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DEMOGRAPHIC ANALYSIS ON MATERNAL MORTALITY RATE IN AKWA IBOM STATE

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ABSTRACT: *This study examined maternal mortality in Akwa Ibom State—a state in the south-south region of Nigeria. Special attention was paid to a fundamental demographic factor, age, and a medical factor. Partitioning the population into age groups, it was realized that the age group with the highest mortality rate (42,105 out of every 100,000) is between 43 and 49, though it has the lowest number of pregnancies. In contrast, the age group with the highest number of pregnancies (1,226) and the lowest maternal mortality rate (9,054, out of every 100,000) is between 25 and 30. Independence tests were carried out to ascertain whether or not mortality status depends on age group and delivery method. The results showed that while status was not affected by delivery method, it significantly depended on age group. This result was further seen in the binary logistic regression model fitted to the data to determine the extent of the relationship between status and these factors. The model showed that age is a significant variable in determining mortality status, while delivery method is not. It is recommended that the age limit at first marriage for young girls be increased in a bid to stem maternal mortality due to complications within the age group (10-19).*

KEYWORDS: Mortality, maternal, demographic, Akwa Ibom.

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INTRODUCTION

Over the years, maternal mortality has remained a serious concern, particularly in developing countries, including Nigeria. Maternal mortality, otherwise known as maternal death, is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy (Shah & Say, 2007). It is one of the major (if not the leading) causes of death among women of reproductive age in developing countries. It is still the leading cause of death for women of reproductive age in many countries and is a serious public health concern, particularly in developing countries. According to the WHO Fact Sheet (2008), the estimated number of maternal deaths worldwide in 2005 was 536,000, compared to 529,000 in 2000. In a more recent study, (Dogbanya, 2025) reported that Nigeria has the highest estimated maternal death rate, accounting for over one-quarter (28.3%) of all estimated global maternal deaths, with approximately 8,200 maternal deaths. Most of these deaths occur in developing countries, and most are avoidable. Of all the health statistics compiled by the World Health Organization (WHO), the largest discrepancy between developed and developing countries occurred in maternal mortality.

Ujah et al. (2005), in the study, reported that 25% of women in the reproductive age live in developed countries, and they contribute only a percent to maternal mortality worldwide.

It is reported that Nigeria contributes an estimated 10% to annual maternal mortality (Shiffman & Okonofua, 2007). This is a statistic to be worried about. Of course, this high rate is not a random event. It can be attributed to obvious factors bordering on awareness and health care services. Olonade et al. (2019), in their review, submitted that maternal mortality has continued to increase in many nations of the world, especially in the African countries of the sub-Saharan regions, caused by factors that include a low level of socioeconomic development. It was reported that in Nigeria, a high percentage of pregnant women do not receive adequate care as a result of a lack of services in the residences they live in or an inability to afford the services because they are exorbitantly charged. (Ekong, et al, 2021; Iseh, et al, 2022)

In Nigeria, inadequate access to and management of maternal health services has long been a significant issue. Nigeria's healthcare system performed 187th out of 191 United Nations member states in 2000, according to the WHO. Because there are either no services available where they reside or because accessing the services is too costly, many pregnant women in Nigeria do not receive the care they require. Because they dislike the way treatment is delivered or because the health services are not providing high-quality care, some women choose not to use services. Furthermore, a pregnant woman may not receive the care she need due to cultural norms or her poor social standing. In Nigeria, around two-thirds of all deliveries take place outside of medical institutions without the presence of medically trained workers. It is important to consider the nation's long-standing governance issues while analyzing the health system's poor performance. Political corruption is pervasive, and social development—including enhancing the health of Nigerians—has primarily been a rhetorical rather than a practical goal of the government (Harrison, 2009). However, in many affluent nations, nearly all pregnant women receive prenatal and postnatal care, and a midwife or doctor is present during the delivery process. Obstacles to obtaining health services and deficiencies in the quality and capability of health systems must be recognized and addressed at all levels, including the community, in order to enhance maternal health. (WHO, 2020).

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Omo-Aghoja et al. (2010), in the study carried out in Benin City, South-south Nigeria, attributed 61.9% of the associated cause of maternal mortality to Type III delay. It was also asserted that the health system of the country is bedeviled by serious issues like lack of skills, unwelcoming staff disposition to patients, inadequate infrastructure, shortage of necessary medications, and general poor service delivery. See also (Nwankwo & George, 2020; Iseh & Bassey, 2021).

