Modeling The Determinants of Maternal Health Care Utilization and Birth Outcome Among Women of Reproductive Age in Nigeria

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Abstract: **This paper examined the maternal health care utilization and birth outcome among women of reproductive ages in Nigeria. Improvements in maternal and child health (MCH) are two of the eight Millennium Development Goals (MDGs); a global health and international development agenda. The antenatal care utilization and birth outcome is measured as whether health care service is utilized by pregnant women as well as her birth outcome (alive or dead), and the impacts of some socioeconomic and maternal related factors on these are determined. Generalized Estimating Equations (GEE) with Independence, Exchangeable and Autoregressive (AR (1)) working correlation matrices was used to estimate these determinants. The models suggested that the estimates of the regression coefficients are different, even for the estimates of the associated standard errors. The results reveal that Place of residence, Region and the educational status have significantly positive association with the odds of health care service utilization and birth outcome among women of reproductive ages in Nigeria. While place of residence was found to be negatively associated with the odds of 'Home' delivery and having a 'Dead' child birth outcome.**

Keywords: **Health care, Birth outcome, Generalized Estimating Equation, Reproductive ages.**

I. INTRODUCTION

The global health and international development agenda are highly concerned with the improvements in health care of women and children, maternal and child mortality reduction. Until 2015, these were integrated into the Millennium Development Goals (MDGs) and remain in the Sustainable Development Goals (SDGs) agenda for 2030 (Moller et al, 2017; Rosário et al, 2019; WHO, 2016). More than ten million women die or experience adverse consequences during pregnancy and child birth each year (WHO, 2005). Progress on maternal and child health has long been recognized as critical to fostering socio-economic development of any country. Thus, it is not surprising that improvements in maternal and child health (MCH) are two of the eight Millennium Development Goals (MDGs). This improvement requires the provision of accessible reproductive health care and skilled attendance at delivery (WHO, 2016). The global coverage of skilled birth attendants (SBA) was 74% in 2013 and the percentage of women with recommended four or more antenatal care (ANC) visits was 64% against 52% and 49% in sub-Saharan Africa (WHO, 2015). The inequalities' reduction is a keystone in the new strategic framework for action in the SDG era, '*leaving no one behind*' (Rosário et al, 2019; UN Secretary-General, 2014).

Major international bodies and funding agencies such as the United States Agency for International Development (USAID) and the World health Organization (WHO) have more than doubled their efforts at improving maternal and child health in Africa (The PLoS Medicine Editors 2010). The interventions and programs that are mostly funded cover mitigating the adverse effects of HIV and malaria in pregnant women and their children. Support is also provided in the delivery of an evidence-based and cost-effective care for mothers and children. Individually, some governments have taken steps to improve maternal and child health.

Nigeria recorded the highest absolute number of maternal mortalities, worldwide, second placed by India between the period of 1990 to 2015 (WHO, UNICEF, UNFPA (2015). Within this period of time, the number of maternal deaths rose from 57,000 to 58,000 ((WHO, UNICEF, UNFPA, 2019). The country shares a disproportionately high global maternal mortality burden in the year 2015. This accounted for about 19% of the estimated 303,000 maternal deaths (precisely 58,000) (WHO, UNICEF, UNFPA, 2015). Nevertheless, there was a declined in maternal mortality ratio from 1,350 deaths per 100,000 live births in 1990 to 814 deaths per 100,000 live births in 2015.

However, given the substantial investment and emphasis on utilizing health care facilities for delivery and other services through the global momentum of the Millennium Development Goals (MDGs), the prevalence of home childbirth in Nigeria stagnated at 67% but decreased marginally to 65% and 63% in the years 2003, 2008 and 2013 respectively (Dahiru & Oche, 2015; Sachs & McArthur, 2005). This marginal decrease falls below expectation (Adewuyi et al, 2019).

