BINARY LOGISTIC REGRESSION MODELING OF FACTORS AFFECTING MATERNAL HEALTH CARE UTILIZATION IN NIGERIA

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ABSTRACT

Maternal mortality is still far too high worldwide, even with major efforts to improve the use of maternal health care services. Thus, this study aimed at assessing the factors affecting maternal health care utilization in Nigeria using binary logistic regression model. The antenatal Care (ANC) utilization was used as an indicator of maternal health care utilization. The data for the study were extracted from 2018 Nigerian Demographic and Health Survey (NDHS) Data. The data extracted was analyzed using single level binary logistic regression model. The findings of the study revealed that maternal age at birth, maternal educational level, ethnicity, place of residence, religion, wealth index, sex of household head, birth type, insurance cover, maternal employment status, preceding birth intervals, household size, region, birth order and age of household head were the significant factors affecting maternal health care utilization in Nigeria. Based on these findings it was recommended among others that the government should focus on improving economic conditions and educational opportunities for women through formulating policies and initiatives that target women with no education and those in lower income groups must be put into place.

Keywords: Antenatal Care Utilization, Binary Logistic Regression, Maternal Health Care Services, NDHS

1.0 Introduction

Maternal healthcare is the health of the mother during pregnancy, childbirth, and the postpartum period. According to World Health Organization (WHO), maternal health care encompasses antenatal care (ANC), institutional delivery, and postnatal care (PNC) (WHO, 2016). The fact that millions of mothers in the reproductive age group could be spared from death if they used maternal health care services appropriately have made maternal health an international public health problem (Gyimah, 2019). Maternal mortality is still far too high worldwide, even with major efforts to improve the use of maternal health care services. In 2016, for example, the global maternal mortality ratio ranged from 2 in Iceland to 957 in South Sudan, with an estimated 254,700 women dying worldwide from pregnancy- or childbirth-related problems

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(Lozano *et al*, 2021). But according to WHO (2010), 99% of these deaths took place in underdeveloped nations, with sub-Saharan Africa accounting for over half of them.

The African Region's maternal mortality ratio was estimated to be 531 deaths per 100,000 live births in 2020. South Sudan (1223 deaths), Chad (1063 deaths), and Nigeria (1047 deaths per 100,000 live births) were the nations with the highest rates of maternal mortality (WHO-Analytical fact sheet, 2023).

The health of the mother and child depends on providing maternal healthcare (Zhao *et al*., 2020). The use of maternal healthcare services is a complicated behavioral phenomenon that involves proper postnatal care services, the number of prenatal care visits that are advised, and the delivery of the child by a trained birth attendant (Chol *et al.*, 2019). These are crucial in order to determine the possible hazards of pregnancy, guarantee a professional delivery, and enhance the mother's and the child's health (Islam, 2017). In spite of the fact that maternal health care service utilization is very important for further improvement of maternal health, limited empirical studies exists on the utilization and predictors of maternal health care services among women of the reproductive age in Nigeria.

Empirically, Berelie *et al.* (2019) used data from the 2016 Ethiopian Demographic and Health Survey to ascertain the prevalence and factors related to the use of maternal care services. The multilevel logistic regression model was utilized for the analysis of the gathered data. The study's conclusions showed that living location and having at least four ANC visits were strongly correlated with the use of maternal care.

Zhao *et al.* (2020) used a demographic survey data to look at the prevalence and factors related to the use of maternal health services in 37 low- and middle-income countries. Prenatal care visits (for women who have had four or more ANC visits) and postnatal care (PNC) provided during the postpartum phase. Univariate and multivariate binary logistic regression analysis were used to examine the gathered data. Based on the study's findings, there was a substantial increase in the use of maternal healthcare services as the wealth index, women's age, age at first birth, and husband/partner's education increased.

Shudura et al. (2020) used the 2019 Hawassa Health and Demographic Surveillance System site in South Ethiopia to evaluate the utilization and predictors of maternal health care services among women of reproductive age. Using a multivariable model and the backward stepwise

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regression technique, the gathered data were evaluated. According to the findings, the overall rates of PNC, ANC, and institutional delivery were 32.7%, 52.1, and 69.1%, respectively. Additionally, it was shown that the following factors were substantially connected with the use of maternal health care: educational level, ANC follow-up, availability of information about the PNC, and a woman's autonomy in making health-related decisions.

