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Factors Influencing the Choice of Place of Delivery of a First Child among Nigerian Women

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Abstract

Among the factors responsible for maternal deaths in developing countries is complications during pregnancy and childbirth, and as such, the choice of place for delivery is vital as the quality of attention received can either aid or reduce the risks attached to child bearing. This study seeks to statistically model factors that determine the place of delivery in Nigeria among women of reproductive age taking into consideration possible nesting structure in the mode of data collection. A two-level hierarchical multilevel logistic model with the individual women as the lower level and the state of residence as the second level was applied to 2018 Nigeria Demographic Health Survey (NDHS) data. Results showed that the odd of choosing a government or private facility reduced by 58.6% and 85.9%, respectively. Women in the rural areas are 12% and 20% less likely to choose either a government or private facility, additional education increases the odd of choosing any of the two facilities against home delivery. Other significant variables were wealth index, religion, assistance during labour and the number of antenatal visits.

Keyword: Place of delivery, Nesting, Multilevel Logistic Model, Odds and Antenatal Care.

Introduction

According to the World Health Organization, 99% of maternal deaths occur in developing countries, and nearly half of these take place in Sub-Saharan Africa (United Nations 2015). Furthermore, women living in Sub-Saharan Africa have higher risks of dying while giving birth than women in any other region of the world. In Nigeria, there has been a non-significant increase in the maternal mortality ratio from 545 deaths per 100,000 live births in 2008 to 576 deaths per 100,000 live births in 2013 according to the Nigerian Demographic and Health Survey (NDHS). According to WHO (2019a, 2019b), about 34% of global maternal deaths occur in Nigeria and India alone (Adam et al. 2005, WHO 2020).

Kitui et al. (2013) and Cameron et al. (2019) pointed out that among the factors responsible for the high number of maternal deaths in developing countries are complications during pregnancy and childbirth which include obstructed labour, sepsis, haemorrhage and hypertensive disorders. Hatt et al. (2009) observed that the high proportion of women who delivered at home does not allow these complications to be handled by qualified skilled birth attendants. Sixty-three per cent of live births took place at home and this was twice as likely in the rural locations than urban settings (NPC and ICF 2014). More so and in

the same report, the proportion of women who delivered at home decreased with increasing wealth index while women who delivered in government or private hospitals/clinics increased with increasing wealth status. Therefore, increasing the percentage of births delivered in health facilities is an important element in reducing deaths arising from complications of pregnancy as adequate care is guaranteed.

Additionally, in order to improve maternal, neonatal and fetal health care, the focused antenatal care (ANC) or four-visit ANC model outlined by the World Health Organization (WHO) are required (WHO 2016). ANC model with a minimum of eight contacts was recently recommended as part of the sustainable development goals (SDG) to reduce perinatal mortality and improve women's experience of care thereby replacing the focused ANC guidelines (WHO 2016, Federal Ministry of Health Nigeria 2017). This can be a mirage for women in rural developing countries without consolidated interventions. WHO (2016) listed the essential interventions in ANC to include identification and management of obstetric complications such as pre-eclampsia, tetanus toxoid immunisation, intermittent preventive treatment for malaria during pregnancy (IPTp) and identification and management of infections including HIV, syphilis and other sexually transmitted infections (STIs). Despite these benefits from ANCs, the choice of home for deliveries by rural women is still preferred (Sialubanje et al. 2015, Sarker et al. 2016)

Utilization of health facilities is hampered by several factors depending on the tribe, location and affluence. According to the NPC 2013 in Nigeria, women gave the following reasons for not utilizing health care services which include cost, facility not open, distance to health facility, poor quality service, no female provider at facility, husband did not allow, not necessary, child born suddenly before going to facility, socioeconomic factors and personal health beliefs. Early researches revealed that individual factors including maternal age, parity, education and marital status, household factors including family size, household wealth, and community factors including socioeconomic status, community health infrastructure, region, rural/urban residence, available health facilities, and distance to health facilities determine place of delivery as these factors interact in diverse ways in each situation to determine place of delivery (Kitui et al. 2013). Subtle differences lie in the choice between private and government facilities. While some women prefer the private facilities due their perceptions for quality service, efficiency, accountability and sustainability, other women prefer the government facilities for reasons such as equitability and evidence-based care (Andaleeb 2000, Basu et al. 2012). Therefore, this study seeks to statistically model factors that determine the place of delivery in Nigeria among women of reproductive age.