A number of studies have focused mainly on factors associated with home and institutional delivery among mothers of reproductive age, several others examined the determinants of utilization or otherwise of healthcare facility for childbirth in Nigeria, and have reported a significant association between

place of delivery and a range of socio-demographic factors. However, for effective intervention this paper is aimed at modeling the determinants of health care service utilization and birth outcome among women of reproductive ages in Nigeria using Nigeria Demographic and Health Survey of 2013 to identify the associated risk factors. The impacts of the identified risk factors shall also be examined using the Generalized Estimating Equation (GEE).

Traditional statistical techniques assume that individual observations (responses) are independent from one another. However, due to the hierarchical nature through which these data were collected, it is sometimes appropriate to assume that responses from individuals that are within the same clusters might be correlated (dependent) and those in different clusters are uncorrelated (independent). Therefore, health care utilization and birth outcome for women that belong to the same cluster are assumed to be correlated but uncorrelated between different clusters. Hence, a generalized estimating equation (GEE) approach that would account for "within cluster" correlation is used to examine the determinants of health care utilization and birth outcome among women of reproductive ages and explore the possible relationships between them and their determinants within the hierarchical nature of the data.

II. METHODOLOGY

The Generalized Estimating Equations (GEE) procedure extends the generalized linear model. GEE estimates population-averaged model parameters and their standard errors. The assumptions for GEE are similar to the assumptions for Generalized Linear Models (GLM). That is; the responses *Y*1,*Y*2,…, *Yn* are correlated or clustered, there is a linear relationship between the covariates and a transformation of the response, described by the link function *g*, within-subject covariance has some structure called working covariance or working correlation matrix (Akter et al, 2018; Diggle et al, 2002; Liang & Zeger, 1986; Ziegler, 1988).

Given a mean model μ_{ij} for cluster i and time j that depends upon regression parameters β_k, and variance structure, V_i, the estimating equation is formed as follows:

$$U(\beta) = \sum_{i=1}^{N} \frac{\partial \mu_{ij}}{\partial \beta_k} V_i^{-1}\{Y_i - \mu_i(\beta)\} = 0 \qquad (1)$$

where $V_i = A_i^{\frac{1}{2}} M_i(\alpha) A_i^{\frac{1}{2}}$ is a working covariance matrix, A_i is a diagonal matrix with known variance function $V(\mu_{ij})$ and $M_i(\alpha)$ is the corresponding working correlation matrix which may depend on some parameters α which is generally unknown, β_k are estimated using the Newton-Raphson Algorithm. The variance structure is chosen to improve the efficiency of the parameter estimates (Akter et al, 2018; Liang & Zeger, 1986; Diggle et al, 2002; Ziegler, 1988).

For the case of normally distributed outcomes with homogeneous variance across time, we get

$$V(\alpha) = \varphi R_i(\alpha) \qquad (2)$$

For normal outcomes, Park (1993) extends this to heterogeneous variance across time by allowing the scale parameter φ_j to vary across time *(j* = 1, . . ., *n).*

The GEE estimator of β is the solution of

$$\sum_{i=1}^{N} D_i'[V(\hat{a})]^{-1}(y_i - \mu_i) = 0 \qquad (3)$$

Where â is a consistent estimate of a and $D_i = \left(\frac{\partial \mu_i}{\partial \beta}\right)$ hence (3) becomes

$$\sum_{i=1}^{N} \left(\frac{\partial \mu_i}{\partial \beta}\right)(V(\hat{a})^{-1})[y_i - \mu_i] = 0 \qquad (4)$$

This is an extension of the estimating equation for β in any GLM. Thus, the GEE solution can be seen as a natural generalization of the GLM solution for correlated data.

