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Application of Multinomial Logistic Regression Model in Maternal Health Care Service Utilization as Assistance During Delivery

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Abstract

Assistance during delivery is an important aspect of maternal health care services. Data is extracted from nationally representative sample of Nepal Demographic Survey 2006 and 2011. The unit of analysis for both studies is Ever Married Women who had at least one live birth in the five year preceding the survey. Two Multinomial Logistic Regression models were developed separately for 2006 and 2011 NDHS data to assess the influence of predictors on use of assistance during delivery. Considering model adequacy test such as goodness of fit tests (Deviance and Pearson's chi-square statistic), Negelkerke R^2 , Classification accuracy showed that both models fit well to the proposed multinomial logistic regression model. Comparing the values of odds ratio obtained from 2006 and 2011 surveys, it is found that the values are only slightly different for most of the predictors under consideration demonstrating consistency of associations found in the two surveys. Few variables like richest wealth index and ANC by Skilled birth attendant have shown marked shifts in their odds ratio between the two surveys.

Key words: Assistance during delivery, Ever Married Women, Multinomial Logistic Regression, Negelkerke R^2,

1. Introduction

Most life threatening complication occurs at the time of delivery or immediately postpartum and requires medical intervention, but it is difficult to predict and prevent these complications during antenatal period [13]. Therefore, to reduce maternal mortality and morbidity, the trend for safe motherhood programs has shifted from primary and secondary prevention to the ensuring of emergency obstetric care and skilled birth attendants [19]. Appropriate delivery care is important for the health of both the mother and the new born, especially if there are child birth complications. To reduce the risk of infection and so that

any complications can be effectively managed, it is important that mothers delivery in hygienic setting and in the presence of Skilled Birth Attendants (SBA) with suitable equipment and supplies. SBA is a professionally trained health worker, usually a doctor, midwife or nurse, with the skill to manage a normal labour and delivery, recognize complications early on and perform any essential interventions, start treatment and supervise the referral of mother and baby to the next level of care if necessary [18].

In developing countries, many women are still assisted in delivery by either traditional births attendants, relatives or their deliver by themselves. According to a report of UNFPA in 2004, only slightly more than half of all deliveries (56 percent) are assisted by skilled personnel [1]. De Bernis et al. stated that "The proportion of births attended by skilled health personnel was used as one of the important indicators to monitor progress towards the achievement of the millennium development goal of reducing maternal mortality rate". Skilled attendants are able to identify early signs of pregnancy complications and can offer immediate emergency obstetric care leading to reduction in maternal and infant mortality [7].

Studies have pointed out that the utilization of maternal health services is a complex behavioral phenomenon. Empirical studies of preventive and curative services have often found that use of health services is related to the availability, quality and cost of the services, that will undoubtedly influence on individual's decision. Other factors, such as the social structure, health belief and personal characteristics of the users and the community are also determining factors [2, 3, 10, 17].

There has been considerable debate in the literature as to whether the mere provision of health services will lead to increase utilization [3, 11, 16]. Provision of services may not be enough, as people will not make use of the available services if they do not have the perceived need to use them. Therefore, it has been argued that utilization of health services is affected not only by access but also by demand for services. People must be made aware of the importance and benefits of using such kind of services. Hence even after controlling for the availability of resources, some women are more likely to use maternal health services than others. This suggests that characteristics of health services may not be the only explanatory factors. Therefore the present study will examine the impact of socio-economic and demographic characteristics to explain why some women are more likely to use maternal health services during pregnancy while others are not. Hence this study will examine the socio-economic and demographic characteristic while controlling the accessibility factor.

2. Methods

2.1 Data

The data for this study is chosen from the Demographic Health Survey (DHS), 2006 and 2011 of Nepal. The 2006 NDHS and 2011 NDHS are third and fourth comprehensive survey conducted in Nepal as part of the world wide DHS project. The unit of analysis for both studies is Ever Married Women (EMW) who had at least one live birth in the five

year preceding the survey. For those EMW, who had more than one birth, only utilization behavior of maternal health services associated with most recent pregnancy within five years was considered, so the sample of this study consists of 4182 EMW for 2006 NDHS and 4079 EMW for 2011 NDHS. Details of the survey procedure and sampling design are available in the individual survey report [15, 16].