Kitabo and Damtie (2020) used Bayesian multilevel logistic regression models to investigate the factors influencing the use of prenatal care services in Ethiopia. Data from the 2016 Ethiopian Demographic and Health Survey were used in the study. The study's conclusions showed that the following variables were significant for ANC usage: birth order, beat, household wealth index, women's educational attainment, husband's educational level, and employment position. There was a notable variance in the use of ANC by region.

Paul and Chouhan (2020) looked at the sociodemographic aspects of Indian women's use of maternal health care. The 2015–2016 Indian National Family Health Survey (NFHS–4) was used in the study. Bivariate and multivariate regression were used to analyze the gathered data. The most important predictors of maternal health care utilization, according to the study's findings, are women's educational attainment, household wealth status, residence in an urban or rural area, caste, religion, age at marriage, women's age, exposure to the media, and region.

Semagn (2023) used data from the 2019 Ethiopian Mini Demographic and Health Survey to evaluate the extent and variables influencing the use of health facilities for the delivery of the most recent live birth among women in rural Ethiopia who are of reproductive age. A multilevel mixed effect logistic regression model was used to examine the gathered data. The study's conclusions showed that having ANC from a skilled provider, visiting 4+ANC, having an educational status, and having wealth index were all statistically significant variables linked to the delivery of healthcare in a health institution.

Zhang and Lu (2023) used data from 470 rural women living in 9 villages in central China to describe the trends and factors influencing the usage of maternal health services between 1991 and 2015. Multivariate logistic regression analysis was used to examine the gathered data. The study's conclusions showed that, with macro-factors accounting for the majority of the effects, the use of maternal health services was influenced by meso-factors (family, community, and

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healthcare factors), micro-factors (individual characteristics), and macro-factors (government-run maternal and child health programs, also known as maternal care health programs).

Shanto *et al* (2023) examined the prevalence and factors associated with maternal healthcare services (MHS) utilization in 37 low-and-middle-income countries using the Demographic and Health Surveys of 37 low- and medium-income Countries. The data collected were analyzed using Multivariate logistic regression. The findings of the study revealed that 33.7% of the respondents properly utilized maternal healthcare services among women of childbearing age. Also, wealth index, women's age, age at the first birth, and husband/partner's education, urban residence, women's autonomy in healthcare decision-making and media exposure, larger family, and families with 7 or more children were the significant predictors MHS utilization.

Using data from the 2016 Ethiopian Demographic and Health Survey, Gebrekrstos *et al*. (2023) modelled the determinant factors for the delivery care service utilization of childbearing mothers in Ethiopia. To analyze the data, the study employed multilevel binary logistic regression. The study's findings showed that women who were 35–49 years old, lived in an urban area, had higher educational attainment than their partners, had a household wealth index, were exposed to mass media every day, had two or more children, used a particular type of contraception, and had more than four prenatal care visits been more likely than their counterparts to give birth in a hospital.

Despite the extensive research on maternal health care utilization in various low- and middle-income countries, including Ethiopia, India, and China, there remains a significant gap in understanding the specific factors influencing maternal health care utilization in Nigeria using binary logistic regression modeling. While studies like those of Berelie et al. (2019), Zhao et al. (2020), and Shanto et al. (2023) have explored predictors such as wealth index, education, and residence, these findings may not fully capture Nigeria's unique socio-cultural, economic, and health system contexts. Furthermore, Nigeria's diverse regional disparities, cultural practices, and varying health infrastructure necessitate a focused study to identify localized predictors that could inform targeted interventions. This research gap highlights the need for a Nigeria-specific binary logistic regression analysis to uncover the key determinants of maternal health care utilization, which could enhance policy formulation and program implementation to improve maternal health outcomes in the country.

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2.0 Materials and Methods

2.1 Source of Data and Variables of the study

The data used in this study were extracted from 2018 Nigerian Demographic and Health Survey (NDHS, 2018) data. The variables used in this study were selected based on existing literatures. The outcome variable is maternal health care utilization where antenatal care utilization which is an indicator of maternal care utilization (WHO, 2016) was adopted in this study. Thus, the ANC visits were defined based on World Health Organization guidelines on the recommended number of ANC visits (WHO, 2016) as follows: Women with less than eight numbers of ANC visits were considered to have incomplete ANC utilization and women with at least eight numbers of ANC visits were considered to have complete ANC utilization. The details of the outcome and explanatory variables were presented in table 1.