2.1 The Working Correlation Matrix

The working correlation matrix $M(\alpha)$ for a balanced design with same number of repeated measurements from each cluster represents the within cluster dependence and takes the following form (Akter et al, 2018):

$$M(\alpha) = \begin{pmatrix} 1 & Corr(Y_{i1}, Y_{i2}) & \dots & Corr(Y_{i1}, Y_{in}) \\ Corr(Y_{i2}, Y_{i1}) & 1 & \cdots & Corr(Y_{i1}, Y_{i2}) \\ \vdots & \vdots & \vdots & \vdots \\ Corr(Y_{in}, Y_{i1}) & Corr(Y_{in}, Y_{i2}) & \cdots & 1 \end{pmatrix}$$

The dimension of the matrix depends on the number of observations (*n*) for each cluster. Different working correlation matrices can be assumed. The most commonly used structures are Independent, Exchangeable (or compound symmetry), Auto-Regressive (AR), M-dependent and Unstructured. For **INDEPENDENT (observations over time are independent):** this assumes that observations from the same cluster are uncorrelated. That is, $M_{i,j} = 0$ if $i \neq j$. Under this assumption, the GEE is equivalent to GLM score equation. For **EXCHANGEABLE (all observations over time have the same correlation):** this assumes equal correlation between the observations. That is, $M_{i,j} = r$ if $i \neq j$, with $-1 \leq r \leq +1$. **AUTO-REGRESSIVE [AR(1)] (correlation decreases as a power of how many time point apart two observations are):** observations from the same cluster have autoregressive relationship. That is, $M_{i,j} = r^{|i-j|}$ if $i \neq j$. The correlation between any two adjacent observations is r and r^2 for the observations that are separated by three consecutive measurements and so on. While for ***M*-DEPENDENT** structure, the consecutive observations have common correlation (say, r_1), pair of observations separated by three measurements common correlation (say r_2) and so on. In general, $M_{i,j} = r_{|i-j|}$ if $i \neq j$. Observations with separation greater than *m* are assumed to be independent, where *m* is an arbitrary value that represents the order of separation. Therefore, the choice of a value of *m* should be less than the dimension of matrix *n* while specifying this structure and **UNSTRUCTURED (correlation between all-time points may be different):** the unstructured correlation assumes no

specific structure of the correlation, i.e., $M_{i,j} = r_{i,j}$ if $i \neq j$. The main disadvantage of this structure is that the number of parameters to be estimated increases with increasing dimension of the matrix. Although the estimate is not affected by the choices of the appropriate working correlation matrix, its mis-specification affects the efficacy of the estimated regression coefficients (Akter et al, 2018; Wang and Carey, 2003).

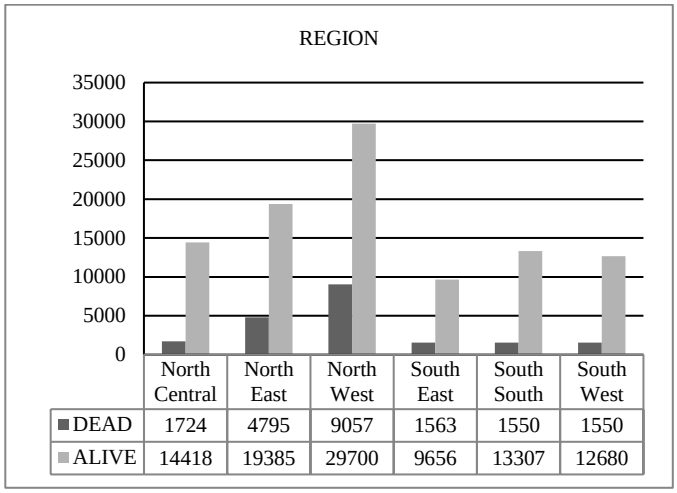
III. DATA ANALYSIS AND RESULTS

From the frequency distribution of Health care utilization and Birth Outcome of all the 119386 samples that are involved in this study as presented in the Table below, the P – value is from chi – square test of independence, showing the significance or otherwise of the factors considered at 5% level of significance.