2.2 Variables

Dependent variable was created from questionnaires included in the maternal health component of the DHS questionnaire. As noted in the literature review, majority of maternal deaths and disabilities occur around the time of delivery. For this reason, delivery care represented by Assistance During Delivery (ADD) was selected as dependent variable. In this study, ADD is characterized as 'by no one', 'by Unskilled Birth Attendants (USBA)' and 'by Skilled Birth Attendants (SBA)'. Skilled birth attendants were defined according to WHO definition and included physicians, midwives, nurses, and assistant physicians. Maternal Child health (MCH) workers/Village Health Workers (VHW)/Traditional Birth Attendant (TBA) as unskilled birth attendant and relative/friend/ no help is considered as no utilization of assistance at delivery.

A number of socio-economic and demographic variables are taken into account based on scientific literature review. The independent variables are mixture of categorical and continuous variables. These variables are current age, education level (no education/ Primary/ secondary and higher), Birth in last five years (1/2/more than 2), wealth index (poorest/poorer/middle/richer/richest), Occupation (never work/agriculture sector/ modern sector), residence (rural/urban), ANC by provider (by no one/by informal sources/by SBA), religion (Hindu/others) and sex of household head (male/female).

2.3 Statistical Modeling

Descriptive analysis is performed to observe the difference in ADD with respect to different variables, which are likely to be associated with it. For building of suitable statistical models, various types of models were explored and different measure of models adequacy test were applied. Finally, two Multinomial Logistic Regression (MNLR) model were developed separately for 2006 and 2011 NDHS data to assess the influence of predictors on the use of ADD.

MNLR model is generally effective when the dependent variable is composed of polychotomous categories having multiple choices. This model can be understood as a simple extension of logistic regression that allows each category of an unordered response variable to be compared to an arbitrary reference category providing a number of logit regression models [9]. MNLR model is equivalent to the simultaneous estimation of multiple logit where each of the categories is compared to one selected base category. But if we would estimate them separately, we would loss information, as each logit would be estimated on a different sample (selected category plus base category, with all other categories omitted from analyses). To avoid that, we use MNLR model.

The assumptions for MNLR model are that the independent variables may either be numerical or categorical. The dependent variable has to be categorized into three or more groups. The data do not need to have a normal distribution, no linear relationship and no equality of variance. To run MNLR model, the minimum sample size required is 15-20 cases per independent variable. In this study, there are nine independent variables and hence sample size is sufficient to run MNLR model. Let y_{i1} be 1 if the i^{th} woman is assistance during delivery by no one and 0 otherwise. Similarly y_{i2} be 1 if the i^{th} woman is assistance during delivery by unskilled birth attendant and 0 otherwise. y_{i3} be 1 if the i^{th} woman is assistance during delivery by skilled birth attendant and 0 otherwise.

The distribution of the count Y_{ij} given the total n_i is given by the multinomial distribution.

$$\Pr\left(Y_{i1} = y_{i1,}..., Y_{ij} = y_{ij}\right) = \begin{pmatrix} n_i \\ y_{i1}, y_{i2,}..., y_{ij} \end{pmatrix} \pi_{i1}^{i1}.....\pi_{ij}^{ij} \tag{1}$$

We now consider models for the probabilities π_{ij}. In practice we would like to consider model where probabilities depend on a vector X_i of covariates associated with the i^{th} individual or groups. Perhaps the simplest approach to multinomial data is to nominate one of the response categories as a baseline or reference cell, calculate log odds of the other categories relative to the base line, and then let the log odds be a linear function of predictors.