Table 1: Description of Variables of the Study

Variables	Category and Code
Maternal Health Care Utilization (Antenatal Care Utilization)	Incomplete = 0; Complete = 1
Maternal Age at Birth	Less than 20 years = 0; 20 – 29 = 1; 30 – 39 = 2, 40 – 49 = 3
Maternal Education level	High Education = 0; Secondary = 1; Primary = 2; No education = 3
Ethnicity	Igbo = 0; Yoruba = 1; Hausa = 2; Others = 3
Place of Residence	Urban = 0; Rural = 1
Religion	Christian = 0; Islam = 1; Others = 2
Wealth Index	Richest = 0; Richer = 1; Middle = 2; Poorer = 3; Poorest = 4
Sex of Household head	Male = 0; Female = 1
Birth Type	Singl = 0; Multiple = 1
Insurance Cover	No = 0; Yes = 1
Media Exposure	No = 0; Yes = 1
Maternal Employment status	No = 0; Yes = 1
Preceding Birth Interval (months)	Less than 24 months = 0; 24 – 33 months = 1 More than 33 months = 2
Household Size	Less than 5 = 0; 5 and above = 1
Region	North Central = 0; North East = 1; North West = 2; South East = 3; South-South = 4; South West = 5
Birth Order	First = 0; Second = 1; Other = 2
Age of Household Head	Less than 20 years = 0; 20 – 29 = 1; 30 – 39 = 2; 40 and above = 3

Source: Authors' compilation

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2.2 Method of Data Analysis

The method of data analysis used in this study is binary logistic regression model. Let Y denote the single level binary logistic regression data matrix of P variables of the maternal health utilization is given as:

$$Y = \begin{bmatrix} 1 & y_{11} & y_{12} & \cdots & y_{1k} \\ 1 & y_{21} & y_{22} & \cdots & y_{2k} \\ \vdots & & \vdots & \vdots & \vdots \\ 1 & y_{n1} & y_{n2} & \cdots & y_{nk} \end{bmatrix} \sim n \times (p+1) \quad (1)$$

$$\beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix} \sim (p+1) \times 1 \quad (2)$$

Where:

Y = is a design matrix

β = is the vector of unknown coefficient of the covariates and intercept.

Then the logistic regression function is given as:

$$\pi_i = \frac{\exp(\beta_0+\beta_1 Y_{i1}+\cdots+\beta_k Y_{ik})}{1+\exp(\beta_0+\beta_1 Y_{i1}+\cdots+\beta_k Y_{ik})} = \frac{\exp(Y_i\beta)}{1+\exp(Y_i\beta)} \quad (3)$$

Where:

$\pi_i (i = 1,2,\ldots,n)$ is the probability of ith mother utilizing maternal health care given the vector of predictor Y_i.

The logistic regression model can be written in terms of an odds ratio for success:

$$\frac{p(Y=1|Y_i)}{1-p(Y=1|Y_i)} = \frac{\pi}{1-\pi} = \beta_0 + \beta_1 Y_1 + \cdots + \beta_k Y_k \quad (4)$$

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The change in the log-odds of using maternal health care per unit change of the relevant continuous covariate is what is meant to be understood by the coefficient. When it comes to categorical predictor variables, Dayton (1992) defines them as the log-odds of using maternal health care with a certain category in comparison to the reference category.

2.2.1 Maximum Likelihood Estimation for Logistic Regression

the maximum likelihood estimation technique is used to estimate parameters of the model. Consider the logistic regression model equation (3), then the likelihood function with n observations is given as:

$$L(\beta, M = 1|Y_i) = \prod_{i=1} \left(\frac{\exp(Y_i\beta)}{1+\exp(Y_i\beta)}\right)^{\sum_{i=1}^{n} m_i} \left[1 - \left(\frac{\exp(M_i\beta)}{1+\exp(M_i\beta)}\right)\right]^{n-\sum_{i=1}^{n} m_i} \quad (5)$$

After taking the log-likelihood function, (5) can be express as:

$$\sum_{i=1}^{n} \left[m_i \log\left(\frac{\exp(Y_i\beta)}{1+\exp(Y_i\beta)}\right)\right] + (n - \sum_{i=1}^{n} m_i)\log\left(\frac{\exp(Y_i\beta)}{1+\exp(Y_i\beta)}\right) \quad (6)$$

The $P + 1$ score functions of β for the logistic regression model cannot be solved analytically. Thus, it is common to use a numerical algorithm, such as the Newton Raphson algorithm, to obtain the maximum likelihood estimation. The information in this case will be a $(p+1) \times (p+1)$ matrix of the partial second derivative with respect to the parameters, β. The inverted information matrix is the covariance matrix for $\hat{\beta}$ (Collet, 1991).