In this study, a two-level hierarchical structure multilevel logistic model is proposed. The model is thereafter applied to study factors that determine the choice of place of delivery in the 2018 Nigerian Demographic Health Survey (NDHS) data among women of reproductive age and to account for the variations in the choice of place delivery that stems out from the different states of residence of the women.

Materials and Methods

The Logistic Regression Model

Suppose that we have k independent observations $y_1, y_2, \dots y_k$, and that the ith observation can be treated as a realization of a random variable Y_i. We assume that Y_i has a binomial distribution. The logit of the underlying probability π_i is a linear function of the predictors

$$logit(\pi_i) = x'\beta \quad (1)$$

Exponentiating Equation (1), the odds for the *ith* unit are given by

$$\frac{\pi_i}{1-\pi_i} = exp(x'\beta) \quad (2)$$

Solving for the probability π_i in the logit model in Equation (2) gives the model

$$\pi_i = \frac{exp(x'\beta)}{1+exp(x'\beta)} \quad (3)$$

When a response variable follows a multinomial distribution, its relationship with a set of explanatory variables can be investigated using logit link as a class of generalised linear models. Fitting a multinomial logit model when all the explanatory variables are categorical is equivalent to fitting a log-linear model for a multi-way contingency table (Agresti 1990).
Suppose Y is a categorical response variable with J-categories, the multinomial logit model for nominal response variables simultaneously describes log odds for all $J-1$ pairs of categories.
Let $\pi_j = pr[Y = j/X]$ at a fixed setting of vector of explanatory variable $X = [X_1, X_2, \dots, X_p]$.
The model,

$$log\left(\frac{\pi_j}{\pi_J}\right) = \beta_0 + \beta_j X, \quad j = 1, \dots, J-1, \quad (4)$$

(Agresti 1996) where J is the baseline category, simultaneously describes the effect of $X's$ on these $J-1$ logits. The effect varies according to the response paired with the baseline. Then, the logit model pairs each response category with the base category (Agresti 1996). Suppose the last category is chosen as the base category, then we need to fit J-1 models, i.e.

$$log\left(\frac{\pi_j}{\pi_J}\right) = \beta_0 + \beta_{j1}X_1 + \cdots + \beta_{jP}X_P, \quad j = 1, \dots, J-1, \quad (5)$$

The $J-1$ equations above are then fitted simultaneously to obtain the estimates of all regression coefficients.

The Multilevel Logistic Regression Model

The multilevel regression model is also known as mixed linear model, random coefficient model, hierarchical linear model. It assumes hierarchical data with the response variable measured at lowest level, while the explanatory variables can exist at all levels.

In a two-level multilevel regression model with levels 1 and 2, the response variable is a binary indicator y_{ij} and the explanatory variables x_{ij} are measured at the lowest level, while the explanatory variable z_j are measured at the second (higher) level. y_{ij} is a realization of a random variable Y_{ij} that take the values one and zero with probabilities π_{ij} and $1-\pi_{ij}$, respectively. Separate level 1 models are developed for each level 2 units. These models are also called within-unit models as they describe the effect in the context of a single group (Gill 2003). The separate regression equation for each group is given as

$$log\left\{\frac{\pi_{ij}}{1-\pi_{ij}}\right\} = \beta_{0j} + \beta_{1j}x_{ij} + e_{ij} \quad (6)$$

where y_{ij} is the dependent variable measured for the ith level 1 unit nested within the jth level 2 unit with probability π_{ij}, x_{ij} is the value on the level 1 prediction, β_{0j} is the intercept for the jth level 2 unit, β_{1j} is the regression coefficient associated with x_{ij} for the jth level 2 unit and e_{ij} is the random error associated with the ith level 1 unit nested within the jth level 2 unit.

