 3
Intercept	0.355** (0.197)	0.272 (0.264)	0.166 (0.163)

$^{\Omega}$ Likelihood ratio test was carried out for each of the three models respectively to compare them with simple logit model. Tests justified usage of multilevel random intercept model

Source: Authors' own calculation

Na not applicable

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

pregnancy complications significantly facilitate utilisation of SBAs (OR 1.47, 1.43 and 1.86 respectively). High random intercept variance ($\sigma_j^2 = 1.54$) indicates that between-village differences are significant. The VPC shows about 32 % of the total unexplained variation could be attributed to between-village differences.

Model 2 shows that after adjustment for household level variables, namely, religion/caste and log of per capita household expenditure, the significance of individual level variables of Model 1 still prevail, except the ever use of contraception is now significant at 5 % confidence level and finally, in model 3, becomes insignificant. Results of Model 2 suggest that in addition to individual-level factors, women belonging to SC, Scheduled Tribe (ST) and minority (largely consisting of Muslims) communities are significantly less likely to utilise SBAs at the time of delivery compared to high caste Hindus (OR 0.59, 0.11 and 0.18, respectively). Further, economic affluence, measured as log of per capita household expenditure, increases the odds of utilisation of SBAs significantly (OR 1.32). The inclusion of household level variables reduces the random intercept variance (σ_j^2) (from 1.54 to 0.86) indicating that the household level variables are able to capture some of the contextual factors, particularly demand-side factors. Nevertheless, the VPC is still quite high with between-village differences explaining about 20 % of total unexplained variation.

After adding village level supply side variables in the regression (Model 3), the significant effect of individual and household level variables persist. Additionally, supply-side characteristics, such as the availability of all-weather roads and availability of any SBA in the villages, significantly increase the odds of an SBA-assisted delivery (OR 1.65 and 1.41 respectively). However, availability of any paramedical personnel and degree of exposure of IEC activities at the village level were not significantly associated with utilisation of SBAs. The random intercept variance (σ_j^2), reduced marginally from 0.85 in Model 2 to 0.78 in Model 3 and remained significant.[7]

[7] Likelihood ratio test was carried out for each of the three models respectively to compare them with a simple logit model. The tests justified usage of a multilevel random intercept model.

This result does not imply that supply side variables play a negligible role. In Model 3 σ_j^2 is more likely to contain supply side factors, which remain only partially observed in this analysis as we have largely accounted for demand side factors which was evidenced by significant reduction in σ_j^2 after introduction of household characteristics in Model 2. We must note that supply side variables used in this study are not a very robust measure of supply as quality-adjusted measures of paramedics, SBAs, IEC activities and roads are not possible due to informational constraints.

Discussion

Using data from an HDSS site of rural India, the present study found that child's birth order, women's educational attainment, comprehensive ANC, knowledge of pregnancy complications, household's economic status and socio-religious affiliation, availability of all-weather roads and SBAs in a village, all significantly influence occurrence of SBA-assisted deliveries. In other words, both demand and supply side factors have significant bearing on utilisation of SBAs.

Higher order births decreased the likelihood of using the maternal healthcare services as observed in other studies [22]. Usually the first pregnancy, in addition to being highly valued, is believed to be more difficult as the woman has no previous experience [23]. As a result women try to obtain the best possible care. Previous experience of pregnancy, childbirth and with institutions among higher parity women reduces likelihood of using SBAs [22, 31]. As an FGD participant narrated, "I have three children. The first two were delivered in hospital. For the third one, I chose home delivery as I know how to manage the delivery" (*A2, age* 25*, Muslim, year* 5 *educated*). Moreover, previous true or perceived unpleasant experiences with providers and local customary practices associated with childbirth could perhaps also reduce the utilisation of SBA services. One FGD participant recounted, "I did not visit hospital due to bad behaviour I experienced earlier" (*A1,*

age 26*, SC Hindu, Year* 7 *educated,* 3 *children*). Another FGD participant narrated, "I preferred home delivery since I was afraid of the hospital. Moreover, neighbours told me that I would not get proper attention at the hospital so I refused to go" (*A*9*, age* 28*, ST Hindu, non-literate,* 2 *children*).

