Understanding the Effects of Older Siblings on Institutional Delivery of Subsequent Births in India: An Application of Multivariate Multilevel Models

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Introduction

Recent estimates show that the maternal mortality ratio (MMR) in India declined from 327 maternal deaths per 100,000 live births in 1999-2001 to 212 maternal deaths per 100,000 live births in 2007-09 (SRS). The pace of this decline is considerably slower than what would be required to meet India's Millennium Development Goal target of reducing the MMR to 109 maternal deaths per 100,000 live births up to 2015 (MDG).

Researcher have already poof that, the majority of deaths are preventable through institutional deliveries and adequate maternal care. However, India is marked by particularly low level of institutional delivery (defined as public or private institution); only 39 percent of women have delivered her birth in an institution in India (NFHS-3). Utilisation of delivery care service is a complex behavioural phenomenon. The use of delivery service is associated to numbers of factors like availability, accessibility, quality, and cost of service. It also depends on social structure, health beliefs as well as personal characteristics of the women (Chakraborty et al., 2003).

Over the past decade interest has grown in examining the socioeconomic inequality, poor-non poor differences, in institutional delivery. Few of the studies also try to link the utilization of prenatal care on institutional delivery. However, no coherent picture of determinants of consistent use of institutional delivery care has yet been provided. The utilization of institutional delivery has usually been studied cross-sectional, which has probably contributed to this lack of knowledge. Hence, the objective of this study is to explain the consistency of utilization of institutional delivery within women across all of her births.

The specific aims of this study is

(1) To determine whether different 'place of delivery' are used by the same women for all of her births (i.e. clustering of use).

(2) To investigate how place of delivery changes over time (consistency of use).

(3) To describe the socio economic demographic characteristics of women for the consistent use.

Given that the slow decline in utilization of delivery care in India, it is important to develop an understanding of factors associated with the consistent utilization of institutional delivery in India. We seek to provide policy makers, health planners and administrators in India with up-to-date information so that they can develop effective delivery care services. To improve coverage of institutional delivery, policy makers and health planners need information not only on those groups of women who never utilize services but also those who are not consistent in their use.

Data and Methodology

In order to achieve the proposed objectives this study will use data from all rounds of National Family Health Survey. The samples are nationally representative and are designed to produce estimates at the national and state levels. NFHS data are collected in a cross sectional format. The dependent variable in present analysis is 'place of delivery' of all children within a woman. Place of delivery has been classified as 'institution' if the delivery has been done either public or private hospital vs. 'home'.

In the first part of the objective, analysis has been carried out on considering women as a lowest level. Further analysis has been carried out first including only women who have given two births in five years time period. First multilevel model comparison has been made between women who were consistent for institutional delivery i.e. those who have delivered her both of the births in an institution with other women (who have delivered her two births at home). In the second model comparison has been made between women who were consistent for institutional delivery with women who have delivered at least one birth in an institution. These models are appropriate since the data are hierarchical, where women are nested within communities (PSU). At last we have also applied multivariate multilevel model.

MLwiN software, version 2.15 http://www.cmm.bristol.ac.uk/ MLwiN, was used for the analyses.

Results

Table 2 presents the fixed part finding of the full model. There were some similarities as well as differences in socioeconomic patterning of place of deliveries for all three births. It was found that for the recent and second last pregnancies' mothers all five regions of residence were more likely to deliver their births in an institution than central living women. For the third pregnancy which has been born during five years from the date of survey except for northeastern region ($OR_{northeastern}$ = 1.00; 95% CI: 0.60–1.66) other four regions had significantly more chance to be delivered birth in hospital compare to central living mothers. Living in urban area preferred hospital for the place of delivery for all three successive births. Moreover, chances were high with the increasing number of births. Being a Muslim was less likely (OR_{Muslim} = 0.83; 95% CI: 0.74–0.93) to deliver recent birth in an institution compare to Hindu women. However, the impact of religion on utilizing the institutional delivery had become insignificant for second and third last births.

Scheduled caste/tribe mother had shown to be a negative predictor of institutional delivery for all three successive births, scheduled caste had no significant association with the use of institutional delivery for second last and third last birth. Mothers with higher education had more chance to be deliver their all three births (OR recent birth = 3.44; 95% CI: 3.06–3.87),

(OR $_{\text{second birth}}$ = 3.81; 95% CI: 3.19–4.56) (OR $_{\text{third birth}}$ = 2.61; 95% CI: 1.65–4.14) in an institution compare to illiterate women. Additionally, with the increasing level of respondent's education, a chance to use institutional delivery also increases. Contradictory to this, if women were only below primary educated at the time of third birth it has no effect on institutional delivery. The same pattern has been emerged for partner's education level. Middle and above educated partners were more likely to prefer medical institution for place of delivery for recent and second last child. However, after controlling for community and individual level variables, association between place of delivery and partners' education for third last birth, disappeared. For recent and second last birth, the increase in the odds of utilizing institutional delivery with increasing education level was smaller than the increase associated with rising wealth quintile. Yet, the odds of institutional delivery associated with each level of education and wealth quintile was found to be varied considerably for all three successive births taken place during last five years from the date of the survey.