3.0 Results

Table 2: Summary Statistics for Covariates based on Antenatal Care Utilization

Variables	Categories	Antenatal Care Utilization		χ^2	P-value
		Incomplete	Complete		
Maternal Age at Birth	< 20	30092(61.5)	1322(2.7)	2206.7	0.000
	20 – 29	1864(28.3)	2448(5.0)		
	30 – 39	868(1.8)	318(0.6)		
	40 – 49	11(0.0)	9(0.0)		
Maternal Education Level	Tertiary	2155(4.4)	839(1.7)	4450..8	0.000
	Secondary	10292(21.0)	2218(4.5)		

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	Primary	7460(15.2)	634(1.3)		
	No Education	24927(50.9)	406(0.8)		
Ethnicity	Igbo	4579(9.4)	1166(2.4)	6113.7	0.000
	Yoruba	2644(5.4)	1393(2.8)		
	Hausa	23804(48.6)	387(0.8)		
	Others	13808(28.2)	1151(2.4)		
Place of Residence	Urban	12989(26.5)	2466(5.0)	1693.2	0.000
	Rural	31846(65.1)	1631(3.3)		
Religion	Christianity	14008(28.6)	2873(5.9)	2512.5	0.000
	Islam	30469(62.3)	1204(2.5)		
	Others	358(0.7)	20(0.0)		
Wealth Index	Richest	4251(8.7)	1430(2.9)	3732.5	0.000
	Richer	6805(13.9)	1194(2.4)		
	Middle	9192(18.8)	862(1.8)		
	Poorer	11628(23.8)	862(1.8)		
	Poorest	12959(26.5)	194(0.4)		
Sex Household Head	Male	40959(83.7)	3339(6.8)	425.4	0.000
	Female	3876(7.9)	758(1.5)		
Birth Type	Singleton	42643(87.1)	3985(8.1)	38.9	0.000
	Multiple	2192(4.5)	112(0.2)		
Insurance Cover	No	44022(90.0)	3908(8.0)	146.7	0.000
	Yes	813(1.7)	189(0.4)		
Media Exposure	No	23715(48.5)	1183(2.4)	866.6	0.000
	Yes	21120(43.2)	2914(6.0)		
Maternal Employment Status	No	14573(29.8)	735(1.5)	370.4	0.000
	Yes	30262(61.8)	3362(6.9)		
Preceding Birth Interval (in Months)	< 24	11212(22.9)	585(1.2)	416.1	0.000
	24 – 33	21547(44.0)	1869(3.8)		
	> 33	12076(24.7)	1643(3.4)		
Household Size	< 5	10055(20.5)	1591(3.3)	557.2	0.000
	≥ 5	34780(71.1)	2506(5.1)		
Region	North Central	7228(14.8)	587(1.2)	6846.2	0.000
	North East	10425(21.3)	170(0.3)		
	North West	17204(35.2)	240(0.5)		
	South East	3803(7.8)	908(1.9)		
	South-South	3355(6.9)	677(1.4)		
	South West	2820(5.8)	1515(3.1)		
Birth Order	1st child	8517(17.4)	1614(3.3)	1135.7	0.000
	2nd child	8081(16.5)	886(1.8)		
	Others	28237(57.7)	1597(3.3)		
Age of Household Head	< 20	100(0.2)	9(0.0)	27.3	0.000
	20 – 29	3868(7.9)	360(0.7)		
	30 – 39	13645(27.9)	1402(2.9)		
	≥ 40	27222(55.6)	4097(8.4)		

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4.0 Source: Author's Compilation

Table 2 presents the results for summary statistics and chi-square test for association between the explanatory variables and maternal health care service utilization (antenatal care utilization). The results also revealed significant association between all the explanatory variables and antenatal care utilization (p-value < 0.05).