While efforts to lower maternal mortality in Nigeria have been made in the past, they have typically not been very successful in producing the intended outcomes, particularly when done by the federal and state governments. However, a few state governments' policy measures have started to show some encouraging effects. A bill ensuring free maternal health services for expectant mothers was approved by the state assembly in 2005 in Anambra state (Shiffman and Okonofua, 2007). A line item for free maternal health services was added by the Kano state government to its budget. State and local budgets in Jigawa state allocated money for the improvement of hospitals' obstetric care facilities, among other things. Despite tremendous international efforts to lower maternal mortality, Nigeria still has one of the highest MMRs in the world. Nigeria was responsible for almost 15% of all maternal fatalities worldwide in 2020, according to the WHO. With 512 deaths for every 100,000 live births, the nation's MMR is significantly higher than the Sustainable Development Goal (SDG) objective of fewer than 70 deaths for every 100,000 live births by 2030. Nigeria's high MMR is a complicated problem that is impacted by a number of demographic variables, including age, income, education, location, and cultural background. To comprehend the connections between these variables and maternal mortality in Nigeria, a thorough demographic analysis is lacking.

The high maternal mortality rate is multifaceted. Apart from the medical services aspect, demographic factors such as age, and so on interplay and may prove to be significant factors. This study, therefore, is tailored to investigate how some of the demographic factors affect maternal mortality in Akwa Ibom State, Nigeria.

METHODOLOGY

Data Collection

The data for this study are recorded cases of live births and maternal deaths, ages and delivery methods collected from St. Luke's Hospital, Anua; Emmanuel General Hospital, Eket and General Hospital, Ikot Ekpene, representing the three senatorial districts – Uyo, Eket and Ikot Ekpene senatorial districts, respectively, in Akwa Ibom State for the years 2022, 2023 and 2024. A total of 3055 patients' records were captured.

Mortality Rates

The data are classified into age groups within the reproductive age; then, the mortality rates are computed for each of the age groups:

$$Maternal\ Mortality\ Rate = \frac{Number\ of\ Maternal\ deaths}{Number\ of\ live\ births} \times 100{,}000$$

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Test of Independence

In order to investigate whether maternal status (dead or alive) depends on age group, a chi-square test of independence is carried out by using the layout of the contingency table presented in Table 1.

Table 1: Layout of Contingency for Test of Independence of Status on Age Group

Age Group	Alive	Dead	Total
Age Group 1	m_{11}	m_{12}	$T_{1.}$
Age Group 2	m_{21}	m_{22}	$T_{2.}$
Age Group 3	m_{31}	m_{32}	$T_{3.}$
Age Group 4	m_{41}	m_{42}	$T_{4.}$
Age Group 5	m_{51}	m_{52}	$T_{5.}$
Age Group 6	m_{61}	m_{62}	$T_{6.}$
Total	$T_{.1}$	$T_{.2}$	$T_{..}$

where

$$T_{i}. = \sum_{j}^{c} m_{ij}\,, j = 1, 2, \ldots, c$$

$$T_{.j} = \sum_{i}^{r} m_{ij}\,, i = 1, 2, \ldots, r$$

The expected values for cell m_{ij} are computed as

$$E_{ij} = \frac{T_{i}.\times T_{\cdot j}}{T_{..}}$$

and the chi-square value is calculated as

$$\chi^{2} = \sum_{i}^{r}\sum_{j}^{c} \frac{\left(O_{ij} - E_{ij}\right)^{2}}{E_{ij}}$$

When the null hypothesis is true, $\chi^{2} \sim \chi^{2}_{(r-1)(c-1)}(\alpha)$

A similar test is carried out to investigate whether the status depends on delivery method or not, and the layout of the contingency table is presented in Table 2.

Table 2: Layout of Contingency for Test of Independence of Status on Delivery Method

Age Group	Alive	Dead	Total
Normal	n_{11}	n_{12}	$T_{1.}$
Caesarean Section	n_{21}	n_{22}	$T_{2.}$
Total	$T_{.1}$	$T_{.2}$	$T_{..}$

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Binary Logistic Regression

This is used when the dependent variable has only two values, such as 0 and 1 or *Yes* and *No*. As applicable to this study, the maternal status is either *Dead* or *Alive*; and the numerical values of 0 and 1 have been assigned, respectively, to these two.