The regression coefficients carry a subscript j indicating that they may vary across the level 2. These are modelled by explanatory variables and random residual term at the level 2. Level 2 models are also referred to as between-unit models as they describe the variability across multiple levels (Gill 2003). Considering the case of a single level 2 predictor, the model is given as

$$\beta_{0j} = \gamma_{00} + \gamma_{01}z_j + u_{0j} \quad (7)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}z_j + u_{1j} \quad (8)$$

where z_j is value on the level 2 predictor, γ_{00} is the overall mean intercept adjusted for z, $\gamma_{10}$is the overall mean intercept adjusted for z, γ_{01} is the regression coefficient associated with z relative to level 1 intercept, $\gamma_{11}$is the regression coefficient associated with z relative to level 1 slope, u_{0j} is the random effects of the jth level 2 unit adjusted for z on the intercept and u_{1j} is the random effects of the jth level 2 unit adjusted for z on the slope.

Substituting Equations (7) and (8) into Equation (6), it gives a single-equation of the multilevel regression model

$$logit\left\{\frac{\pi_{ij}}{1-\pi_{ij}}\right\} = \gamma_{00} + \gamma_{10}x_{ij} + \gamma_{01}z_j + \gamma_{11}z_j x_{ij} + u_{ij}x_{ij} + u_{0j} + e_{ij} \quad (9)$$

assuming there are p-explanatory variables at the lowest level and q-explanatory variables

at the higher level, then, Equation (9) becomes

$$logit\left\{\frac{\pi_{ij}}{1-\pi_{ij}}\right\} = \gamma_{00} + \sum_p \gamma_{p0}x_{pij} + \sum_q \gamma_{0q}z_{qj} + \sum_p \sum_q \gamma_{pq}z_{qj}x_{pij} + \sum_p u_{pj}x_{pij} + u_{0j} + e_{ij} \quad (10)$$

The γ are the regression coefficients, *u* are the residuals at the group level and the *e* is the residual at the lowest level.

The probability can be written as

$$\pi_{ij} = \frac{exp\{\gamma_{00}+\sum_p \gamma_{p0}x_{pij}+\sum_q \gamma_{0q}z_{qj}+\sum_p \sum_q \gamma_{pq}z_{qj}x_{pij}+\sum_p u_{pj}x_{pij}+u_{0j}+e_{ij}\}}{1+exp\{\gamma_{00}+\sum_p \gamma_{p0}x_{pij}+\sum_q \gamma_{0q}z_{qj}+\sum_p \sum_q \gamma_{pq}z_{qj}x_{pij}+\sum_p u_{pj}x_{pij}+u_{0j}+e_{ij}\}} \quad (11)$$

The proportion of variance in the population explained by the hierarchical structure is given by the intra-class correlation ρ which is estimated using the null model, that is, the model with no explanatory variable, called the intercept-only model;

$$logit\left\{\frac{\pi_{ij}}{1-\pi_{ij}}\right\} = \gamma_{00} + u_{0j} + e_{ij} \quad (12)$$

The intra-class correlation ρ is estimated by the equation:

$$\rho = \frac{\sigma_{u0}^2}{\sigma_{u0}^2 + \pi^2/_3} \quad (13)$$

Application of multilevel logistic regression model to data on place of delivery of first birth

The 2018 Nigeria Demographic and Health Survey (NDHS) data set were analyzed. A sample individual data for 20957 women whose information were complete are used. The survey was designed to provide information at zone and state levels. Information on the place of delivery of the first child was collected from the women. The data captures the 36 states and Federal Capital territory in Nigeria. As a result, the data is hierarchical in structure with level 1 (individuals) nested within level 2 (States).

The information collected on woman *i* from state *j* was recorded as (y_{ij}, (i=1…20957), (*j*=1… 37). The place of birth is divided into three categories; home, private owned facility and government owned facility. The hierarchical structure of the dataset as used in this study is therefore described as follows:

Individual level*:* The place of delivery of first birth of the individual woman is considered the lowest level and the unit of analysis in this study.

State level*:* Each woman belongs to one of the 37 distinct geographical locations (districts) that represent the states.

The response variable (place of delivery) is grouped into three non-overlapping nominal categories (home, government facility and private facility) measured at the individual level (lowest level), while the independent variables include; place of residence (rural and urban), highest education attained (no education, primary, secondary and higher), religion (Islam and Christianity), wealth index (poor, middle and rich), number of antenatal visits (less than four visits and four and above), assistance during labour (professional and non-professional), birth cohort (less than 20 years, 20-29 years and 30 years and above) and age at first birth (less than 18 years and at least 18 years).