Table 3: Binary Logistic Regression of factors affecting Antenatal Care Utilization

Covariates	Categories	Estimate (SE)	P-value	OR	95% CI
Maternal Age at Birth	< 20	***Ref.***			
	20 – 29	-1.346(0.503)	0.007	0.260	(0.097, 0.697)
	30 – 39	-1.074(0.502)	0.032	0.342	(0.128, 0.913)
	40 – 49	-0.889(0.506)	0.079	0.411	(0.153, 1.108)
Maternal Education Level	Tertiary	***Ref.***			
	Secondary	1.168(0.087)	0.000	3.215	(2.710, 3.814)
	Primary	0.878(0.072)	0.000	2.406	(2.089, 2.770)
	No Education	0.460(0.075)	0.000	1.583	(1.366, 1.835)
Ethnicity	Igbo	***Ref.***			
	Yoruba	0.299(0.081)	0.000	1.348	(1.151, 1.580)
	Hausa	0.548(0.075)	0.000	1.730	(1.493, 2.004)
	Others	-0.147(0.093)	0.114	0.863	(0.720, 1.036)
Place of Residence	Urban	***Ref.***			
	Rural	0.182(0.042)	0.000	1.199	(1.103, 1.303)
Religion	Christianity	***Ref.***			
	Islam	0.835(0.244)	0.001	2.304	(1.428, 3.718)
	Others	0.869(0.249)	0.000	2.385	(1.464, 3.886)
Wealth Index	Richest	***Ref.***			
	Richer	0.741(0.096)	0.000	2.097	(1.737, 2.533)
	Middle	0.626(0.091)	0.000	1.869	(1.563, 2.236)
	Poorer	0.544(0.089)	0.000	1.724	(1.447, 2.054)
	Poorest	0.295(0.093)	0.002	1.343	(1.119, 1.611)
Sex of Household Head	Male	***Ref.***			
	Female	-0.219(0.051)	0.000	0.803	(0.727, 0.887)
Birth Type	Singleton	***Ref.***			
	Multiple	0.835(0.106)	0.000	2.304	(1.871, 2.838)
Insurance Cover	No	***Ref.***			
	Yes	-0.296(0.099)	0.003	0.744	(0.613, 0.904)
Media Exposure	No	***Ref.***			
	Yes	-0.028(0.042)	0.509	0.973	(0.896, 1.056)
Maternal Employment Status	No	***Ref.***			
	Yes	-0.153(0.048)	0.002	0.858	(0.781, 0.944)
Preceding Birth Interval (in Months)	< 24	***Ref.***			
	24 – 33	-0.661(0.056)	0.000	0.516	(0.463, 0.576)

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	> 33	-0.457(0.042)	0.000	0.633	(0.584, 0.687)
Household Size	< 5	***Ref.***			
	≥5	-0.137(0.044)	0.002	0.872	(0.800, 0.951)
Region	North Central	***Ref.***			
	North East	-1.042(0.076)	0.000	0.353	(0.304, 0.409)
	North West	-1.958(0.112)	0.000	0.141	(0.113, 0.176)
	South East	-1.987(0.118)	0.000	0.137	(0.109, 0.173)
	South-South	-0.571(0.097)	0.000	0.565	(0.467, 0.683)
	South West	-0.448(0.081)	0.000	0.639	(0.545, 0.749)
Birth Order	1st child	***Ref.***			
	2nd child	1.077(0.046)	0.000	2.937	(2.685, 3.212)
	Others	0.366(0.051)	0.000	1.442	(1.304, 1.593)
Age of Household Head	< 20	***Ref.***			
	20 – 29	-0.315(0.396)	0.427	0.730	(0.336, 1.586)
	30 – 39	-0.283(0.071)	0.000	0.753	(0.655, 0.867)
	≥ 40	-0.126(0.041)	0.002	0.882	(0.813, 0.956)
Constant		-2.541(0.590)	0.000	0.097	

Pseudo R-square = 0.343 Percentage correctly classified = 92.0

Source: Author's Compilation ***Note***: Ref – Reference; OR – Odd Ratio

Table 3 presents the results of binary logistics regression results for the factors affecting antenatal care utilization. Maternal age at birth, maternal education level, ethnicity, place of residence, religion, wealth index, sex of household head, birth type, insurance cover, maternal employment status, preceding birth interval, household size, region, birth order and age of household head were significantly associated with antenatal health care utilization. However, media exposure was not a significantly associated with antenatal care utilization.