The decisive influence of maternal education in the uptake of maternal and child health services has been noted in literature [24]. Educated women are more likely to influence decision-making processes within the household in these issues.

The study reconfirms that the uptake of ANC services and having received advises regarding pregnancy complications had a crucial effect on the occurrence of SBA-assisted deliveries [17, 22]. Comprehensive ANC coupled with advice regarding pregnancy complications helps in early detection of complication and leads women to seek skilled assistance during delivery. Moreover, ANC may be beneficial in providing opportunities to care providers to assist expectant women and their families to make birth preparedness plans [9]. Surprisingly IEC activities at the community level were not significant in increasing the probability of utilisation of SBAs. Participant responses in the FGDs highlighted that the ANM, ASHA and AWW do provide information individually regarding the signs of risky pregnancy, childbirth and post-natal complications, the availability of ambulances and other benefits of using SBAs but seldom communicate at the community level. However sustained IEC activities can potentially generate greater demand for services and enhance utilisation of SBAs. Furthermore, community-based interventions, training, and supporting members in the communities could also enhance use of modern healthcare facilities [32].

The likelihood of SBA utilization increases with household economic status, which corresponds with other studies [22, 24, 26, 31]. This finding begged an examination of affordability of SBA-assisted deliveries. FGD participants, however, did not consider OOP expenditure as a decisive factor restricting them from seeking an SBA-assisted delivery. Public institutions in survey blocks cost between US$10 and US$20, which is not too expensive compared to a home delivery without an SBA (from US$5 to US$10). However private facilities cost between US$50 and US$100. Our study area appears to be far cheaper than the all-India average (i.e., US$39 and US$139 for public and private institutions, respectively) as reported by Mohanty and Srivastava [26].

Muslim, ST and SC women were significantly less likely to utilise assistance from an SBA even after controlling for a number of confounding factors, including supply side factors, confirming earlier findings [22, 27]. An FGD participant belonging to the Muslim community confidently said, "We Muslim mothers don't need to go to the hospital; we are capable of delivering our child at home. So I didn't visit the hospital"(*A*1, *age* 25*, non-literate,* 4 *children*). Another participant of the same community recounted, "I delivered my first three children in the hospital and the last two at home because of bad experiences. I was suffering from labour pain and I had told the nurse. She shouted at me and attended to me after a long time" (*A*2*, age* 23*, year* 9 *educated,* 5 *children*). Notably, the likelihood of utilization of SBAs among Muslim mothers was higher by 5 % in villages that had a female doctor.

An FGD participant from the ST community narrated, "I did not go to the hospital because I have language difficulties and nurses often use slang and doctors unnecessarily cut the vagina during delivery, even if it is a normal delivery"(*A*6*, age* 20*, ST Christian, non-literate,* 2 *children*). Another participant belonging to the same community lamented, "I had a home delivery and my child died within 5 min. My husband and in-laws were reluctant to take me to the hospital, even though I wanted to go there for delivery" (*A*9, *age* 20, *year* 12 *educated, no children*). We had another participant say, "ASHA… informed me about the hospital delivery but due to pressure from family members I could not visit the hospital" (*A*8*, ST,* 28 *years, non-literate,* 2 *children*).

Overall, the FGDs reveal a clear disparity in knowledge, attitude, practices and the influence of household members on the basis of socio-religious affiliation. Our analysis also indicates that consideration of socio-religious needs of the community may improve acceptability of SBAs, such as allocating female doctors and doctors with similar socio-religious backgrounds among minority and socially disadvantaged communities.

With regards to supply side determinants, we found that availability of all-weather roads (which also implies availability of transport) and availability of an SBA in a village enhance the likelihood of utilisation of SBA services. In spite of a general perception regarding their importance, these factors were not regularly considered in earlier studies due to paucity of data [23, 33, 34]. We speculate that the large variance of the village level intercept term contains a significant amount of unobserved supply factors.