Thus, a two multilevel model for the two-hierarchical level model is fitted. The categorisation is given as

$$k = \begin{cases} 0\ for\ delivery\ at\ home \\ 2\ for\ delivery\ at\ government\ facility \\ 3\ for\ delivery\ at\ private\ establishment \end{cases}$$

Consequently, we define

$$y_{ijk} = \begin{cases} 1\ if\ the\ ith\ woman\ is\ from\ state\ j\ and\ delivered\ at\ k(2,3) \\ 0\ if\ the\ ith\ woman\ is\ from\ state\ j\ and\ delivered\ at\ home \end{cases}$$

where group 0 (home) is the baseline category.

The model to be estimated is given as

$$logit\left\{\frac{\pi_1}{\pi_0}\right\} = \gamma_{00} + \gamma_1 Rural + \gamma_2 Middle + \gamma_3 Rich + \gamma_4 Primary + \gamma_5 Secondary + \gamma_6 Higher + \gamma_7 Christian + \gamma_8 Age + \gamma_9 Nvisit + \gamma_{10} Cohort2 + \gamma_{11} Cohort3 + u_{0j(state)} + e_{ijk(individual)} \quad (14)$$

The overall aim is to assess the extent to which the observed factors at various levels (individual and state) affect the place of delivery of the first birth where $e_{ijk(individual)}$ is nested within $u_{0j(state)}$. The variances σ^2_e *and* σ^2_{uo} represent the variances of random effects due to individual and state, respectively. The higher the value of σ^2_e the greater the degree of differences in the individual women place of delivery of first birth. Also, the higher the value of σ^2_{uo}, the greater the degrees of differences induced by state clustering.

Since there is possibility of having some of the individual levels (level 1) predictors to vary across the states, a post hoc test is carried out to know whether the variables vary and to know whether the random coefficient model is better than the random intercept model by using the log likelihood ratio test.

Results

Table 1 presents the places of delivery based on background characteristics of the women. Overall, a little above two-thirds (68%) of rural women had their last deliveries in homes compared to a third in urban settings. These percentages are indication that women in the rural areas have more of home delivery of their first child than women who reside in the urban areas of the country.

Table 1: Background characteristics and place of delivery

		Place of delivery		
Background characteristics	**Home N (%)**	**Private N (%)**	**Govt. N (%)**	**Total N (%)**
Location				
Urban	2700 (37.0)	2998 (41.0)	1606 (22.0)	7294 (34.8)
Rural	9520 (68.1)	990 (15.2)	3153 (16.7)	13663 (65.2)
Wealth index				
Poor	7910 (81.1)	347 (3.6)	1491 (15.3)	9748 (19.2)
Middle	2400 (54.6)	505 (11.5)	1487 (33.9)	4392 (20.1)
Rich	1910 (28.0)	1744 (25.6)	3163 (46.4)	6817 (20.3)
Highest level of education				
No education	7971 (84.7)	163 (1.7)	1273 (13.5)	9407 (41.8)
Primary	1823 (56.4)	349 (10.8)	1060 (32.8)	3232 (20.2)
Secondary	2226 (33.8)	1496 (22.6)	2889 (43.7)	6611 (29.8)
Higher	200 (11.7)	588 (34.4)	919 (53.8)	1707 (8.2)
Age at first birth				
<18 years	5798 (75.1)	373 (4.8)	1551 (20.1)	7722 (56.5)
18+ years	6422 (48.5)	2223 (16.8)	4590 (34.7)	13235 (43.5)
Religion				
Islam	9272 (73.9)	579 (4.6)	2698 (21.5)	12549 (43.7)
Christianity	2948 (35.1)	2017 (24.0)	3443 (40.9)	8408 (56.3)
Number of antenatal visits				
< 4	7548 (84.3)	320 (3.8)	1085 (12.1)	8953 (40.9)
4+	4672 (38.9)	2276 (19.0)	5056 (42.1)	12004 ()
Birth cohort				
< 20 year	8606 (71.6)	705 (5.9)	2704 (22.5)	12015 ()
20-29 years	3460 (42.1)	1610 (19.6)	3150 (38.3)	8220 ()
30 + years	154 (21.3)	281 (38.9)	287 (39.8)	722 (59.1)
Total	12220 (58.3)	2596 (12.4)	6141 (29.3)	**20957 (**100.0**)**