Women with age at birth within the interval of 20 – 29 and 30 - 39 were significantly associated with lower odd of complete antenatal care utilization (OR = 0.260, $p < 0.05$ and OR = 0.411; $p < 0.05$) as compared to those with less than 20 years at birth and was statistically significant at 5%. maternal educational levels: secondary, primary and no education were significantly associated with higher odd of complete antenatal care utilization (OR = 3.215, $p < 0.05$; OR = 2.406, $p < 0.05$ and OR = 1.583, $p < 0.05$) respectively as compared to those with tertiary education level. The odds of complete antenatal care utilization increase as the maternal educational level increases. Women from Yoruba and Hausa ethnic group were associated with higher odd of complete antenatal care utilization (OR = 1.348, $p < 0.05$ and OR = 1.730, $p< 0.05$) as compare to those from Igbo ethnic group. Place of residence was a significant predictors of complete

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antennal care utilization. Women that were from rural areas has higher odd of complete antenatal care utilization (OR = 1.199, $p < 0.05$) as compared to those from urban and was statistically significant at 5% level of significant.

Women with religion Islam and others were associated with higher odds of complete antenatal care utilization (OR = 2.304, $p < 0.05$ and OR = 2.385, $p < 0.05$) as compared to those that were Christian. The wealth index richer, middle, poorer and poorest were significantly associated with the odd of complete antenatal care utilization (OR = 2.097, $p < 0.05$; OR = 1.869, $p < 0.05$; OR = 1.724, $p < 0.05$ and OR = 1.343, $p < 0.05$) as compared to wealth index richest. The odd increases as the wealth index increase from poorest to richest. Household head who were female has lower odd of antenatal care utilization (OR = 0.803, $p < 0.05$) as those whose household head were male. Women with multiple birth type were associated with higher odd of complete antenatal care utilization (OR = 2.304, $p < 0.05$) as compared to those with single birth type. Women with insurance cover were associated with increase in odd of complete ANC (OR = 0.744, $p < 0.05$). Similarly, women who were employed are significantly associated with decrease odd of complete ANC utilization (OR = 0.858, $p < 0.05$).

Women with preceding birth interval 24 – 33 and greater than 33 months were significantly associated with decrease odd of complete ANC utilization (OR = 0.516, $p < 0.05$ and OR = 0.633, $p < 0.05$) respectively as compared to those with less than 24 months. Similarly, Women with at least 5 household size were significantly associated with decrease in odd of complete ANC utilization (OR = 0.872, $p < 0.05$) as compared to those with household size less than 5. Also, women from North-East, North-West, South-East, South-South and South-West regions were significantly associated with lower odd of complete ANC utilization (OR = 0.353, $p < 0.05$; OR = 0.141, $p < 0.05$; OR = 0.137, $p < 0.05$, OR = 0.565, $p < 0.05$ and OR = 0.639, $p < 0.05$) as compare to those from the North-Central region.

In addition, it was discovered that women with 2nd and others birth order were associated with increase in odd of complete ANC utilization (OR = 2.937, $p < 0.05$ and OR = 1.442, $p < 0.05$) as compared to those with first birth order. This indicates that the odd for complete ANC utilization decreases as the birth order increases. The odd of household head with age 20 – 29 is 0.753, $p < 0.05$) and that of age 30 – 39 is 0.882, $p < 0.05$. This implies that household head with age 20 – 29 and 30 – 39 has decrease odd of complete ANC utilization.

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The pseudo R-square of the estimated model is 0.343 indicating that 34.3% of the variance in ANC utilization is explained by the explanatory variables considered in this study. Also, 92% of the group membership were correctly classified.