It must be acknowledged, however, that the current study has certain limitations. First, the study uses cross-sectional data, which cannot help establish cause-effect relationships. Second, due to the non-availability of variables that could influence SBA utilisation (e.g. variables related to health beliefs during pregnancy and childbirth, perceived quality of care, decision-making regarding healthcare, and status of women), the odds ratios may have been overestimated by some degree. Finally, although the data used in the analysis were based on self-reported information, various socio-demographic indicators

obtained in the present dataset are comparable with estimates from national surveys and the Indian census [14, 35].

The present analysis uncovered interesting findings, particularly with regard to the role of supply side village level factors. Tailoring the supply side to suit socio-religious needs of the community, along with collective advocacy, can go a long way in ensuring equitable outcomes in maternal health. However comprehensive measures of supply side factors are needed for future studies to rigorously establish the importance of supply side determinants in uptake of SBA-assisted deliveries.

Acknowledgments We acknowledge contributions from Professor Susanta Bandyopadhyay, Director of Medical Education (Government of West Bengal) and Dr. Biswaranjan Satpathi, Director of Health Services (Government of West Bengal). We would like to express our gratitude to Professor Achin Chakraborty, Director, Institute of Development Studies Kolkata (IDSK) and Professor Abhijit Choudhury, Project Director, SHDS, for their valuable advice. We would like to thank Ashoke Gorain, Survey Manager, SHDS and Saikat Majumdar, Data Manager, SHDS for data collection and compilation. We are also indebted to the anonymous referees for their critical and constructive comments. Finally, the SHDS team deserves special mention for their overall effort in collecting data.