Deliveries in private or government health facilities were higher among dwellers of urban locations. With regards to the women's education, the proportion of women who delivered at home decreased from 85% among women with no education to 18% among women with higher education. Religiosity indicates the predominance of Muslim women delivering at home compared to their Christian counterparts. The women's wealth indices showed a decrease in the proportion of home deliveries as the wealth index rises for women who delivered at home, while the converse is true for women delivering in any of the health facilities with the government showing a gradual ascent. Overall, younger women reported more deliveries at home (75%) than older women (49%), whereas majority (84%) of women who claimed delivery at home have inadequate number of antenatal visits.

Table 2 presents the results for the intercept only model for delivering at government establishments and private hospitals. A simple model with no predictors was first fitted, an intercept-only model that predicts the probability of delivering at government establishment. As observed from the Table 2, the odd of women giving birth to their first child in government facility and private facility decreased by 58.6% and 85.9%, respectively.

The model is given as

$$logit\left\{\frac{\pi_i}{\pi_{home}}\right\} = \gamma_{00}$$ i = government or private facility (15)

Table 2: Intercept only model

Place of delivery	Coefficient (β)	Odd ratio	Std. error	P-value	95% CI (β)	
Govt.	-0.8807	0.4145	0.021	<0.0001	-0.9105	-0.851
Private	-1.9563	0.1414	0.0152	<0.0001	-1.9974	-1.9152

Table 3 presents the Null Model with Random intercept without the inclusion of variables to calculate the intra-class correlation coefficient between the states for both government and private facilities against home. The intra-class correlation coefficient represents the percentage of variation in place of delivery of first child from the state.

$$\rho = \frac{\sigma_{u0}^2}{\sigma_{u0}^2 + {\pi^2}/{3}} \quad (16)$$

Using Equation (16), the intra-class correlations at state level were estimated as 0.1731 and 0.5812 for government and private facilities against home. It indicates that 17.3 per cent of the odds of delivering at government facility to home as place of delivery stems from differences among the states, while 58.1 per cent of the odds of delivering at private facility to home as place of delivery stems from differences among the states.

Table 3: The Null model with random intercept

Place of delivery	Coefficient (β)	Odd ratio	Std. error	P-value	95% Conf. Int. (β)	
Government facility (Constant)	-0.7899	0.4539	0.1375	<0.0001	-1.0594	-0.5204
Private facility (Constant)	-2.7114	0.0664	0.347	<0.0001	-3.3915	-2.0313
Random intercept	**Estimate (σ_{u0}^2)**		**Std. Dev.**		**95% Conf. Int.**	
Government facility state (Variance)	0.6885		0.1633		0.4325	1.096
Private state (Variance)	4.5664		1.1986		2.7299	7.6383

The test to know whether there is significant difference between varying intercept model and varying coefficient model gives Prob > 0.05 indicating that there is no statistically significant difference between the two models. Therefore, the result of the varying intercept model with individual level predictors is upheld. Further discussions of effects of the observed factors on factors influencing the place of delivery and the level variances are therefore based on Model 14.

Table 4 presents the varying intercept model with the individual level predictors. No variable was declared for the state level as they account for the hierarchical nature of the data. Comparison of births at government facility to births at home, showed that women living in the rural areas are 13% less likely to deliver at government facility and 20% less likely to deliver at private facility compared to women living the urban areas.

Also, increase in wealth index of the women improves the odds of delivering in either government or private facilities to home when compared with women in the poor category of the wealth index. Additional educational level increases the odd of giving birth at government facility to giving birth at home by 1.8, 2.1 and 2.5 times for primary, secondary and higher educational levels, respectively. This is also true of giving birth in a private facility compared to home, the odd of giving birth in private facility to giving birth at home increase by 1.6, 2.3 and 3.3 times for primary, secondary and higher educational levels, respectively. Women whose ages at first birth are at least 18 years are 1.2 and 1.3 times more likely to give birth in government and private facilities, respectively than home compared to women who are younger than 18 years at first birth.