Typically, we pick the last category as a baseline and calculate the odds that a member of group i fall in category j as opposed to the base line as $\frac{\pi_{i1}}{\pi_{ij}}$. In this study, attempt has been made to look at the odds of being 'assistance by SBA' rather than 'assistance by no one and odds of using 'assistance by USBA rather than 'assistance by no one". In our study J = 3 categories, we contrast category 1 versus 3 and 2 versus 3. The missing contrast between categories 1 and 2 can easily be obtained in terms of the other two. Since

$$\ln \frac{\pi_{i1}}{\pi_{i2}} = \frac{\pi_{i1}}{\pi_{i3}} - \frac{\pi_{i2}}{\pi_{i3}} \tag{2}$$

Since there are 4182 individuals in the data set of 2006 NDHS and 4079 in the data set of 2011, number from i =1 to n. If the outcome for individual i is in category 1, then we let y_{i1} be equal to 1 otherwise y_{i1} is equal to zero. We similarly create outcome variables y_{i2}, and y_{i3} to indicate whether the outcome is in category 2 or category 3.

$$Y_{ij} = \begin{cases} 1 \text{ if the individual fall in category } j \\ 0, \text{ otherwise} \end{cases} \tag{3}$$

Where, J =1,2,3, and

$$\text{let, } \pi_{ij} = \Pr\left(Y_{ij} = j \mid X\right) \tag{4}$$

denote the probability that $Y_{ij} = j$

Assuming that the response categories are mutually exclusive then it can be written as

$$\sum_{j=1}^{3} \pi_{ij} = 1 \tag{5}$$

Now consider model for π_{ij}. The logit of having $Y_{ij} = j$ as a linear function of the explanatory variables, that is

$$\ln \frac{\pi_{ij}}{\pi_{i1}} = \ln \frac{P(\mathrm{Y}_{ij} = \mathrm{j} \mid \mathrm{X})}{P(\mathrm{Y}_{ij} = 1 \mid \mathrm{X})} = \alpha_j + \sum_{k=1}^{g} \beta_{jk} X_k \tag{6}$$

Where j = 2, 3, andα_j is a constant

β_{jk} is the regression coefficient for j =2,3 and

X_k(k =1, 2, …, g) are explanatory variables.

The MNLR model may also be written in terms of probability π_{ij} rather than odds.

$$\pi_{ij} = \frac{e^{\alpha_j + \sum_{k=1}^{g} \beta_{jk} X_k}}{1 + e^{\alpha_j + \sum_{k=1}^{g} \beta_{jk} X_k}} \tag{7}$$

Estimation of the parameters of this MNLR model is done by what is known as iteratively reweighted least square, which is identical to the logarithm of fisher scoring or Newton-Raphsons, and lead to maximum likelihood estimates as shown by McCullagh and Nelder [12].

2.4 Model Adequacy Test

Once the particular MNLR model has been fitted, we begin the process of model assessment. Model-fit statistics interpreted is much the same way as for a standard logistic regression model. First step in the process is the overall model evaluations. The likelihood ratio scores and Wald test were examined to determine the improvement of MNLR model over the intercept model (also called null model). The overall goodness of fit of the estimated model is judged by deviance and Pearson's chi square as in logistic

regression model. To support the model, significance value greater than 0.05 is needed that is if p value for the Deviance and Pearson's chi square test is greater than 0.05, we will not reject the null hypothesis. It means that there is no difference between observed and model predicted values which suggest that the estimated model fit well to the MNLR model.

As MNLR model is not a linear model, we can't calculate R^2 directly as for linear regression model. A large pseudo R^2 indicate that more of the variation is explained by the model, from a minimum of 0 to maximum of 1. It should also be noted that pseudo R^2values tend to be very low for MNLR model, much lower than for linear regression model. This is because we are trying to predict the outcome whereas the MNLR model only given us the probability of outcomes.

