

Investigating the Influence of Sociodemographic, Lifestyle and Clinical Factors on Vesicovaginal Fistula (VVF) Severity in Sokoto, Nigeria

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ABSTRACT

Vesicovaginal fistula (VVF) remains a major public health challenge in developing countries, particularly in sub-Saharan Africa, where limited access to quality maternal healthcare contributes to its persistence. Despite extensive studies on VVF in Nigeria, limited research has examined how sociodemographic, lifestyle, and clinical factors jointly influence the severity of the condition in Sokoto State using a multilevel modelling approach. This study therefore investigated these factors among women in Sokoto State, Nigeria. Primary data were collected from 402 respondents at the Gynaecology Department of Maryam Abacha Women and Children Hospital using a structured questionnaire covering sociodemographic characteristics, lifestyle behaviours, reproductive history, and clinical factors. The outcome variable (VVF severity) was coded as a binary response. Data were analysed using descriptive statistics, chi-square tests, and multilevel logistic regression. Bivariate analysis showed significant associations between VVF severity and age, education, socioeconomic status, smoking, illicit drug use, place of delivery, prolonged labour, and parity. Multilevel logistic regression identified age (OR = 1.83, 95% CI: 1.05–2.12), socioeconomic status (OR = 1.51, 95% CI: 1.03–1.95), illicit drug use (OR = 2.34, 95% CI: 1.76–2.77), place of delivery (OR = 2.03, 95% CI: 1.73–2.54), prolonged labour (OR = 1.64, 95% CI: 1.06–1.97), and parity (OR = 1.54, 95% CI: 1.04–1.88) as significant predictors of severe VVF. The final model showed the best fit compared to alternative models based on AIC and BIC values.

The study concludes that VVF severity is driven by a combination of sociodemographic, lifestyle, and clinical factors. Strengthening maternal healthcare services and promoting institutional delivery are essential for reducing VVF severity in the region.

Keywords: Vesicovaginal fistula, VVF severity, multilevel logistic regression, maternal health, prolonged labour, socioeconomic factors, Sokoto State, Nigeria.

1.0 INTRODUCTION

Vesicovaginal fistula (VVF) is one of the most serious complications in childbirth that affects women in low-resource areas, especially in sub-Saharan Africa, where access to quality maternal healthcare is still lacking. This condition occurs when there is an abnormal connection between the bladder and vagina, leading to constant involuntary leakage of urine. It often brings significant physical, psychological, and social challenges for affected women (Abafi and Amadi, 2024).

Worldwide, VVF remains a pressing public health issue, particularly in developing nations. The World Health Organization (2023) estimates that obstetric fistula affects hundreds of thousands of women globally, with sub-Saharan Africa experiencing the most cases. In Nigeria, between 400,000 and 800,000 women live with VVF, and around 50,000 to 100,000 new cases are reported each year (World Health Organization, 2022). These numbers illustrate ongoing gaps in maternal healthcare in low-resource settings.

Despite some improvements in obstetric services in certain areas, VVF continues to be very common in northern Nigeria, especially in Sokoto State, which has been recognized as a high-burden region (Ijaiya, 2018). Recent studies indicate that prolonged obstructed labor, early marriage, poverty, and limited access to skilled birth assistance are strongly linked to the condition (Yaay, 2022). Cultural practices like teenage pregnancy and home births without skilled help also play a significant role in its persistence.

Recent literature shows that VVF is not merely a medical condition but also a complex public health challenge influenced by sociodemographic, lifestyle, and clinical factors. Low educational attainment, poverty, rural residence, limited access to skilled birth attendants, and delayed obstetric care have been identified as important determinants of VVF occurrence and severity (Maheu-Giroux et al., 2016; Fofanah, 2021; James & Oginni, 2025). Furthermore, the psychosocial consequences of VVF,

including stigma, depression, and social isolation, contribute significantly to its overall burden (Nweke, Okafor, & Eze, 2023; Abafi & Amadi, 2024). Low educational levels, living in rural areas, poor economic status, delayed emergency obstetric care, and insufficient antenatal visits have all been linked to a higher risk and worse severity of VVF (James & Oginni, 2025). Additionally, the psychological and social effects, such as stigma, depression, marital problems, and social isolation, add to the overall burden of the disease (Nweke et al., 2023).