Further mothers who belonged to top three wealth quintiles had significantly higher chance to deliver all three successive births in an institution. However, if mother were from poorer household at the time of last third birth, had no significant effect on the place of choice of delivery but interestingly, at the time of second last and most recent birth, poorer household had a significant positive role on the choice of place of delivery. The reasons could be the introduction of different 'free maternity benefit schemes', which attracts women to utilize the institutional delivery even if she belonged to poorer household. Women who have experienced at least one child loss during their reproductive carrier were more likely to give all three successive births in an institution. Sex compositions of living children were found to be statistically not significant predictor (except for second last birth) for use of institutional delivery. At the time of second last birth, if women had less number of sons than daughters, the odds of utilizing institutional delivery was almost two times more likely (OR = 2.14; 95% CI: 1.01–4.55) compared to 'no living son and daughter'. Women who had experienced the terminated pregnancy had had significantly higher chance to deliver their most recent and second last birth in an institution, but at the time of third last birth, this variable had lost loss its significance effect. Result shows that children those who have born two-three years back from the date of survey were having less chance to get delivered in an institution than recent born child. For third last birth child's age had no important effect. Compare to second order birth, first order birth were more likely to deliver in an institution, but third and higher (3+ order birth) order birth have less chance to delivered in an institution.

Result of random parameter estimate for two level multivariate multilevel regression model for utilization of institutional delivery in India derived from NFHS-2005-06 shows that covariance between place of birth of most recent and second last birth was higher (0.46) than between most recent and third last birth (0.28). The covariance between second and third last birth was slightly lower (0.41) than recent subsequent birth. Result also shows that utilization of institutional delivery for two subsequent births was significantly related to each other.

Using the second order approximation and maximize quasi-likelihood method The unconstrained binomial variance parameter for the three pregnancy outcome was estimated to be σ^2_{e11}=1.00,σ^2_{e22}=0.97and σ^2_{e33}=0.95 , which was very close to one. This shows that the data constructed in a multivariate multilevel model have follow the binomial assumption. The estimated covariates derived from multivariate multilevel model were positive and highly significant, analysis come out with the interesting finding that correlation between successive pregnancies were high compared to alternative pregnancies estimate. This suggests that once the decision has been made for the place of delivery of one birth, the behavior of the mother is unlikely to change for the next and, to a lesser extent, subsequent birth.

Table 1: Patterns of use of institutional delivery for women starting with the first birth for which information is available in the 5-year period before the NHFS.

	Consistency in institutional delivery					
	NFHS-1992-93		NFHS-1998-99		NFHS-2005-06	
Women With One Birth	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**
Home	71.54	18234	65.48	15985	52.56	10956
Institute	28.46	8314	34.52	8997	47.44	13080
Total	**100**	**26548**	**100**	**24982**	**100**	**24036**
Women With Two Births						
Home, Home	72.58	7243	62.61	2540	59.73	6007
Home, Institution	4.31	463	5.65	231	5.87	686
Institution, Home	6.08	645	7.33	302	8.21	890
Institution, Institution	17.04	1801	24.40	975	26.19	3448
Total	**100**	**10158**	**100**	**4048**	**100**	**11031**
Women With Three Births						
Home, Home, Home	66.80	436			63.05	1006
Institution, Home, Home	2.20	19			5.98	95
Institution, Institution, Home	3.14	23			2.98	48
Institution, Institution, Institution	15.42	106			15.55	301
Home, Institution, Institution	3.49	25			2.60	58
Home, Home, Institution	5.14	32			5.08	96
Home, Institution, Home	2.63	19			2.24	31
Institution, Home, Institution	1.18	13			2.51	43
Total	**100**	**673**			**100**	**1678**
Women With Four Births						
Home, Home, Home,Home					63.36	64
Home, Institution, Home, Home					1.53	1
Home, Institution, Institution, Home					2.63	1
Home, Institution, Institution, Institution					2.87	5
Home, Home, Institution, Institution					3.52	3
Home, Home, Home, Institution					3.61	2
Home, Home, Institution, Home					1.53	1
Home, Institution, Home, Institution					0.77	1
Institution Home Home Home					1.09	2
Institution Institution Home Home					1.71	1
Institution Institution Institution Home					1.53	1
Institution Institution Institution Institution					10.36	14
Institution Home Institution Institution'					2.38	3
Institution Home Home Institution					1.71	1
Institution Institution Home Institution					1.40	2
Total					**100**	**102**
Women With Five Births						
Institution Institution Institution Institution Institution					30.69	1
Home Home Home Home Home					47.71	1
Institution Institution Institution Institution Home					21.60	1
Total					**100**	**3**

Table 2: Fixed parameter estimates for two-level (mother and PSU) multivariate multilevel regression models for use of Institutional Delivery, India, NFHS-2005-06.