A more useful measure to assess the utility of MNLR model is classification accuracy, which compare predicted group membership based on the MNLR model to the actual known group membership, which is the value of the response variable. The benchmark that will use to characterize, a MNLR model as useful is a 25 percent improvement over the rate of accuracy achievable by chance alone. The estimate of by chance accuracy that will use is the proportional accuracy rate, computed by summing the squared percentage of case in each group. Greater the classification accuracy than a proportional by chance accuracy suggest that the estimated model fit well to the MNLR model.

3. Results

3.1 Descriptive Analysis

Some descriptive analysis are performed to examine the difference in ADD with respect to different relevant variables which can be linked to ADD and changed in ADD observed in 2011 NDHS compared to 2006 NDHS. Table1 shows that the proportion of ADD by SBA increased from 20 percent in 2006 to 35 percent in 2011 even though 4 percent of women ADD by no one in 2011.

Table1. Distribution of use of ADD in NDHS 2006, 2011

Variables	Description	2006		2011	
		Freq.	percent	Freq.	percent
Assistance during delivery	By no one	316	7.6	155	3.8
	By unskilled birth attendant (USBA)	3015	72.1	2516	61.7
	By skilled birth attendant (SBA)	851	20.3	1408	34.5
		4182	100	4079	100

The mean age has remained almost same (27 years) in both surveys. Wealth index, religion and region have also showed no different in both surveys. More than 70 percent of women have one birth in last five years, which was higher than 2006 survey (66 percent). The secondary/ higher educated women were higher in 2011 NDHS (36 percent) as compared to 2006 NDHS (24 percent). It can be seen in table2 that 64 percent of the women's occupation were agriculture in 2011 as compared to 74 percent from 2006

NDHS. It is reported that approximately 59 percent of women have ANC by SBA in 2011 compared to 45 percent of women in 2006.

Table2. Socio- economic and Demographic characteristics in the sample data of Nepal, NDHS 2006, 2011

Variables	Description	2006		2011	
		Freq.	Percent	Freq.	percent
Age of women	Continuous variable	Mean = 27.04	Min =15 Max =49	Mean = 27.0	Min =15 Max =49
Religion	Hindu	3633	86.9	3480	85.3
	Others	549	13.1	599	14.7
Region	Scare (M. W & F. W)	1471	35.2	1320	32.4
	Moderate (E & W)	1680	40.2	1905	46.7
	Adequate (Central)	1031	24.6	854	20.9
Education Level	No education	2455	58.7	1765	43.3
	Primary	745	17.8	817	20.0
	Secondary or higher	982	23.5	1495	36.7
Wealth index	Poorest	1111	26.6	1160	28.4
	Poorer	866	20.7	832	20.4
	Middle	751	18	739	18.1
	Richer	773	18.5	677	16.6
	Richest	681	16.3	671	16.5
Birth in last five years	1	2740	65.5	2972	72.9
	2	1287	30.8	992	24.3
	3or more	155	3.7	115	2.8
Sex of household head	Male	3294	78.8	3002	73.6
	Female	888	21.2	1077	26.4
Currently working	No	1148	27.5	1513	37.1
	Yes	3034	72.5	2566	62.9
Husband's education*	No education	985	23.6	770	18.9
	SLC and below	2818	67.6	2779	68.1
	Above SLC	364	8.7	514	12.7
Occupation	Never work	750	17.9	962	23.6
	Agricultural sector	3099	74.1	2603	63.8
	Modern Sector	333	8.0	514	12.6
ANC by provider	By no one	1161	27.8	611	15.0
	By informal sources	1071	25.6	1079	26.5
	By SBA	1950	44.6	2389	58.5
Total		**4182**	**100**	**4079**	**100**

* There are some missing cases for this variable.

Table3 shows the Chi square test of POD by some independent variables. Most of the variables are found statistically significant in explaining the assistance during delivery for both 2006 and 2011 NDHS. Sex of the household head is found to be statistically not significant in both surveys. Religion is not significant for 2006 NDHS but significant for 2011 NDHS.