If θ denotes the proportion of observations with an outcome of 1, then $1-\theta$ is the probability of an outcome of 0. The ratio $\frac{\theta}{1-\theta}$ is called the odds, and the logit is the logarithm of the odds, simply called the log odds. This transformation is written as

$$I = logit(\theta) = ln\ ln\left(\frac{\theta}{1-\theta}\right)$$

The logistic regression equation is then

$$ln\ ln\left(\frac{\theta}{1-\theta}\right) = \alpha_0 + \sum_{i=1}^{k} \alpha_i X_i;$$

where X_i are the independent variables, and what $\alpha_i \in R$ is the impact of variable $X \quad i$ to $\quad i$ the model.

Solving for θ, the probability of outcome with code 1;

$$ln\ ln\left(\frac{\theta}{1-\theta}\right) = t; t = \alpha_0 + \sum_{i=1}^{k} \alpha_i X_i$$

$$\frac{\theta}{1-\theta} = e^t$$

$$\theta = \frac{e^t}{1+e^t} = \frac{e^{\alpha_0 + \sum_{i=1}^{k} \alpha_i X_i}}{1 + e^{\alpha_0 + \sum_{i=1}^{k} \alpha_i X_i}}$$

Statistical Tests

There are two available methods for testing for the significance of the independent variables in the logistic regression. These are the likelihood ratio test and the Wald test.

Though the likelihood ratio test performs better than Wald's test in simulation studies, Wald's test performs about the same as the likelihood ratio test in large samples (Agresti, 2015; Pawitan, 2001).

Wald's Test

The Wald's test statistic is calculated the same way as the common t-test for testing the significance of a particular regression coefficient in multiple regression analysis. The Wald's test statistic is

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$$z_i = \frac{a_i}{s_{a_i}},$$

where s_{a_i} an estimate of the standard deviation of a_i, provided by the square root of the corresponding diagonal element of the covariance matrix $V(\hat{\alpha})$.

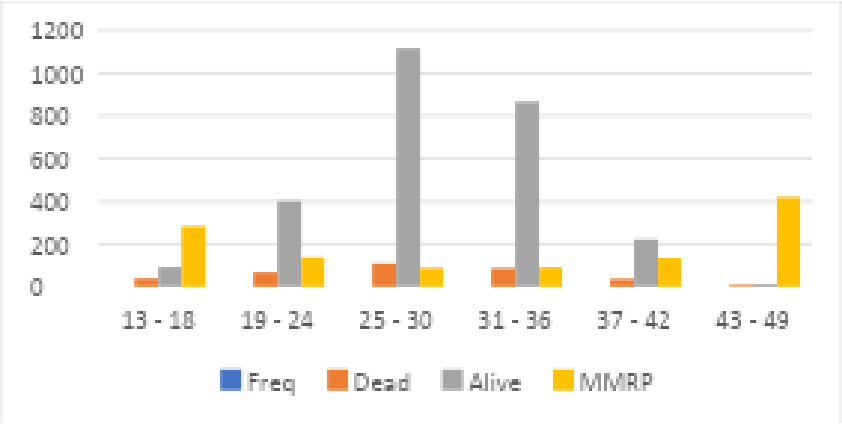
RESULTS

This section presents the major results of the study. Table 3 summarizes the data, as classified into age groups and the maternal mortality rates for each group. Figure 1 gives further insight to the data.

Table 3: Maternal Mortality Rates across Age Groups

Age Group	Number of Women	Dead	Alive	Maternal Mortality Rate
13 - 18	131	37	94	28244.275
19 - 24	468	65	403	13888.889
25 - 30	1226	111	1115	9053.8336
31 - 36	954	89	865	9329.1405
37 - 42	257	35	222	13618.677
43 - 49	19	8	11	42105.263

Figure 1: Chart depicting the number of 'Dead', 'Alive' and the Maternal Mortality Rates for the different age groups



Executing the Tests of Independence

The tests of independence to ascertain whether or not the status depends on age group or on delivery method are carried out, as described in section two. This is done with the help of Minitab statistical software (version 17). The expected counts and test statistic values are given in subsequent tables.