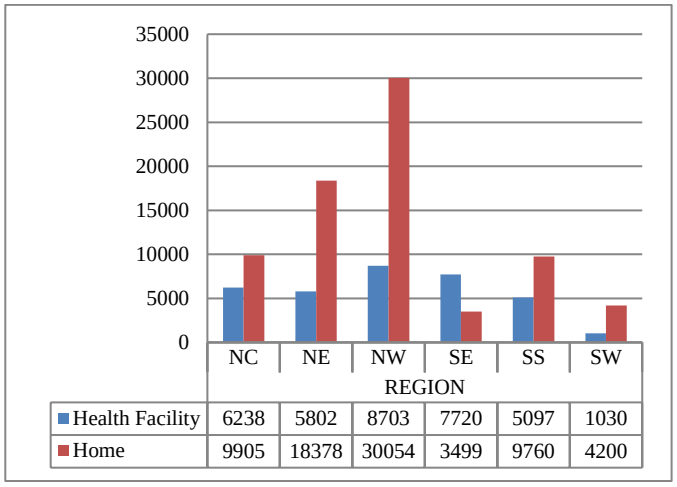
Table 1: Frequency distribution of the Health care utilization and Birth outcome samples

FACTORS	LEVELS	HEALTH CARE UTILIZATION		P – VALUE	BIRTH OUTCOME		P - VALUE
		Health Facility n(%)	Home n(%)		Dead (n%)	Alive (n%)	
REGION	NC	6238(38.64%)	9905(61.36%)	<0.001	1724(10.68%)	14418(89.32%)	<0.001
	NE	5802(24%)	18378(76%)		4795(19.83%)	19385(80.17%)	
	NW	8703(22.46%)	30054(77.54%)		9057(23.37%)	29700(76.63%)	
	SE	7720(68.81%)	3499(31.19%)		1563(13.93%)	9656(86.07%)	
	SS	5097(34.31%)	9760(65.69%)		1550(10.43%)	13307(89.57%)	
	SW	1030(19.69%)	4200(80.31%)		1550(10.89%)	12680(89.11%)	
RESIDENCE	Rural	4822(5.98%)	75778(94.02%)	<0.001	15455(19.18%)	65144(80.82%)	<0.001
	Urban	38768(99.95%)	18(0.05%)		4784(12.33%)	34002(87.67%)	
AGE	15-19	551(34.76%)	1034(65.24%)	0.263	198(12.49%)	1387(87.51%)	<0.001
	20-29	9426(36.13%)	16661(63.87%)		3472(13.31%)	22615(86.69%)	
	30-39	17240(37.44%)	28802(62.56%)		7280(15.81%)	38762(84.19%)	
	40+	16373(35.85%)	29299(64.15%)		9289(20.34%)	36382(79.66%)	
EDUCATION	No Education	12799(21.06%)	47979(78.94%)	0.009	13277(21.85%)	47501(78.15%)	<0.01
	Primary	11543(41.31%)	16402(58.69%)		3997(14.30%)	23947(85.70%)	
	Secondary	14529(59.57%)	9859(40.43%)		2504(10.27%)	21884(89.73%)	
	Higher	4719(75.2%)	1556(24.8%)		461(7.35%)	5814(92.65%)	
MARITAL STATUS	Single	454(50.78%)	440(49.22%)	< 0.001	109(11.07%)	876(88.93%)	<0.01
	Married	38610(35.52%)	70092(64.48%)		18621(17.13%)	90080(82.87%)	
	Living with partner	982(43.72%)	1264(56.28%)		237(10.55%)	2009(89.45%)	
	Widowed	2345(47.74%)	2567(52.26%)		788(16.04%)	4124(83.96%)	
	Divorced	536(44.74%)	662(55.26%)		240(20.03%)	958(79.97%)	
	Separated	572(42.59%)	771(57.41%)		244(18.17%)	1099(81.83%)	
HEALTH PERSONNEL	None	254(0.35%)	72267(99.65%)	<0.001	14912(20.56%)	57609(79.44%)	<0.01
	Doctor	4247(80.51%)	1028(19.49%)		249(4.72%)	5026(95.28%)	
	Nurse	4944(73.78%)	1757(26.22%)		359(5.36%)	6341(94.64%)	
	Midwife	460(56.65%)	352(43.35%)		73(8.99%)	739(91.01%)	
	Community H/W	836(69.09%)	374(30.91%)		96(7.93%)	1114(92.07%)	
	Traditional	32848(99.95%)	18(0.05%)		4550(13.84%)	28316(86.16%)	