Table 4: Varying intercept model with individual level covariates

	Government facility		**Private facility**	
Fixed effect	**Coef. (β)**	**Odd ratio**	**Coef. (β)**	**Odd ratio**
Location of residence				
Rural	**-0.1438	0.8661	**-0.2289	0.7954
Wealth index				
Middle	**0.5950	1.813	0.1176	1.1248
Rich	**0.7805	2.1826	**0.4336	1.5428
Highest educational qualification				
Primary	**0.5978	1.8181	**0.4666	1.5946
Secondary	**0.7595	2.1372	**0.8385	2.3129
Higher	**0.9012	2.4626	**1.1837	3.2664
Age at first birth				
>17 years	**0.1540	1.1665	**0.2577	1.294
Religion				
Christianity	**0.2124	1.2366	0.0548	1.0563
Number of antenatal visits				
4+	**1.1080	3.0283	**0.6109	1.8421
Assistance during labour				
Professional	**5.0951	163.2202	**5.3521	211.051
Birth cohort				
20–29 years	0.0754	1.0783	**0.2865	1.3318
>29 years	-0.1747	0.8397	**0.6351	1.8872
Constant	**-2.6216	0.0727	**-3.9609	0.0191
Random effect	**Estimate**		**Estimate**	
State	0.3423		2.5867	

** Indicate the variables that are significant at 5% level of significance.

Christian women are 1.2 and 1.1 times more likely to deliver in the government and private facilities, respectively compared to Muslim women. Women with the recommended (4+) number of antenatal visits are 3 and 1.8 times more likely to deliver at government and private facilities, respectively compared to women who do not have up to the minimum required number of four antenatal visits as specified by WHO (WHO 2016). The birth cohort of the women were not significant in determining the odd of giving birth in the government facility against home delivery, but women who had 20–29 years were 1.3 times more likely to give birth in the private facility than women who were less than 20 years, while women who were above 29 years were 1.8 times more likely to give birth in the private facility than women are less than 20 years. Women who deliver in private hospitals have a higher likelihood of being attended to by health professionals.

Discussion

The study revealed that majority of the rural dwellers among the women preferred home as place for the delivery of their first births, while very few among them went to either government or private facilities (Sialubanje et al. 2015, Sarker et al. 2016). The reason for the choice of home delivery among the women dwelling in the rural areas could be associated with lack of adequate healthcare facilities and personnel, even where they exist; they are long distances away from the reach of most rural dwellers as pointed out by Adedini et al. (2014).

The finding that women whose wealth status are wealthier are more likely to deliver in government or private facilities more than their poor counterparts has also been presented in other studies (Letamo and Rakgoasi 2003, Kitui et al. 2013, Dickson et al. 2016, Shahabuddin et al. 2017, Yaya et al. 2019). This finding proves the continual inability of the poor to access optimum care as they cannot afford it. This invariably determines the number of times that they might be able to attend ANC for any pregnancy. The financial status of the poor could be the cause of the disparity in the choice of place of delivery as poor women might have financial challenges in meeting the demands of government or private health facilities.

The study showed that educated women are more likely to choose from government or private owned facilities to home delivery as also revealed in previous studies (Idris et al. 2006, Envuladu et al. 2013, Kitui et al. 2013, Okeshola and Sadiq 2013, Egharevba et al. 2017, Gebregziabher et al. 2019, Ofonime et al. 2020). The level of education is a significant factor because basic education is needed to comprehend health education materials, which in turn helps in making better health choices including the choice of place of delivery.

Religion affiliation of the women was found to have significant effects on the choice of place of delivery of the first child. This was similar with some previous studies where Christian women were more likely to deliver in government or private health facilities as compared to Muslim mothers (Solanke et al. 2015, Umar and Bawa 2016, Shahabuddin et al. 2017). The pathways in which religion affects the choice of place of delivery need to be addressed among the religious leaders as their teachings have great influence on their followers (Al-Mujtaba et al. 2016).

The number of ANC visits before delivery is also a significant factor in the choice of place of delivery as women who have the basic minimum of four visits as recommended by WHO are more likely to give birth at either government or private health facilities than those who do not have the minimum number of visits. This could be due to the fact that increased contact time with health care providers during ANC visits creates a platform to put emphasis on the importance of the type of facility to choose during delivery (Bako et al. 2017, Boah et al. 2018).