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Table 4: Observed Counts for Test of Independence Status on Age Group

Age Group	Dead	Alive	Total
13 - 18	37	94	131
19 - 24	65	403	468
25 - 30	111	1115	1226
31 - 36	89	865	954
37 - 42	35	222	257
43 - 49	8	11	19
Total	345	2710	3055

Table 5 Expected Counts for Test of Independence Status on Age Group

Age Group	Dead	Alive	Total
13 - 18	14.8	116.2	131
19 - 24	52.9	415.1	468
25 - 30	138.5	1087.5	1226
31 - 36	107.7	846.3	954
37 - 42	29.0	228.0	257
43 - 49	2.1	16.9	19
Total	345	2710	3055

Pearson Chi-Square = 69.927, df = 5, p-Value = 0.000

Using the same procedure, the test of independence of status on delivery method is also carried out. The observed values, expected values and the test result are shown in Tables 6 and 7, respectively.

Table 6: Observed Counts for Test of Independence Status on Delivery Method

Age Group	Dead	Alive	Total
Normal	163	1333	1496
CS	182	1377	1559
Total	345	2710	3055

Table 7: Expected Counts for Test of Independence Status on Delivery Method

Age Group	Dead	Alive	Total
Normal	168.9	1327.1	1496
CS	176.1	1382.9	1559
Total	345	2710	3055

Pearson Chi-Square = 0.462, df = 1, p-Value = 0.497

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Fitting the Binary Logistic Model

Table 8 describes the variables for the Binary logistic regression model.

Table 8: Description of Variables

Variable	Category
Status (Dependent Variable)	0 is the code for "Alive." 1 is the code for "Dead."
Age Group	1 is for age group 13 – 18 2 is for age group 19 – 24 3 is for age group 25 – 30 4 is for age group 31 – 36 5 is for age group 37 – 42 6 is for age group 43 – 49
Delivery Method	1 is the code for normal delivery 2 is the code for delivery by Caesarean Section (CS)

Having described the data, the model is fitted to the data with the help of the Statistical Package for Social Sciences (SPSS), version 20.0, and the results are presented in Table 9.

Table 9: Result Summary

Factors and their levels	Coefficient	S.E.	Wald	df	p-value	Odds Ratio
Delivery (1)	-0.100	0.116	0.738	1	0.390	0.905
Age Group			61.700	5	0.000	
Age Group (1)	-0.623	0.504	1.530	1	0.216	0.536
Age Group (2)	-1.524	0.484	9.907	1	0.002	0.218
Age Group (3)	-2.004	0.476	17.750	1	0.000	0.135
Age Group (4)	-1.969	0.478	16.955	1	0.000	0.140
Age Group (5)	-1.545	0.499	9.566	1	0.002	0.213
Constant	-0.256	0.470	0.295	1	0.587	0.774

DISCUSSION

Gaining insight from Figure 1, which is a plot of Table 3, it is seen that age group 25 – 30 has the highest number of reproductions, followed by age group 31 – 36. As much as this may be attributed, partially, to selection bias, the group with the highest maternal mortality rate is 43 – 49. This is a clear indication that age contributes as a factor in maternal mortality. This claim is confirmed by the result of the test of independence of status on age group, presented in Table 5, where (from the p-value) the result is seen to be significant – hence, the conclusion that maternal status is dependent on age group. Though the maternal status significantly depends on age group, the study reveals that status does not depend on delivery method, as seen from the p-value in Table 7. This result supports the existing result in the literature.

The chi-square tests of independence are corroborated by binary logistic regression model results in Table 9. While delivery method, with a p-value of $0.390 > 0.05$, does not contribute significantly to the model, the age factor contributes significantly to the overall model fit, with

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a Wald's test statistic of 61.7 and a p-value of 0.000. It is further observed that the Wald's test statistics for all the age groups, except group 1, are significant (with p-values of less than 0.05)—meaning that they all contribute significantly to determining the outcome of maternal mortality. The odds ratio for normal delivery is 0.905, meaning that normal delivery has 9.5% lower odds against CS, which is the reference value.

The odds ratios for age groups 1 – 5 are all less than 1, signifying lower odds against age group 6, the reference age group. This is also explained by the high mortality rate for the group, as seen in Figure 1, and is relatable to what happens in our society. Pregnant women within these age brackets are prone to a lot of health-related complications, which may contribute to the high mortality rates in this age group. It is observed that the age group for relatively safe reproduction is between 25 and 30, as this group boasts the highest number of pregnancies and the lowest mortality rates.