4.0 Discussion of Findings

When the antenatal care utilization was used as the response variable, it was found that women with age at birth within the interval of 20 – 29 and 30 - 39 were significantly associated with lower odd of complete ANC utilization (OR = 0.260, $p < 0.05$ and OR = 0.411; $p < 0.05$) as compared to those with less than 20 years at birth and was statistically significant at 5%. These findings were similar to finding of Zhao et al (2020). Maternal educational levels: secondary, primary and no education were significantly associated with higher odd of complete ANC utilization (OR = 3.215, $p < 0.05$; OR = 2.406, $p < 0.05$ and OR = 1.583, $p < 0.05$) respectively as compared to those with tertiary education level. These findings were in line with findings of Zhao et al (2020) and Shudura et al (2020). The odds of complete ANC utilization increase as the maternal educational level increases. Women from Yoruba and Hausa ethnic group were associated with higher odd of complete ANC utilization (OR = 1.348, $p < 0.05$ and OR = 1.730, $p< 0.05$) as compare to those from Igbo ethnic group. Place of residence was a significant predictor of ANC utilization. Women that were from rural areas has higher odd of complete ANC utilization (OR = 1.199, $p < 0.05$) as compared to those from urban and was statistically significant at 5% level of significant. This finding was in line with findings of Kitabo and Damtie (2020) and Berelie *et al* (2019).

Women with religion Islam and others were associated with higher odds of ANC utilization (OR = 2.304, $p < 0.05$ and OR = 2.385, $p < 0.05$) as compared to those that were Christian. The wealth index richer, middle, poorer and poorest were significantly associated with complete ANC utilization (OR = 2.097, $p < 0.05$; OR = 1.869, $p < 0.05$; OR = 1.724, $p < 0.05$ and OR = 1.343, $p < 0.05$) as compared to wealth index richest. These findings were similar to findings of Zhao et al (2020) and Shanto et al (2023). The odd increases as the wealth index increase from poorest to richest. Household head who were female has lower odd of complete ANC utilization (OR = 0.803, $p < 0.05$) as those whose household head were male. Women multiple birth type was associated with complete ANC utilization (OR = 2.304, $p < 0.05$) as compared to those with single birth type. Women with insurance cover were associated with increase in odd of complete

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ANC utilization (OR = 0.744, $p < 0.05$). Similarly, women who were employed are significantly associated with decrease odd of complete ANC utilization (OR = 0.858, $p < 0.05$). This finding was in agreement with findings of Kitabo and Damtie (2020).

Women with preceding birth interval 24 – 33 and greater than 33 months were significantly associated with decrease odd of complete ANC utilization (OR = 0.516, $p < 0.05$ and OR = 0.633, $p < 0.05$) respectively as compared to those with less than 24 months. Similarly, Women with at least 5 household size were significantly associated with decrease odd of complete ANC utilization (OR = 0.872, $p < 0.05$) as compared to those with household size less than 5. Also, women from North-East, North-West, South-East, South-South and South-West regions were significantly associated with lower odd of complete ANC utilization (OR = 0.353, $p < 0.05$; OR = 0.141, $p < 0.05$; OR = 0.137, $p < 0.05$, OR = 0.565, $p < 0.05$ and OR = 0.639, $p < 0.05$) as compare to those from the North-Central region. These findings were similar to findings of Paul and Chouhan (2020).

In addition, it was discovered that women with 2nd and others birth order were associated with increase odd of complete ANC utilization (OR = 2.937, $p < 0.05$ and OR = 1.442, $p < 0.05$) as compared to those with first birth order. This indicates that the ANC utilization increases as the birth order increases. This finding was in line with findings of Kitabo and Damtie (2020) and Gebrekrstos *et al* (2023). The odd of household head with age 20 – 29 is 0.753, $p < 0.05$) and that of age 30 – 39 is 0.882, $p < 0.05$. This implies that household head with age 20 – 29 and 30 – 39 has decrease odd of ANC utilization. This finding was in agreement to findings of Shanto et al (2023).

5.0 Conclusion and Recommendations

The study determined the factors affecting maternal health care utilization in Nigeria using binary logistic regression modelling. In this study, we adopted antenatal health care utilization as an indicator of maternal health care utilization. Based on the findings of the study, it was concluded that Maternal age at birth, maternal educational level, ethnicity, place of residence, religion, wealth index, sex of household head, birth type, insurance cover, maternal employment status, preceding birth intervals, household size, region, birth order and age of household head were the significant factors affecting maternal health care utilization in Nigeria.

Based on this conclusion, the following recommendations were made:

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i. To increase the use of maternal health care, the government should focus on improving economic conditions and educational opportunities for women through formulating policies and initiatives that target women with no education and those in lower income groups must be put into place.

ii. The high rate of maternal death in Nigeria may be reduced by women's health care initiatives that address socioeconomic disparities and imbalances by raising public awareness of the need to obtain and use easily available healthcare facilities.

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