Conclusion

The study was carried out on place of delivery of first child among Nigerian women using dataset from 2018 Nigeria Demographic and Health Survey (NDHS).

For the study, a two-level model which accounts for hierarchical structure of the data was used. The individual women place of delivery was considered as the lower level nested in the states. The hierarchical structure was introduced to account for the amount (percentage) of variability in the choice of places of delivery that exist among the different states of residence of the women. Variability in the choice of delivering of first children lies in the differences among the states. Results of the post hoc test revealed that varying intercept model is not significantly different from the varying coefficient model.

The study found out that rural dwellers among the women choose home delivery more than their counterparts in the urban areas. Maternal education is a major factor influencing the places of delivery among the women because assimilation of health information is a function of educational level of an individual as education and information are interwoven, therefore more attention should be drawn to improving the educational status of women in order to improve the utilization of maternal health services. To address the effects of religion on the choice of places of delivery, health education programs should include religious leaders as target audiences. In order to bridge the gap between the rich and the poor in accessing government or private health facilities for deliveries, women empowerment programmes should be introduced particularly in the rural areas to improve their economic status. The result of these findings showed that the number of ANC visits has great influence on the choice of places of delivery; this is a wake-up call to encourage women on the adoption the WHO guideline on minimum of 4 ANC visits by the health authorities, at all levels of health services delivery. Finally, more efforts should be made in making maternal health services accessible and acceptable by women irrespective of the socioeconomic status.

Ethical Approval

Permission to use data from NDHS 2018 was obtained through online registration with Macro International Incorporation via the DHS website (www.measuredhs.com). Respondent confidentiality was intact as no names and addresses were included in the data set and therefore the respondents cannot be traced by the researcher.

Conflict of Interest

The authors declare no conflict of interest.

References

Adam T, Lim SS, Mehta S, Bhutta ZA, Fogstad H, Mathai M, Zupan J and Darmstadt GL 2005 Cost effectiveness analysis of strategies for maternal and neonatal health in developing countries. *Bri. Med. J. (Clin. Res. Ed.)* 331: 1107-1110.

Adedini SA, Odimegwu C, Bamiwuye O, Fadeyibi O and De Wet N 2014 Barriers to accessing healthcare in Nigeria: Implications for child survival. *Glob. Health Act.* 7(1):23499.

Agresti A 1990 Categorical Data Analysis. John Wiley & Sons, New York.

Agresti A 1996 Introduction to Categorical data Analysis. John Wiley & Sons, New York.

Al-Mujtaba M, Cornelius LJ, Galadanci H, Erekaha S, Okundaye JN, Adeyemi OA, Sam-Agudu NA 2016 Evaluating religious influences on the utilization of maternal health services among Muslim and Christian women in north-Central Nigeria. *BioMed Res. Int*. 2016: 1-8.

Andaleeb SS 2000 Public and private hospitals in Bangladesh: Service quality and predictors of hospital choice. *Heath Pol. Plan*. 15: 95-102.

Bako IA, Ukpabi ED and Egwuda L 2017 Utilization of antenatal and delivery services: A cross sectional survey of mothers in Makurdi, Benue State, Nigeria. *J. Fam. Med. Comm. Health* 4(2): 1104-1110.

Basu S, Andrews J, Kishore S, Panjabi R and Stuckler D 2012 Comparative performance of private and public healthcare systems in low- and middle-income countries: a systematic review. *PLoS Med*. 9(6): 1001244.

Boah M, Mahama AB and Ayamga EA 2018 They receive antenatal care in health facilities, yet do not deliver there: predictors of health facility delivery by women in rural Ghana. *BMC Pregnancy Childbirth* 18: 125.

Cameron L, Suarez DC and Cornwell K 2019 Understanding the determinants of maternal mortality: An observational study using the Indonesian population census. *PLoS One* 14(6): 0217386.

Dickson KS, Adde KS and Amu H 2016 What influences where they give birth? Determinants of place of delivery among women in rural Ghana. *Int. J. Reprod. Med.* 2016.

Egharevba J, Pharr J, Wyk B and Ezeanolue E 2017 Factors influencing the choice of child delivery location among women attending antenatal care services and immunization clinic in Southeastern Nigeria. *Int. J. MCH & AIDS* 6(1): 82–92.