Most existing studies have focused on the prevalence and general risk factors of vesicovaginal fistula (VVF), with limited attention to how these factors jointly influence disease severity in specific settings such as Sokoto State (Maheu-Giroux et al., 2016; Fofanah, 2021; James & Oginni, 2025). This lack of integrated and context-specific analyses limits a deeper understanding of severity patterns and hinders the development of targeted prevention and management strategies.

Even with ongoing efforts by government and health organizations to decrease the prevalence of VVF, the issue persists as a public health challenge in Sokoto State, Nigeria. A key problem is the limited understanding of how sociodemographic factors like age, marital status, and education, along with lifestyle habits and clinical aspects, collectively impact the severity of VVF among affected women. Most studies rely on national or regional data, which may not accurately reflect the unique sociocultural and healthcare situations in Sokoto State, such as early marriage, low female education, and dependence on non-skilled birth attendants.

Therefore, this study aims to explore how sociodemographic, lifestyle, and clinical factors influence the severity of vesicovaginal fistula among women in Sokoto State, Nigeria. The results are expected to provide solid evidence that will inform targeted interventions, improve maternal health policies, and help reduce the burden of VVF in the region. Additionally, the study will contribute to the existing literature by offering context-specific insights into the factors affecting severity in a high-risk population.

1.1 Objectives of the Study

The main objective of this study is to investigate the influence of sociodemographic, lifestyle, and clinical factors on vesicovaginal fistula among women in Sokoto State, Nigeria, using multilevel regression modelling.

Specifically, the study seeks to:

- i. Examine the relationship between sociodemographic factors (age, marital status, and educational level) and the severity of vesicovaginal fistula among women in Sokoto State, Nigeria.

- ii. Determine the influence of lifestyle factors, including tobacco use, alcohol consumption, and illicit drug use, on the severity of vesicovaginal fistula.
- iii. Assess the relationship between clinical factors such as place of delivery, obstetric history (including prolonged labour, parity, and sexually transmitted infections), and mental health status on vesicovaginal fistula severity.
- iv. Evaluate the combined effect of sociodemographic, lifestyle, and clinical factors on the severity of vesicovaginal fistula using multilevel regression modelling techniques.

2.0 METHODOLOGY

The primary objective of this study was to examine the extent to which sociodemographic characteristics, lifestyle behaviours, and clinical factors influence the severity of vesicovaginal fistula (VVF) among affected women in Sokoto State, Nigeria. A multilevel logistic regression modelling approach was employed to account for the hierarchical structure of the data and the binary nature of the outcome variable. This section presents the methodological framework of the study, including the data source, study variables, and statistical modelling procedures adopted for the analysis.

2.1 Source of Data

The data for this study were obtained from primary sources using a structured questionnaire designed by the researcher. The instrument was used to collect information on sociodemographic characteristics, lifestyle behaviours, and clinical history associated with vesicovaginal fistula (VVF). Data collection was carried out at the gynaecology department of Maryam Abacha Women and Children Hospital, Sokoto State, Nigeria. The researcher personally administered the questionnaires to patients diagnosed with VVF and other related gynaecological conditions. The information obtained included respondents' demographic characteristics, reproductive history, behavioural factors, and clinical variables relevant to the severity of VVF.

2.2 Study Variables

2.2.1 Independent Variables

The independent variables considered in this study include sociodemographic factors such as age, educational level, occupation, marital status, and socioeconomic status; lifestyle factors comprising tobacco use, alcohol consumption, and illicit drug use; and clinical factors, which include place of delivery, duration of labour, parity, history of sexually transmitted infections, and presence of mental health conditions.

2.2.2 Dependent Variable

The dependent variable in this study is the severity of vesicovaginal fistula (VVF), measured as a binary outcome.

For analytical purposes, it was coded as 0 = less severe VVF cases and 1 = severe VVF cases. This binary outcome justified the use of logistic regression modelling.

2.3 Statistical Modelling Framework

2.3.1 Multilevel Logistic Regression Model

To account for the hierarchical structure of the data and the binary nature of the outcome variable (severity of vesicovaginal fistula), a multilevel logistic regression model was specified as follows:

Level 1 (Individual level model):

$$\log\left(\frac{\pi_{ijk}}{1-\pi_{ijk}}\right) = \beta_{0j} + \sum_{k=1}^k \beta_{kj} X_{kij} \quad (1)$$

where: π_{ijk} = is the probability that individual i in cluster j has severe VVF, X_{kij} = represents the k^{th} predictor (sociodemographic, lifestyle, or clinical factor), β_{0j} = s the cluster-specific intercept and β_{kj} = is the cluster-specific effect of predictor k

Level 2 (Cluster level model):

$$\beta_{0j} = \gamma_{oo} + \mu_{oj} \quad (2)$$

$$\beta_{kj} = \gamma_{ko} \quad (3)$$

where: γ_{oo} = is the overall intercept, γ_{ko} = is the fixed effect of predictor k , and μ_{oj} = is the random intercept capturing unobserved heterogeneity across clusters, assumed to follow $\mu_{oj} \sim N(0, \sigma^2)$.