CONCLUSION

This study has been able to investigate the relationships between some factors that contribute to maternal mortality in Akwa Ibom State. The binary logistic regression has proven to be adequate in modeling the outcome of maternal mortality. The result of the study has revealed that while delivery method is not a significant factor in maternal mortality, age is a very significant factor. It has been established, from the study, that the reproductive age group with the least associated risk is between 25 and 30. This is also the age group with the highest number of pregnancies, from the data collected. As the age increases from this point, the risk of mortality also increases. It is recommended that the age limit at first marriage for young girls should be increased in a bid to stem complications like pregnancy-induced hypertension, increased likelihood of anemia, premature rupture of membranes, and prolonged labors, among others, which contribute to maternal mortality within the age group (13 - 18). Proper data collection and monitoring systems should be implemented to identify and follow up on the outcomes of pregnant women and track progress toward reducing maternal mortality rates in the state.

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REFERENCES

Agresti, A. (2015). Foundations of linear and generalized linear models. Wiley.

Dogbanya, G. (2025). Maternal Mortality in Nigeria: Holding the Line in Uncertain Times. Annals of Global Health, 91(1), 1 - 2. doi: https://doi.org/10.5334/aogh.4710

Ekong, N., Moffat, I., Usoro, A., & Iseh, M. (2021). A comparative study of the impact of dummy variables on regression coefficients and canonical correlation indices: An empirical perspective. *International Journal of Analysis and Applications, 19*(4), 576 - 586. doi:10.28924/2291-8639-19-2021-576

Article DOI: 10.52589/AJMSS-AUAICTX8
DOI URL: https://doi.org/10.52589/AJMSS-AUAICTX8

Harrison, K. A. (2009). The struggle to reduce high maternal mortality in Nigeria. *African Journal of Reproductive Health, 13*(3), 9 - 20.

Iseh, M. J., & Bassey, K. J. (2021). A new calibration estimation of population mean for a small area with nonresponse. *Asian Journal of Probability and Statistics, 12*(2), 41 - 51. doi:10.9734/AJPAS/2021/v/2i230286

Iseh, M., Usoro, A., Ekong, N., & Ukpe, I. (2022). Juxtaposing Vertically Transmitted Infections (VTIs) and the Spread of HIV/AIDS in a Typically Infection-Prevalent Region in Nigeria. *Journal of the Nigerian Society of Physical Sciences, 4*(2022), 99 - 104. doi:10.46481/jnsps.2022.418

Nwankwo, C. H., & George, E. U. (2020). Optimization of a network of queues in a university teaching hospital. *African Journal of Mathematics and Statistics Studies, 3*(1), 35 - 53.

Olonade, O., Olawande, T. I., Alabi, O. J., & Imhonopi, D. (2019). Maternal Mortality and Maternal Healthcare in Nigeria: Implications for Socio-Economic Development. *Open Access Macedonian Journal of Medical Science*, 849 - 855. doi: oamjms.2019.041

Omo-Aghoja, L. O., Aisien, O. A., Akuse, J. T., Bergstrom, S., & Okonofua, F. E. (2010). Maternal mortality and emergency obstetric care in Benin City, South-south Nigeria. *Journal of Clinical Medicine and Research, 2*(4), 55 - 60.

Pawitan, Y. (2001). *In all likelihood: Statistical modeling and inference using likelihood.* Oxford University Press.

Shah, I. H., & Say, L. (2007). Maternal Mortality and Maternal Care from 1990 to 2005: Uneven but Important Gains. *Reproductive Health Matters, 15*(30), 17 - 27. doi: 10.1016/S0968-8080(07)30339-X

Shiffman, J., & Okonofua, F. (2007). The state of political priority for safe motherhood in Nigeria. *BJOG: An International Journal of Obstetrics and Gynaecology, 114*, 127 - 133. doi:10.111/j.1471-0528.2006.01184.x

Ujah, I. A., Aisien, O. A., Mutihir, J. T., Vanderagt, D. J., Glew, R. H., & Uguru, V. E. (2005). Factors Contributing to Maternal Mortality in North-central Nigeria: A Seventeen-year Review. *African Journal of Reproduction Health, 9*(3), 27 - 40.

World Health Organization (2008). Factsheet, Maternal Mortality, Department of Making Pregnancy Safer.

World Health Organization (2020). *Sexual and Reproductive Health. Maternal Health in Nigeria: Generating Information for Action*. Accessed January 7, 2020. https:// www.who.int/reproductivehealth/maternal-health-nigeria/en/

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