Table3. Chi square test of ADD by independent variables in NDHS 2006, 2011

Variables	2006		2011	
	χ^2	p value	χ^2	p value
Religion	2.89	0.236	11.72	0.003
Education level	780.7	<0.001	102.18	<0.001
Wealth index	718.83	<0.001	72.66	<0.001
Birth in last 5 years	125.46	<0.001	12.45	<0.001
Sex of household head	0.653	0.362	1.33	0.513
Currently working	196.9	<0.001	12.45	<0.001
Husband's education*	455.35	<0.001	351.27	<0.001
Occupation	470.57	<0.001	561.6	<0.001
ANC by provider	840.02	<0.001	700.53	<0.001
Residence	459.73	<0.001	445.79	<0.001
Region	81.77	<0.001	29.96	<0.001

* There are some missing cases for this variable.

3.2 MNLR Model

The overall fit of the model is assessed using the log likelihood (LL) statistics. In this analysis rather than reporting log likelihood itself, the value is multiplied by -2 (-2LL, which has approximately chi square distribution). At the final stage -2LL should be less than the value when only constant is included in the model (lower value of -2LL indicates that the model is predicated the outcome variable more accurately). When only constant was included, -2LL = 5657.763 (5671.664 for 2011NDHS) but when other variables have been included, this -2LL has been reduced to 4045.932 (4150.954 for 2011 NDHS). This reduction tells us that the model is better predicting output variable than it has only the constant included. The difference between these two measures follows a chi-square distribution with 30 degree of freedom and measures how well the independent variable affect the outcome or response variable. In this study chi square = 1611.831 (1520.714 for 2011NDHS). In the fitted models, the p values are highly significant so we can say that over all model is predicting ADD significantly better than it was only constant included.

3.3 Model Parameter Estimates and their Interpretations

Table 4 shows the estimated coefficients, odds ratios and the 95 percent confidence interval for ADD by USBA verses no one. For age, the MNLR coefficient of EMW is found to be -0.071(-0.060 for 2011 NDHS) and odds ratio is 0.93 (0.94 for 2011 NDHS) which can be understood as increase in one year of age, 7 (6 for 2011 NDHS) percent less of performing ADD by USBA verses no one. It is highly significant with p value <0.001 in both surveys. The place of residence did not show significant effect for the ADD by USBA verses anyone in both surveys. The odds ratio of performing ADD by USBA verses no one is 1.94 (1.16 for 2011 NDHS) times higher for EMW with a secondary/higher education relative to no education. It is significant with p value < 0.05 for 2006 but it did not show significant for 2011. The odd ratio of performing ADD by USBA verses no one is 1.89 times higher for EMW with a poorer relative to poorest and the rest three contrast variables are found to be insignificant for 2006. EMW with middle is found to have 2.81 odds of performing ADD by USBA verses no one compared to poorest but richer/ richest relative to poorest are found to

have insignificant. Corresponding to adequate regions is 1.99 (2.016 for 2011NDHS) times more likely to ADD by USBA verses no one compared with scare region. The odds ratio of performing ADD by USBA verses no one is about 68 percent (1-0.32 = 0.68) lower for EMW with 3 or more birth order and 33 percent (1- 0.67) lower for 2 birth order relative to one birth order but it is not significant for 2011. The odds ratio of performing ADD by USBA verses no one is 2.25 (2.97 for 2011NDHS) times higher for EMW with ANC provided by informal sources and 2.29 (2.95 for 2011NDHS) times higher for EMW with ANC by formal sources relative to ANC by no one. It is to be noted that estimated parameter coefficients of ANC provider are statistically highly significant with p value less than 0.001 for both survey. The odds ratio of performing ADD by USBA verses no one is 2.39 times higher for EMW with currently not working relative to currently working but it is not significant for 2011.