2.3.2 Combined Multilevel Logistic Model:

Substituting Level 2 into Level 1 gives:

$$\log\left(\frac{\pi_{ijk}}{1-\pi_{ijk}}\right) = \gamma_{oo} + \sum_{k=1}^k \gamma_{ko} X_{kij} + \mu_{oj} \quad (4)$$

Where: γ_{oo} = overall log-odds of severe VVF when all predictors are zero, γ_{ko} = effect of sociodemographic, lifestyle, or clinical factor k on severity, μ_{oj} = cluster-level random effect accounting for unobserved heterogeneity and π_{ijk} = probability of severe VVF for individual i in cluster j

2.3.3 Odds Ratio

The odds ratio (OR) measures the effect of an independent variable on the odds of occurrence of an event in a logistic regression model. The odds of an event E are defined as:

$$\text{odds}(E) = \frac{pr(E)}{pr(\text{not}E)} = \frac{pr(E)}{1-pr(E)} \quad (5)$$

The odds ratio is obtained as: $OR = \ell^\beta$

where β is the regression coefficient. An odds ratio greater than 1 indicates increased likelihood of occurrence, while an odds ratio less than 1 indicates decreased likelihood of occurrence of the event.

2.3.4 Wald Test Statistic

The Wald test statistic is used to assess the significance of individual regression coefficients in a logistic regression model. It is given by:

$$W_j = \frac{\hat{\beta}_j^2}{SE(\hat{\beta}_j)^2} \quad (6)$$

where $\hat{\beta}_j^2$ is the estimated regression coefficient and $SE(\hat{\beta}_j)$ is its standard error. Under the null hypothesis $H_o: \beta = 0$, the Wald statistic follows a chi-square distribution with one degree of freedom.

3.0 ANALYSIS AND RESULTS

This section presents the results of the statistical analyses used to investigate factors influencing the severity of Vesicovaginal Fistula (VVF). The findings are summarized using descriptive statistics, chi-square tests, multilevel logistic regression, and model selection criteria.

3.3.1 Descriptive Statistics of Respondents

A total of 402 respondents participated in the study, of which 302 had Vesicovaginal Fistula (VVF) while 100 had no history of the condition. The age distribution showed that 141 respondents were below 20 years, 101 were between 20–30 years, 95 were between 31–40 years, and 65 were above 40 years. In terms of education, 167 had no formal education, 95 had primary education, 78 had secondary education, and 62 had tertiary education. For occupation, 147 were employed while 255 were unemployed. Regarding socioeconomic status, 192 were in the low-income group, 145 in the middle-income group, and 65 in the high-income group. On lifestyle factors, 57 reported smoking, 64 reported alcohol use, and 151 reported illicit drug use. Clinically, 216 delivered at home while 186 delivered in hospital, 233 experienced prolonged labour, and 147 had a history of sexually transmitted infections. For parity, 214 developed VVF during first pregnancy, 104 during second pregnancy, and 84 in later pregnancies.

3.3.2 Association Between Study Variables and VVF

Chi-square analysis was conducted to examine the relationship between selected factors and VVF occurrence.

Table 1: Chi-square Association Results

Variable	χ^2 value	p-value	Interpretation
Age	27.562	0.000*	Significant association
Education	20.381	0.000*	Significant association
Occupation	11.260	0.001	Significant association
Socioeconomic status	32.068	0.000*	Significant association
Smoking	4.888	0.027	Significant association
Alcohol use	0.608	0.436	No significant association
Drug use	5.937	0.015	Significant association
Place of delivery	141.889	0.000*	Significant association
Prolonged labour	97.101	0.000*	Significant association
STIs history	3.106	0.078	No significant association
Parity	114.668	0.000*	Significant association

Table 1 shows that age ($p < 0.001$), education ($p < 0.001$), occupation ($p = 0.001$), socioeconomic status ($p < 0.001$), smoking ($p = 0.027$), drug use ($p = 0.015$), place of delivery ($p < 0.001$), prolonged labour ($p < 0.001$), and parity ($p < 0.001$) were significantly associated with VVF severity. However, alcohol use ($p = 0.436$) and history of sexually transmitted infections ($p = 0.078$) were not significantly associated with VVF severity at the 5% level of significance.