References

1. Sample Registration System (2006). Maternal mortality in India: 1997–2003 trends causes and risk factors, Office of the Registrar General, India, New Delhi. http://www.health.mp.gov.in/Maternal_Mortality_in_India_1997-2003.pdf. Accessed 11 June 2015.
2. Sample Registration System (2014). Maternal mortality ratio bulletin 2011–13, Office of the registrar general, India, New Delhi. http://www.censusindia.gov.in/vital_statistics/mmr_bulletin_2011-13.pdf. Accessed 11 June 2015.
3. World Health Organization, United Nations Children's Population Fund, United Nations Fund for Population Activities, The World Bank. (2012). *Trends in maternal mortality: 1990–2010*. Geneva: World Health Organization.
4. Ronsmans, C., & Graham, W. J. (2006). Maternal mortality: Who, when, where, and why. *The Lancet, 368*(9542), 1189–1200.
5. AbouZahr, C. (2003). Global burden of maternal death and disability. *British Medical Bulletin, 67*, 1–11.
6. Harvey, S. A., Ayabacab, P., Bucague, M., et al. (2004). Skilled birth attendant competence: An initial assessment in four countries, and implications for the safe motherhood movement. *International Journal of Gynaecology and Obstetrics, 87*, 203–210.
7. Planning Commission Government of India. (2013). *Evolution of the family welfare programme*. New Delhi: Planning Commission Government of India, no date. http://planningcommission.nic.in/aboutus/committee/strgrp/stgp_fmlywel/sgfw_ch3.pdf. Accessed 31 October 2013.
8. National Population Policy 2000. (2000) http://india.unfpa.org/drive/NationalPopulation-Policy2000.pdf. Accessed 31 December 2013.
9. Department of Family Welfare Ministry, Government of India (2012). *Reproductive and child health program. secondary reproductive and child health program*. New Delhi: Department of Family Welfare Ministry, 2012. http://www.mohfw.nic.in/NRHM/RCH/Index.htm. Accessed 31 December 2013.
10. Ministry of Health & Family Welfare, Government of India (2012). *National rural health mission*. New Delhi: Department of Family Welfare Ministry, no date. http://mohfw.nic.in/NRHM.htm. Accessed 31 December 2013.
11. Sharma, N., Walia, I., & Saini, S. K. (2009). A descriptive study of skilled birth attendants (Nursing personnel and health workers female) in Chandigarh city. *Nursing and Midwifery Research Journal, 5*(2), 59–68.
12. Ministry of Health & Family Welfare (2005). *Guidelines for ante-natal care andskilled attendance at birth by ANMs and LHVs*. New Delhi: Maternal Health Division, Ministry of Health and family Welfare, Government of India. http://www.indiannursingcouncil.org/pdf/SBA-MODULE-Guideline-forAntenatalCare.pdf. Accessed 18 February 2013.
13. International Institute for Population Sciences (IIPS) and Macro International (2007). *National family health survey* (NFHS -3), (Vol. 1), 2005–06. Mumbai: IIPS.
14. International Institute for Population Sciences (IIPS) (2010). *District level household and facility survey* (DLHS-3), 2007–08: Mumbai: IIPS.
15. United Nations Fund for Population Activities (UNFPA) (2009). *No woman should die giving life*. The Communication Initiative Network. New York; 2008. http://www.unfpa.org/safemotherhood. Accessed 11 January 2013.
16. Yanagisawa, S., Oum, S., & Wakai, S. (2006). Determinants of skilled birth attendance in rural Cambodia. *Tropical Medicine and International Health, 11*(2), 238–251.
17. Mishra, V., & Retherford, R. D. (2008). The effect of antenatal care on professional assistance at delivery in rural India. *Population Research and Policy Review, 27*, 307320.
18. World Health Organization (WHO). (2008). *Skilled birth attendants, factsheet*. Geneva: World Health Organisation.
19. Nwakoby, B. N. (1994). Use of obstetric services in rural Nigeria. *Journal of Social Health, 114*(3), 132–136.
20. Addai, I. (2000). Determinants of use of maternal-child health services in rural Ghana. *Journal of Biosocial Science, 32*(1), 1–15.
21. Obermeyer, C. M., & Potter, J. E. (1991). Maternal health care utilization in Jordan: A study of patterns and determinants. *Studies in FamilyPlanning, 22*(3), 177–187.
22. Gabrysch, S., & Campbell, O. M. R. (2009). Still too far to walk: Literature review of the determinants of service delivery use. *BMC Pregnancy Childbirth, 9*, 34.
23. Navaneetham, K., & Dharmalingam, A. (2002). Utilization of maternal health care services in Southern India. *Social Science and Medicine, 55*(10), 1849–1869.
24. Kumar, C., Rai, R. K., Singh, P. K., et al. (2013). Socioeconomic disparities in maternity are among Indian adolescent. *PLoS One, 8*(7), e69094.
25. Nair, M., Ariana, P., & Webster, P. (2012). What influences the decision to undergo institutional delivery by skilled birth attendants? A cohort study in rural Andhra Pradesh, India. *Rural Remote Health, 12*, 2311.
26. Mohanty, S. K., & Srivastava, A. (2013). Out-of-pocket expenditure on institutional delivery in India. *Health Policy Planning, 28*, 247–262.
27. Thind, A., Mohani, A., Banerjee, K., et al. (2008). Where to deliver? Analysis of choice of delivery location from a national survey in India. *BMC Public Health, 8*, 29.
28. Society for Health & Demographic Surveillance (SHDS). (2013). *Report of the activities of the society for health and demographic surveillance 2013*. Birbhum District, West Bengal: Department of Health and family Welfare, Government of West Bengal.
29. Ghosh, S., Barik, A., Majumder, S., et al. (2014). Profile: Birbhum Population Project (Birbhum HDSS). *International Journal of Epidemiology*. doi:10.1093/ije/dyu228.
30. Goldstein, H. (2003). *Multilevel statistical methods*. London: Arnold.

31. Hazarika, I. (2011). Factors that determine the use of skilled care during delivery in India: Implications for achievement of MDG-5 targets. *Maternal and Child Health Journal, 15*, 1381–1388.
32. Kurk, M. E., Rockers, P. C., Mbaruku, G., et al. (2010). Community and health system factors associated with facility delivery in rural Tanzania: A multilevel analysis. *Health Policy*. doi:10.1016/j.healthpol.2010.05.002.
33. Stephenson, R., & Tsui, A. O. (2002). Contextual influences on reproductive health service use in Uttar Pradesh, India. *Studies in Family Planning, 33*(4), 309–320.
34. Gage, A. J., & Guirlene Calixte, M. (2006). Effects of the physical accessibility of maternal health services on their use in rural Haiti. *Population Studies (Camb), 60*(3), 271–288.
35. Registrar General of India. (2011). *Primary Census Abstract, 2011*. Ministry of Home Affairs: New Delhi.