Envuladu EA, Agbo HA, Lassa S, Kigbu JH and Zoakah AI 2013 Factors determining the choice of a place of delivery among pregnant women in Russia village of Jos North, Nigeria: achieving the MDGs 4 and 5. *Int. J. Med. Biomed Res.* 2(1): 23-27.

Federal Ministry of Health Nigeria 2017 Antenatal Care: An Orientation Package for Health Care Providers.

Gebregziabher NK, Zeray AY, Abtew YT, Knife TD and Abrha DT 2019 Factors determining choice of place of delivery: analytical cross-sectional study of mothers in Akordet town, Eritrea. *BMC Pub. Heath* 19: 924

Gill J 2003 Hierarchical linear models. Academic Press, New York.

Hatt L, Stanton C, Ronsmans C, Makowiecka K and Adisasmita A 2009 Did professional attendance at home births improve early neonatal survival in Indonesia? *Health Pol. Plan*. 24(4): 270–278.

Idris SH, Gwarzo UMD and Shehu AU 2006 Determinants of place of delivery among women in a semi-urban settlement in Zaria, Northern Nigeria. *Ann. Afr. Med.* 5(2): 68-72.

Kitui J, Lewis S and Davey G 2013 Factors influencing place of delivery for women in Kenya: an analysis of the Kenya demographic and health survey, 2008/2009. *BMC Preg. Childbirth* 13: 40.

Letamo G and Rakgoasi SD 2003 Factors associated with non-use of maternal health services in Botswana. *J. Health Pop. Nut.* 21(1): 40–47.

National Population Commission (NPC) [Nigeria] and ICF International 2014 Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International.

Ofonime EJ, Obidike PC, Eroh MU, Okpon AA, Bassey EI, Patrick PC, Ebong PE and Ojumah E 2020 Choices and determinants of delivery location among mothers attending a primary health facility in Southern Nigeria. *Nig. Postgra. Med. J.* 27: 42–48.

Okeshola FB and Sadiq IT 2013 Determinants of home delivery among Hausa in Kaduna South Local Government Area of Kaduna State. *Nig. Am. Int. J. Cont. Res*. 3(5): 78–85.

Sarker BK, Rahman M, Rahman T, Hossain J, Reichenbach L and Mitra DK 2016 Reasons for preference of home delivery with traditional birth attendants (TBAs) in Rural Bangladesh: A qualitative exploration. *PloS One* 11(1): 0146161.

Shahabuddin ASM, De Brouwere V, Adhikari R, Delamou A, Bardaj A and Delvaux T 2017 Determinants of institutional delivery among young married women in Nepal: Evidence from the Nepal Demographic and Health Survey 2011. *BMJ Open* 7(4): 012446.

Sialubanje C, Massar K, Hamer DH and Ruiter RAC 2015 Reasons for home delivery and use of traditional birth attendants in rural Zambia: a qualitative study. *BMC Pregnancy Childbirth* 15: 216.

Solanke BL, Oladosu OA, Akinlo A and Olanisebe SO 2015 Religion as a social determinant of maternal health care service utilisation in Nigeria. *Afr. Pop. Stud. 29*(2): 1868–1881.

Umar AS and Bawa SB 2016 Determinants of institutional delivery in Yobe state, Nigeria. *Am. J. Public Health Res.* 4(1): 1-7.

United Nations 2015 Millennium development goals. Retrieved from http://www.un.org/millenniumgoals/2015 MDG Report/pdf/MDG/pdf. Reviewed July 1st 2015.

WHO 2016 World Health Organisation recommendations on antenatal care for a positive pregnancy experience. Geneva.

WHO 2019a World Health Organisation Fact sheets*: Maternal Health.*

WHO 2019b Trends in Maternal Mortality: 1990 to 2015: Estimates Developed by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division.

WHO 2020 Sexual and Reproductive Health. Maternal Health in Nigeria: Generating Information for Action.

Yaya S, Bishwajit G and Gunawardena N 2019 Socioeconomic factors associated with choice of delivery place among mothers: a population-based cross-sectional study in Guinea-Bissau. *BMJ Glob. Health* 4(2): 001341.