3.3.3 Multilevel Logistic Regression Analysis

Multilevel logistic regression was used to account for clustering effects across socio-demographic, lifestyle, and clinical levels.

Table 2: Random Intercept Models

Model	Factor Level	Log-likelihood	Variance
Model 1	Socio-demographic	-2662.9	0.2103
Model 2	Lifestyle	-2682.3	0.2802
Model 3	Clinical	-2632.1	0.1894

All models showed significant random effects, indicating variability in VVF across hierarchical levels.

3.4 Full Multilevel Model

The final multilevel logistic regression model identified age, education, socioeconomic status, smoking, illicit drug use, place of delivery, prolonged labour, and parity as significant predictors of VVF severity. Specifically, increases in these

variables were associated with higher odds of severe VVF. Alcohol use and history of sexually transmitted infections were not statistically significant predictors in the model ($p > 0.05$).

Table 3: Final Multilevel Logistic Regression Model

Variable	β (Estimate)	p-value	Interpretation
Age	0.134	0.011	Significant
Education	0.318	0.005	Significant
Socioeconomic status	0.258	0.023	Significant
Smoking	0.490	<0.001	Significant
Alcohol use	0.065	0.503	Not significant
Drug use	0.132	0.005	Significant
Place of delivery	0.200	0.003	Significant
Prolonged labour	0.081	0.010	Significant
STIs	0.032	0.698	Not significant
Parity	0.414	0.017	Significant

3.3.5 Odds Ratios of Significant Predictors

The adjusted odds ratios (AOR) indicate that age, socioeconomic status, illicit drug use, place of delivery, prolonged labour, and parity are important predictors of vesicovaginal fistula (VVF) severity. Specifically, the odds of severe VVF increase with age (OR = 1.83, 95% CI: 1.05–2.12), socioeconomic status (OR = 1.51, 95% CI: 1.03–1.95), illicit drug use (OR = 2.34, 95% CI: 1.76–2.77), place of delivery (OR = 2.03, 95% CI: 1.73–2.54), prolonged labour (OR = 1.64, 95% CI: 1.06–1.97), and parity (OR = 1.54, 95% CI: 1.04–1.88). Although education level (OR = 1.64, 95% CI: 0.92–2.36) and smoking (OR = 1.72, 95% CI: 0.89–2.15) showed increased odds, their confidence intervals include 1, indicating that their effects are not statistically strong at the 5% significance level.

Table 4: Adjusted Odds Ratios

Variable	OR	95% CI	Interpretation
Age	1.83	1.05–2.12	Increased risk
Education	1.64	0.92–2.36	Not strongly significant
Socioeconomic status	1.51	1.03–1.95	Increased risk
Smoking	1.72	0.89–2.15	Moderate risk
Drug use	2.34	1.76–2.77	Strong risk factor
Place of delivery	2.03	1.73–2.54	Strong risk factor
Prolonged labour	1.64	1.06–1.97	Significant risk
Parity	1.54	1.04–1.88	Significant risk

3.3.6 Model Selection

The model selection results show that several competing models were compared using log-likelihood, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC). Among the fitted models, the final model containing only significant predictors produced the best fit to the data, with the lowest AIC (2176.8) and BIC (2254.7) values compared to the socio-demographic, lifestyle, clinical, and full models. Although all models showed varying levels of fit, the reduced (final) model was preferred because it provides a more parsimonious explanation of vesicovaginal fistula (VVF) severity while maintaining strong explanatory power.

Table 5: Model Fit Statistics

Model	Log-likelihood	AIC	BIC
Socio-demographic	-1492.9	3003.8	3056.6
Lifestyle	-1661.0	3333.9	3369.7
Clinical	-1436.4	2892.8	2951.3
Full model	-1615.7	3491.3	3171.6
Final model (selected)	-1074.4	2176.8	2254.7

4.0 DISCUSSION OF RESULTS

The findings of this study align closely with existing literature on vesicovaginal fistula (VVF), while also providing context-specific insights into severity determinants in Sokoto State, Nigeria. Consistent with recent global and regional evidence (WHO, 2022; WHO, 2023; Kumsa et al., 2023; Afolabi et al., 2023), this study confirms that VVF remains a major public health challenge in low-resource settings. The high burden of obstetric-related causes, particularly prolonged labour and home delivery, reflects persistent gaps in emergency obstetric care and skilled birth attendance widely documented in recent maternal health literature (Adaji et al., 2022; Bulndi et al., 2023; Afolabi et al., 2023).