3.1 Graphical Representations

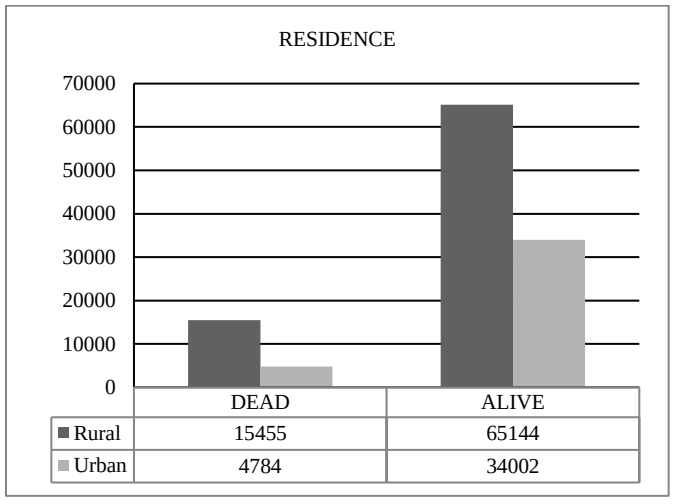


	North Central	North East	North West	South East	South South	South West
DEAD	1724	4795	9057	1563	1550	1550
ALIVE	14418	19385	29700	9656	13307	12680

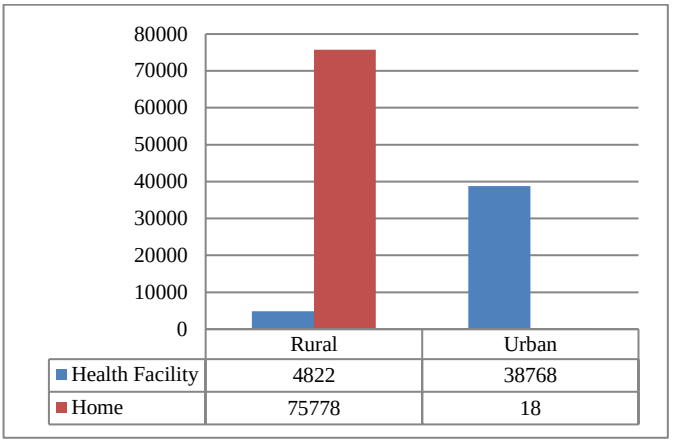


	NC	NE	NW	SE	SS	SW
	REGION					
Health Facility	6238	5802	8703	7720	5097	1030
Home	9905	18378	30054	3499	9760	4200

Figure 1**:** Bar chart of the number Health care utilization and child birth outcome (Dead and Alive) across Regions. The Mothers with 'Dead' child outcome in the North West have the highest experience likewise in they have the highest number of home delivery, followed by those in North East and Mothers in South West being the least.