Table4. MNLR Estimates of the Odds Ratios of Selected Socio-economic and Demographic Characteristic on ADD by USBA verses ADD by no one

Variables	2006			2011		
	b(S.E)	e^b	95% CI for OR	b(S.E)	e^b	95% CI for OR
Constant	3.540***(0.341)			3.137***(0.42)		
Age	-0.071***(0.010)	0.931	0.914-0.949	-0.060***(0.01)	0.942	0.918-0.967
Residence:						
Rural(R)						
Urban	0.345(0.215)	1.412	0.926-2.152	0.088(0.31)	0.915	0.498-1.682
Education level:						
No edu (R)						
Primary	0.381*(0.174)	0.683	0.486- 0.960	-0.003(0.25)	1.003	0.613-1.639
Sec/higher	0.690*(0.186)	1.939	1.071 -3.512	0.145(0.32)	1.156	0.623-2.145
Wealth index:						
Poorest(R)						
Poorer	0.639***(0.181)	1.894	1.327-2.703	0.610*(0.24)	1.841	1.146-2.958
Middle	-0.038(0.177)	0.963	0.681-1.361	1.031**(0.36)	2.805	1.400-5.620
Richer	0.303(0.224)	1.354	0.873-2.101	0.196(0.30)	1.216	0.600-2.466
Richest	-0.368(0.319)	0.692	0.730-1.294	0.579(0.58)	1.784	0.568-5.603
Region:						
Scare(R)						
Moderate	0.308*(0.144)	1.361	1.020-1.386	0.548**(0.19)	1.793	1.231-2.614
Adequate	0.690***(0.186)	1.994	1.805-2.870	0.701*(0.28)	2.016	1.176-3.456
Birth order:						
1(R)						
2	-0.406**(0.135)	0.666	0.512-0.867	-0.236(0.19)	0.790	0.541-1.153
3 or more	-1.142***(0.245)	0.319	0.16-0.197	-0.533(0.40)	0.575	0.260-1.270
ANC by provider:						
No one (R)	0.813***(0.159)	2.254	1.652-3.075	1.089***(0.22)	2.971	1.922-4.591
Info sources	0.828***(0.172)	2.289	1.634-3.206	0.083***(0.29)	2.954	1.921-4.541
SBA						
Cur.working:						
Yes						
No	0.869***(0.226)	2.385	1.532-3.715	0.430(0.23)	1.538	0.974-2.428

C.I = Confidence Interval; Exp. = Exponent; R = Reference category, * = p < 0.05, ** = p < 0.01, *** = p = 0.001

Table5 shows the estimated coefficients, odds ratios, and the 95 percent confidence interval for ADD by SBA versus no one. For age, both surveys have nearly equal odds ratio (0.93for

2006 and 0.92 for 2011NDHS) which can be understood as increase in one year of age, 7 (8 for 2011) percent less of performing ADD by SBA verses no one. Both are highly significant with p value < 0.001. The odds ratio performing ADD by SBA verses no one is 1.94 (2.31 for 2011NDHS) times higher for EMW with a secondary/higher education relative to no education but it shows insignificant for primary education in both survey. ENW with richest is found to have 2.72 (10.14 for 2011NDHS) odds of performing ADD by SBA verses no one compared to poorest. It is significant at p value < 0.01for 2006 and highly significant (p < 0.001) for 2011but middle relative to poorest is insignificant for 2006. Similarly the odds of performing ADD by SBA verses no one is 3.05 (2.09 for 2011NDHS) times higher for EMW living in adequate region relative to scare region and it is highly significant. The odds ratio of performing ADD by SBA verses no one is about 85 (69 for 2011 NDHS) percent lower for EMW with 3 or more birth order relative to one birth order. Similarly, the odds ratio of performing ADD by SBA verses no one is 3.27 (6.47 for 2011NDHS) times higher for EMW with ANC provided by informal sources and 12.46 (16.48 for 2011NDHS) times higher for EMW with ANC by formal sources relative to ANC by no one. Both are highly significant.