Background Characteristic	Recent Birth			Second last Birth			Third last Birth		
	EXP (B)	95.0% C.I. for EXP(B)		EXP (B)	95.0% C.I. for EXP(B)		EXP (B)	95.0% C.I. for (B)	
		Lower	Upper		Lower	Upper		Lower	Upper
Regions									
Central®									
North	1.63	1.38	1.92	1.56	1.27	1.90	1.61	1.11	2.32
East	2.49	2.10	2.96	2.70	2.19	3.34	2.39	1.60	3.57
Northeast	1.82	1.53	2.16	1.61	1.29	2.02	1.00	0.60	1.66
West	6.92	5.73	8.35	5.77	4.59	7.24	5.14	3.30	8.01
South	17.67	14.79	21.12	15.20	12.15	19.00	8.02	5.25	12.25
Place of residence									
Rural®									
Urban	2.80	2.51	3.14	2.70	2.35	3.11	2.44	1.85	3.24
Religion									
Hindu®									
Muslim	0.83	0.74	0.93	0.88	0.75	1.03	0.96	0.69	1.32
Others	1.06	0.92	1.21	0.97	0.79	1.19	1.24	0.77	1.98
Caste of women									
Others®									
Scheduled caste	0.83	0.75	0.90	0.93	0.81	1.06	0.90	0.65	1.23
Scheduled tribe	0.53	0.47	0.61	0.58	0.48	0.70	0.57	0.37	0.88
Respondent education									
Illiterate®									
Literate but below primary	1.41	1.26	1.59	1.31	1.09	1.57	0.84	0.51	1.39
Primary but below middle	1.54	1.40	1.70	1.76	1.53	2.03	2.30	1.65	3.20
Middle but below high school	1.95	1.76	2.17	2.05	1.75	2.40	2.65	1.80	3.90
High school and above	3.44	3.06	3.87	3.81	3.19	4.56	2.61	1.65	4.14
Partner education									
Illiterate®									
Literate but below primary	1.15	1.01	1.31	1.04	0.85	1.28	1.43	0.90	2.27
Primary but below middle	1.24	1.12	1.38	1.15	0.98	1.35	1.08	0.75	1.55
Middle but below high school	1.27	1.14	1.41	1.31	1.12	1.54	1.20	0.82	1.75
High school and above	1.36	1.22	1.51	1.26	1.07	1.48	1.38	0.94	2.03
Wealth index									
Poorest®									
Poorer	1.46	1.29	1.65	1.46	1.22	1.75	1.09	0.85	1.38
Middle	2.23	1.97	2.52	1.97	1.64	2.37	1.55	1.02	2.35
Richer	3.57	3.12	4.08	2.82	2.32	3.43	2.22	1.42	3.47
Richest	8.58	7.30	10.07	5.87	4.62	7.46	3.75	2.10	6.68
Child loss									
None®									
At least one	1.22	1.11	1.34	1.20	1.06	1.37	1.46	1.12	1.90
Sex composition of living children									
No son and no daughter®									
No. of sons greater than daughters	1.22	0.91	1.63	2.09	0.99	4.44	2.57	0.11	59.55
No. of sons less than daughters	1.20	0.90	1.61	2.14	1.01	4.55	2.83	0.12	65.43
Equal sons and daughters	1.17	0.86	1.58	2.05	0.97	4.35	2.42	0.10	56.31
Ever had terminated pregnancy									
No®									
Yes	1.31	1.21	1.42	1.38	1.21	1.57	1.40	1.00	1.94
Child age (in months)									
0 - 23®									
24 - 35	0.98	0.91	1.06	0.78	0.65	0.95	0.53	0.12	2.34
36 - 47	0.83	0.76	0.90	0.72	0.60	0.87	0.60	0.15	2.48
48 - 59	0.82	0.74	0.90	0.66	0.55	0.79	0.51	0.12	2.07
Birth order									
Second order birth®									
1st order birth	2.09	1.91	2.30	2.33	2.06	2.65	1.88	1.39	2.54
3rd order birth	0.71	0.64	0.78	0.68	0.58	0.81	0.63	0.41	0.97
3+ order birth	0.63	0.57	0.70	0.59	0.49	0.70	0.73	0.49	1.11