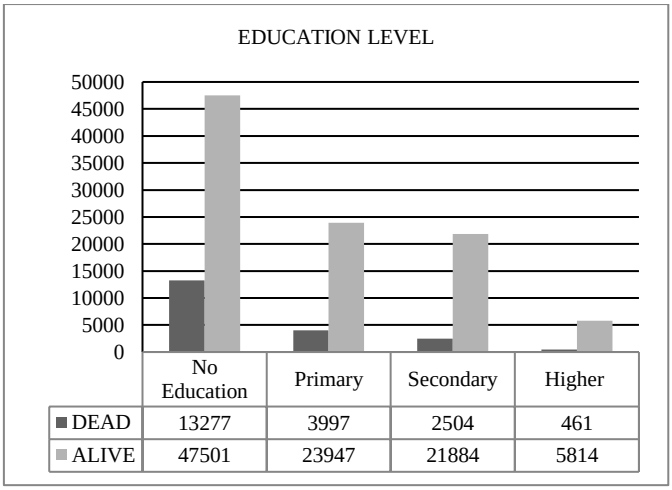


	DEAD	ALIVE
Rural	15455	65144
Urban	4784	34002

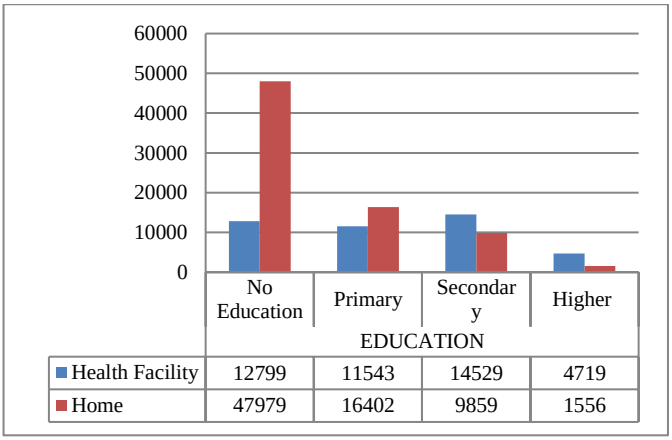


	Rural	Urban
Health Facility	4822	38768
Home	75778	18

Figure2: Bar chart of the number of health care utilization at birth and that of children birth outcome (Dead and Alive) across Residence of the respondents. The Mothers with 'Dead' outcome in the Rural areas have the highest number of home deliveries as a result they have the highest experience in dead children birth outcome, followed by those in North East and Mothers South West being the least.



	No Education	Primary	Secondary	Higher
DEAD	13277	3997	2504	461
ALIVE	47501	23947	21884	5814



	No Education	Primary	Secondary	Higher
	EDUCATION			
Health Facility	12799	11543	14529	4719
Home	47979	16402	9859	1556

Figure 3: Bar chart of the number of child birth outcome (Dead and Alive) and that of health care utilization across the Mothers' Educational Status. The Mothers with 'no education' have the highest number of Dead children and home delivery followed by the Mothers with Primary, Mothers with Higher education being the least.

3.2 Generalised Estimating Equation (Gee)

Table 2: Parameter estimates for GEE based on three (3) working correlation matrices

	Parameter	INDEPENDENCE			EXCHANGEABLE			AR(1)		
FACTORS		B	Std. Error	Sig.	B	Std. Error	Sig.	B	Std. Error	Sig.
	INTERCEPT	-1.25	1.24	0.32	-3.48	0.02	0.98	3.66	386443.27	0.99
RESIDENCE	RURAL	-0.21	0.14	0.16	-0.23	0.15	0.16	-0.21	0.14	0.16
	URBAN (ref)									
AGE	15-19	0.04	0.18	0.81	-0.05	0.19	0.82	0.04	0.18	0.82
	20-29	0.38	0.12	0.02	0.47	0.13	0.02	0.38	0.12	0.00
	30-39	0.30	0.10	0.03	0.32	0.00	0.00	0.30	0.10	0.00
	40+(ref)									
EDUCATION	NO EDUCATION	-0.48	0.17	0.05	-0.38	0.17	0.00	-0.48	0.17	0.01
	PRIMARY	-0.56	0.17	0.01	-0.54	0.17	0.00	-0.56	0.17	0.00
	SECONDARY	-0.35	0.16	0.03	-0.35	0.16	0.03	-0.34	0.16	0.03
	HIGHER (ref)									
HEALTH PERSONNEL	NONE	0.16	0.18	0.37	0.19	0.18	0.37	0.16	0.18	0.37
	DOCTOR	0.92	0.16	0.00	0.91	0.16	0.00	0.91	0.16	<0.01
	NURSE	0.85	0.15	0.00	0.85	0.15	0.00	0.85	0.15	<0.01
	MIDWIFE	0.42	0.24	0.08	0.40	0.24	0.08	0.42	0.24	0.08
	COMM/HEALTH	0.73	0.24	0.02	0.70	0.24	0.02	0.72	0.24	0.00
	TRAD (ref)									

Table 2 contains the estimated regression parameter, its standard error and the *P*-values to justify the significance or otherwise of each categorical factor in the model across three correlation matrices considered due to time factor.