Table5. MNLR Estimates of the Odds Ratios of Selected Socio-economic and Demographic Characteristic of ADD by SBA versus ADD by No One

Variables	2006			2011		
	b(S.E)	**e^b**	**95% CI for OR**	**B(S.E)**	**e^b**	**95% CI for OR**
Intercept	-0.210(0.468)			0.719(0.57)		
Age	-0.070***(0.013)	0.932	0.918-0.967	-0.089***(0.02)	0.915	0.888-0.942
Residence:						
Rural(R)						
Urban	0.888***(0.233)	2.431	1.541-3.834	0.572(0.32)	1.772	0.952-3.299
Education level:						
No education(R)						
Primary	0.012(0.212)	1.012	0.668-1.533	0.272(0.27)	1.312	0.776-2.219
Secondary/higher	1.942***(0.318)	3.740	8.639-12.99	0.838**(0.32)	2.312	1.222-4.375
Wealth index:						
Poorest(R)						
Poorer	0.883**(0.254)	2.418	1.469-2.980	1.005***(0.27)	2.732	1.611-4.631
Middle	0.274(0.251)	1.315	0.805-2.149	1.647***(0.37)	5.190	2.507-10.48
Richer	0.846**(0.279)	2.330	1.348-4.027	1.213**(0.38)	3.364	1.611-7.025
Richest	1.003**(0.356)	2.728	1.357-5.482	2.316***(0.59)	10.14	3.181-32.30
Region:						
Scare(R)						
Moderate	0.324(0.180)	1.383	0.972-1.979	0.461*(0.18)	1.585	1.055-2.382
Adequate	1.116***(0.221)	3.051	1.967-4.704	0.741*(0.29)	2.098	1.186-3.714
Birth in last 5 years:						
1(R)						
2	-1.021***(0.172)	0.360	0.257-0.504	-0.478*(0.21)	0.620	0.411-0.937
3 or more	-1.910***(0.408)	0.148	0.067-0.330	-1.170*(0.48)	0.310	0.120-0.803
ANC by provider:						
No one (R)						
Informal sources	1.187***(0.256)	3.277	1.984-5.412	1.868***(0.29)	6.475	3.671-11.421
SBA	2.523***(0.240)	12.461	7.792-19.929	2.802***(0.28)	16.48	9.553-28.435
Currently working:						
Yes						
No	1.036***(0.243)	2.818	1.749-4.539	0.796**(0.24)	2.217	1.378-3.567

C.I= Confidence Interval; Exp. = Exponent; R= Reference category, * = p < 0.05, ** = p < 0.01, *** = p = 0.001

3.4 Model Adequacy Test

Overall goodness of fit of the estimated model is judge by deviance and Pearson's chi square. Deviance residual is found to be 5791.651 at 5818 d.f. (5192.156 at 5660 d.f. for 2011) and Pearson's chi square is found to be 3565.790 (3594.07for 2011). Both are found to be statistically non-significant with p values of 0.99 (0.594) and 1.00 respectively. Non-significant p values suggest that the MNLR model fit well for the given data set. Negelkerke R^2 (pseudo R^2) measure the proportion of the variation in the dependent variable that can be explained by predictors in the model. Here R_N^2 = 0.411 and 0.392 for 2006 and 2011 NDHS respectively.

It should also be noted that pseudo R^2 values tend to be very low for logistic regression model, much lower than for linear regression model. A more useful measure to assess the utility of MNLR model is classification accuracy, which compare predicted group membership based on the MNLR model to the actual known group membership, which is the value of the response variable. The proportional by chance accuracy criteria is $1.25(0.076^2 + 0.721^2 + 0.203^2) = 70.85$ percent ($1.25(0.017^2 + 0.342^2 + 0.342^2) = 66.01$ percent for 2011 NDHS) since the classification accuracy rate was 77.9 percent (73.3 percent for 2011 NDHS) for which were greater than by chance accuracy. Hence the classification accuracy is satisfied in this study.