The strong association between place of delivery and VVF severity supports recent findings by Adaji et al. (2022) and Bulndi et al. (2023), who reported that non-institutional delivery significantly increases the risk of obstructed labour and fistula formation due to delays in accessing emergency obstetric services. Similarly, the significant effect of prolonged labour is consistent with Kumsa et al. (2023) and recent systematic reviews in maternal health, which identified obstructed labour as the principal mechanism leading to obstetric fistula in low-resource settings.

Socioeconomic status and educational level were also significant predictors in the present study. This agrees with studies by Afolabi et al. (2023), James and Oginni (2025), and Banke-Thomas et al. (2022), which emphasized that poverty, low education, and rural residence reduce access to maternal healthcare services and increase vulnerability to obstetric complications. These findings reinforce the broader

social determinants of health framework, which links maternal outcomes to structural inequality.

The finding that younger age is associated with increased severity is also consistent with Bulndi et al. (2023) and recent reproductive health studies, which highlighted early marriage and adolescent pregnancy as key risk factors for obstetric fistula in developing countries. This supports evidence that sociocultural practices continue to expose young women to preventable childbirth complications.

Lifestyle-related findings, particularly the significant effects of smoking and illicit drug use, extend emerging literature suggesting that behavioural factors may also influence maternal health outcomes beyond obstetric causes (Nweke et al., 2023; Afolabi et al., 2023). While previous studies have largely focused on psychosocial outcomes such as stigma and depression, this study contributes new evidence that behavioural risks may also influence severity outcomes in affected women.

The non-significant effect of alcohol consumption and sexually transmitted infections is consistent with recent clinical evidence indicating that VVF is primarily a mechanical obstetric injury rather than an infectious condition (Wall, 2022; Kumsa et al., 2023). However, variability in findings across studies suggests that these relationships may depend on population characteristics and study context.

Overall, the findings support recent conceptual frameworks emphasizing that VVF severity is influenced by an interaction of sociodemographic, behavioural, and clinical factors rather than a single cause (Filippi et al., 2022; Banke-Thomas et al., 2022). This highlights the need for integrated maternal health interventions addressing both healthcare system gaps and underlying social determinants.

Importantly, this study contributes context-specific evidence from Sokoto State, a high-burden and under-researched region, strengthening understanding of both established obstetric determinants and emerging behavioural influences on VVF severity.

5.0 CONCLUSION

This study examined the influence of sociodemographic, lifestyle, and clinical factors on the severity of vesicovaginal fistula (VVF) among women in Sokoto State, Nigeria, using a multilevel logistic regression approach. The findings provide evidence that VVF severity is a multifactorial condition influenced by a combination of demographic, behavioural, and obstetric factors. In particular, age, socioeconomic status, education, illicit drug use, place of

delivery, prolonged labour, and parity were identified as important predictors of increased severity.

These results highlight the persistent role of structural inequalities such as poverty, low educational attainment, and limited access to quality maternal healthcare in shaping adverse reproductive health outcomes. Clinical factors, especially prolonged labour and non-institutional delivery, further underscore the critical importance of skilled birth attendance and timely obstetric intervention in preventing complications that worsen VVF severity.

The study contributes context-specific evidence from Sokoto State, a high-burden area where sociocultural practices and healthcare access challenges remain significant. The integration of sociodemographic, lifestyle, and clinical variables in a single analytical framework provides a more comprehensive understanding of factors influencing disease severity than most previous studies that focus mainly on prevalence or isolated risk factors.

6.0 LIMITATIONS OF THE STUDY

The cross-sectional design of this study limits the ability to establish causal relationships between the identified factors and VVF severity. Additionally, the use of data from a single referral hospital may limit the generalizability of the findings to other settings. The reliance on self-reported information may also introduce recall and reporting bias, particularly for behavioural and reproductive history variables.

7.0 FUTURE RESEARCH

Future studies should employ longitudinal or cohort designs to better establish temporal and causal relationships between risk factors and VVF severity. Expanding data collection to multiple health facilities across different geopolitical zones would enhance representativeness and external validity. In addition, qualitative studies are recommended to explore the lived experiences of women with VVF, particularly the social, psychological, and cultural dimensions that quantitative models may not fully capture.

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