IV. CONCLUSIONS

The GEE model results suggested that under the correlation models, the estimates of the regression coefficients are slightly different, even for the estimates of the associated standard error. The results revealed that involvement of health personnel and the educational status of the respondents (women of reproductive age) have significantly positive association with the odds of health care utilization and birth outcome. For example, the odds of having 'Home' delivery and 'Dead' birth outcome among women of child bearing age (educational status) with No education was 61% higher $(\boldsymbol{OR = e^{-0.479} = 1.61})$, while those with Primary was **76%** higher $(\boldsymbol{OR = e^{-0.564} = 1.757})$, those with secondary was **41%** higher $(\boldsymbol{OR = e^{-0.345} = 1.411})$. But place of residence was found to be negatively associated with the odds of having a 'Home' delivery and 'Dead' child birth outcome by **19%**. For example, people living in urban area were found to have significantly lower odds of having such experience.

It can be easily verified that mother's educational status plays important role at determining the time a pregnancy starts. Out of the **119,386** mothers covered by this study, more than half **(51%),** precisely, **60,778** are not educated (i.e. did not attend any school). About **17% (20,239)** of all the women delivered at home and have dead children delivery outcome. More than half of these women amounting to **66%** (precisely **13,277**) of them are illiterates who have no educational background as stated earlier. Unfortunately, about **75% (15,128**) mothers delivered at home and about **46%** of them were **40 years old and above**. Although, **75% (15,218)** of them were **10 – 19 years old** at first birth. Moreover, about **61% (72,521)** of all the mothers considered in this study have no health personnel. However, only about **21%** (precisely, **14,912)** of them delivered at home and have dead child birth outcome.

Obviously, this is not unconnected with apparent increase in literacy levels among women of reproductive age in Nigeria over the time. The localities where mothers domiciled up to the time of delivery plays a significant role at determining their health care service utilization and birth outcome. About **68%** of mothers in this study (precisely **80,599** women) live in the rural areas. Only about **19%** of this number (precisely **15,455**

women) gave birth at home and experience dead child birth outcome.

This shows that those (mothers) who are well educated, attended to by expert health personnel, living with their husbands, are at low risk of having a home delivery as well as 'Dead' child birth. The results showed that the relative risk of not having institutional delivery and dead child birth outcome decreased by about **19%** for women living in the rural areas compared to their counterparts living in the urban areas **(OR = 0.81).** This generally showed that localities where mothers domicile have significant impacts on health services utilization and birth outcome. Pregnant mothers living in urban areas are less likely to deliver home and have dead child outcome than their rural counterparts, this may be as a result of their easy accessibility to adequate information on the need for antenatal care visitations coupled with their relatively higher literacy levels. In view of this, intensive enlightenment programs are needed to sensitize mothers of child bearing age living in the rural areas of the country on the importance and advantages of utilizing health care services and taking good care of themselves and their concerned ones immediately they conceive pregnancy. This would tremendously help at reducing the spate of child deaths at birth in the country.

Pregnant women should be strongly encouraged to adhere to necessary antenatal treatments and advices. This will surely avail them the opportunity of receiving appropriate information on child and maternal care. All these shall immensely help at reducing several cases of complications at birth that often resulted to caesarean delivery which might in turn incapacitate mother after the child birth.

REFERENCES

[1] Adewuyi, E. O. & Zhao, Y. (2017). Determinants of neonatal mortality in rural and urban Nigeria: evidence from a population-based national survey. Pediatr Int, 59: 190–200.

[2] Adewuyi, O. E., Khanal, V., Zhao, Y., David, L., Bamidele, D. O. & Auta A. (2019). Home childbirth among young mothers aged 15–24 years in Nigeria: a national population-based cross-sectional study. BMJ Open, 9: 1-12

[3] Babalola, S., & Fatusi, A. (2009) Determinants of use of maternal health services in Nigeria – Looking beyond individual and household factors. BMC Pregnancy Childbirth, 9:43.