4. Discussion

The descriptive analysis showed the increasing trend of assistance during delivery by SBA, 20 percent from 2006 to 35 percent in 2011 but until the time of survey 62 percent assistance during delivery by USBA. In both survey mean age of women were 27 years. Majority of respondents are Hindu religion. Women with secondary/higher education level are increased 20 percent from 2006 to 37 percent in 2011. Around 24 percent in 2006 and 20 percent in 2011 of women's husband did not have education attainment.

MNLR models have been developed for 2006 and 2011 NDHS. Two of the independent variables (sex of household head and religion) are excluded from the model due to their insignificant association with ADD. Husband's education was excluded from the model due to missing observations. The model selection criterion for the inclusion of relevant variables in the models is based upon likelihood ratio criteria. Finally, in both surveys altogether 8 variables are found statistically significant. These variables are current age, education level (no education/ Primary/ secondary and higher), Birth in last five years (1/ 2/ more than 2), wealth index (poorest/ poorer/ middle/ richer/ richest), region (scare/ moderate/ adequate), residence (rural/ urban), ANC by provider (by no one/ by informal sources/ by SBA) and currently working (yes/ no).

However there is a debate in literature about women's age and ADD. The presents result showed the negative effect of age on ADD by SBA and USBA with reference to ADD by no one. This finding clearly indicated that younger women are more likely to AD by USBA and SBA that their older counterparts. Whereas many studies found a positive

correlation between age and the use of skilled attendants at child birth [5, 8, 16], others have found a curvilinear relationship [8].

It has been shown that increase in education level tended to have increased the use of SBA as assistance during delivery. This finding is consistent with many previous studies that showed education of women to be the most significant predictor of increased utilization of health services [3, 4, 5]. There are a number of reasons that education of women has a significant positive relation with maternal health care utilization. Educated women are more likely to realize the benefits of using maternal health services. Therefore, they are more likely to use the services. In addition, education may enhance female autonomy, hence, increasing women's ability to make decisions regarding their own health.

Women with birth order 3 or more, 85 percent less likely to ADD by SBA as compared to women with 1st birth order for 2006 NDHS. It is highly significant. This finding is similar with other studies [20]. One study from Bangladesh showed that women with parity of five or more were seen to have a low health seeking behavior when compared to those who had only one child. The possible explanation could be women who have more children usually do not have enough time to go to the health services. In addition to this as the number of children in the household increase there will also be scarcity of resources [6].

In both survey the strong positive association that has been shown to exist between ANC by provider and assistance during delivery, all are highly significant. Antenatal care by formal sources itself emerged as a most important factor for utilization of other services. Antenatal care provides the opportunity to educate women about danger signs of pregnancy, potential complications, where to seek help and importance of other maternal health care services. Additionally, helps to offer preventive care that will benefit the infant as well as the mother and to treat existing diseases that may be aggravated by pregnancy. Therefore, enabling women to get adequate antenatal care by formal sources may bring immediate change on utilization of other services and well-being of women. Similarly there was a strong positive association between working status and assistance during delivery in both survey but it is insignificant for delivery by USBA versus no one in 2011 NDHS.

5. Conclusion

There is no doubt that uses of maternal health services improve reproductive outcomes. In this analysis assistance during delivery is taken as dependent variable. This study identifies the factors which affect the ADD as maternal health services utilization by using MNLR model. Considering model adequacy test such as goodness of fit tests (Deviance and Pearson's chi-square statistic), Negelkerke R^2 , Classification accuracy (which compare predicted group membership based on the MNLR model to the actual known group membership) showed that both models fit well to the proposed MNLR model. It is important that programmed aimed at improving maternal health include

targeting women, especially those from rural areas, with low level education, higher birth order and from poor household given their high risk during pregnancy.

Comparing the values of odds ratio obtained from the analysis carried out based on the NDHS2006 and 2011, it is found that the values are only slightly different for most of the predictors under consideration demonstrating consistency of associations found in the two surveys. Few variables like richest wealth index and ANC by SBA have shown marked shifts in their odds ratio between the two surveys.

Conflict of interest

The author declares that she has no competing interest.

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