[4] Buse K, Hawkes S. (2015) Health in the sustainable development goals: ready for a paradigm shift? Global Health, 11:13.

[5] Dahiru, T. & Oche, O. M. (2015). Determinants of antenatal care, institutional delivery and postnatal care services utilization in Nigeria. Pan African Medical Journal, 21.

[6] Emelumadu, OF, Ukegbu, AU, Ezeama, NN, Kanu O.O., Ifeadike, C.O. & Onyeonoro, U.U. (2014). Socio demographic determinants of maternal health-care service utilization among rural women in Anambra State, South East Nigeria. Ann Med Health Sci Res; 4:374-82.

[7] Fapohunda, B. M. & Orobaton, N. G. (2013). When women deliver with no one present in Nigeria: who, what, where and so what? PLoS One, 8: 69569.

[8] Lule, E., Ramana, GN. & Rosen J. (2011) Maternal and Reproductive Health Services. Washington DC, USA. World Bank Group; Available from: http://www.web.worldbank.org. [Last accessed on 2012 Oct 5].

[9] McArthur, J. W., Rasmussen, K. & Yamey, G. (2018). How many lives are at stake? Assessing 2030 sustainable development goal trajectories for maternal and child health. BMJ, 360.

[10] Moller, A-B., Petzold, M., Chou, D. & Say, L. (2017) Early antenatal care visit: a systematic analysis of regional and global levels and trends of coverage from 1990 to 2013. The Lancet Global Health, 5(10):e977–e83. https://doi.org/10.1016/S2214-109X(17)30325-X

[11] 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.

[12] Rosário, EVN., Gomes, MC., Brito, M. & Costa, D. (2019) Determinants of maternal health care and birth outcome in the Dande Health and Demographic Surveillance System area, Angola. PLoS ONE, 14(8): e0221280. https://doi.org/10.1371/journal.pone.0221280

[13] Sachs, J. D. & McArthur, J. W. (2005). The Millennium Project: A plan for meeting the millennium development goals. Lancet, 365: 347–53.

[14] Say L, Chou D, Gemmill A, et al. (2014). Global causes of maternal death: a who systematic analysis. Lancet Glob Health, 2: 323–33.

[15] The PLoS Medicine Editors. (2010). Maternal health: Time to deliver. PLoS Medicine 7(6), e1000300.

[16] UN Secretary-General (2014). The Road to Dignity by 2030: Ending Poverty, Transforming All Lives and Protecting the Planet. Synthesis Report of the Secretary-General on the Post-2015 Agenda New York: United Nations.

[17] UNFPA (2014) "Maternal health". www.unfpa.org. Retrieved 2019-12-22.

[18] UNICEF (2014). UNICEF — Millennium Development Goals. Accessed March 18, 2014. http://www.unicef.org/mdg/index_maternalhealth.htm.

[19] WHO (2013) World Health Organization |Antenatal care (at least 4 visits) WHO http://www.who.int/gho/urban_health/services/antenatal_care_text/en/. Accessed May 22

[20] WHO (2015). The Millennium Development Goals Report 2015. World Health Organization: Geneva.

[21] WHO (2016). WHO recommendations on antenatal care for a positive pregnancy experience. World Health Organization: Geneva.

[22] WHO, UNICEF, UNFPA (2015), United Nations population division. Trends in maternal mortality, 1990 to 2015, 32, 1–55.

[23] WHO, UNICEF, UNFPA (2019). Maternal mortality in Nigeria 1990–2015. Available: www.who.int/gho/maternal_health/countries/nga.pdf [Accessed 5 January, 2020].

[24] WHO, UNICEF, UNFPA, World Bank Group, United Nations Population Division (2016) Trends in maternal mortality: 1990 to 2015. Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division; World Health Organization: Geneva; 2016

[25] WHO. (2005). The World health report 2005 – Make every mother and child count. Geneva: World Health Organization. http://www.who.int/whr/2005/en. Accessed November 10, 2012.