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Drivers of Human Immunodeficiency Virus among Pregnant Women in Conflict and Non-conflict Zones of Nigeria

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ABSTRACT

Background and Objective: Human immunodeficiency virus (HIV) is a major public health concern among pregnant women in Nigeria, with seven in every hundred women likely to have an HIV infection. Understanding factors associated with HIV infection among pregnant women is critical to improving prevention strategies, especially in conflict regions. This study investigates demographic, socio-economic, and behavioral determinants of HIV among pregnant women in Nigeria, with conflict exposure included as a key predictor in the analysis.

Methods: This study is a cross-sectional design using data from the 2018 Nigeria HIV/Acquired Immunodeficiency Syndrome (AIDS) Indicator and Impact Survey, the largest population-based HIV survey globally, implemented between July and December 2018 across all 36 states and the Federal Capital Territory of Nigeria. We analyzed weighted data from 3,879,192 pregnant women (both HIV-positive and negative), conducting bivariate and multivariate analyses to identify predictors of HIV infection among women aged 15–49 years while adjusting for potential confounders. Adjusted Odds Ratios (AORs) with 95% confidence intervals (CIs) were generated using unconditional logistic regression models to determine significant predictors.

Results: Our analysis revealed that women in conflict zones were younger, less educated, and more likely to be in polygynous marriages and the lowest wealth quintile compared to those in non-conflict zones. In a multivariable analysis, residence in a conflict zone was associated with nearly twofold adjusted odds of HIV positivity (AOR = 1.93; CI: 0.98–3.82; p = 0.057). Increasing maternal age (AOR = 1.06; CI: 1.02–1.10; p = 0.002) and middle to fourth wealth quintile status (AOR = 4.10 and 3.80, respectively; $p < 0.05$) were significantly associated with a higher likelihood of HIV infection. Recent non-marital sexual activity was also significantly associated with HIV positivity (AOR = 2.96; p = 0.037).

Conclusion and Global Health Implications: The study identifies conflict exposure and socio-economic status as significant predictors of HIV infection among pregnant women in Nigeria. Our analysis reveals important demographic, socio-economic, and behavioral factors associated with HIV prevalence in this population. These findings underscore the need for comprehensive HIV prevention strategies that address the complex interplay of social determinants, particularly in vulnerable populations.

Keywords: Behavior, Conflict, Human Immunodeficiency Virus, Pregnancy, Risk, Women

INTRODUCTION

Human immunodeficiency virus (HIV)/Acquired immunodeficiency syndrome (AIDS) remains a significant public health challenge in sub-Saharan Africa, particularly among women of reproductive age.[1] In Nigeria, approximately 1.2 million women aged 15 and over were living with HIV in 2023, with a prevalence rate of 1.7% among women aged 15–49.[2] HIV among women significantly increases the chance of vertical transmission, also known as mother-to-child transmission (MTCT) during pregnancy, labor, and breastfeeding.[3]

Despite the widespread scale-up of prevention of MTCT (PMTCT) services, coverage remains suboptimal, with only 33% of pregnant women receiving antiretroviral therapy (ART) in 2023.[2] This has contributed to continued vertical transmission, with an estimated 8,200 new HIV infections averted due to PMTCT programs that year,[2] while advancements in highly active ART have significantly improved survival and quality of life for people living with HIV, challenges, including armed conflict continue to affect equitable access to prevention and treatment services.[4] Conflict-affected settings exacerbate women's vulnerability to HIV infection through mechanisms such as gender-based violence, family disintegration due to displacement, and the collapse of healthcare systems.[4] Understanding the unique drivers of HIV among pregnant women in these volatile settings is essential for designing targeted interventions that can mitigate disparities and improve outcomes.

Recent literature has drawn attention to the destabilizing effect of conflict on HIV care services. Armed conflicts often disrupt epidemiological patterns by displacing large populations, eroding healthcare infrastructure, and increasing the risk of HIV transmission through violence and limited access to care.[5] In some war-torn areas of sub-Saharan Africa, viral load non-suppression rates have increased up to 30%, with loss to follow-up as high as 43.5%.[6] However, despite the tremendous challenges associated with health care in war-torn zones, experiences from organizations such as Médecins Sans Frontières have demonstrated that continuity of ART is feasible through innovative strategies like the distribution of run-away bags containing several months of ART medication.[7] Nevertheless, significant gaps remain in our understanding of how conflict interacts with social determinants, such as education, poverty, and stigma, to influence HIV risk among vulnerable populations. Pregnant women in conflict zones may face unique exposures and barriers that are often reported in existing epidemiological studies.

This study explores predictors of HIV infection among pregnant women in Nigeria, including conflict zone residence as the key variable. The findings provide population-level evidence to guide HIV prevention strategies in high-risk settings.

METHODS

Study Design

This study employed a cross-sectional design using data from the Nigeria HIV/AIDS Indicator and Impact Survey (NAIIS), the largest population-based HIV survey in the world at the time, was designed as a nationally representative study to generate reliable estimates of HIV prevalence, viral load suppression, and other key epidemiological indicators. It also assessed the burden of other associated co-infections, including hepatitis B virus, hepatitis C virus, and tuberculosis. Detailed survey methodology is available in the NAIIS Final Report.[8]

This study was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines to ensure transparent and comprehensive reporting of our cross-sectional analysis.[9]

Study Population and Sampling

Our analysis restricted the study population to pregnant women aged 15–49 years. The NAIIS excluded individuals from military barracks, prisons, and other institutional settings. The sampling frame consisted of 662,855 Enumeration Areas (EAs) derived from the 2006 Nigerian National Population and Housing Census, which covered an estimated 28.9 million households and over 140 million individuals. A two-stage, stratified cluster sampling design was employed to ensure national and sub-national representativeness. In the first stage, EAs were selected using a probability proportional to size method. In the second stage, households within each selected EA were systematically sampled. All eligible household members were invited to participate in the survey, including undergoing HIV testing and completing detailed socio-demographic and behavioral questionnaires.

Study Variables

Outcome variable

The primary outcome was HIV status among pregnant women, determined through confirmatory laboratory testing using dried blood spots. Participants were categorized as HIV-positive or HIV-negative based on national testing algorithms.

Explanatory variables

Socio-demographic variables included, age (15–49 years), language (Hausa, Yoruba, Igbo, English, others), religion (Islam, Christianity, and others), educational status (no education, primary, secondary, and post-secondary), marital status (married and unmarried), type of marital union (not in union, polygynous union, and not in polygynous union), and wealth quintile (lowest, second, middle, fourth, and highest).

Sexual behavior and risk factors variables included the number of previous pregnancies, number of sexual partners in the past 12 months, sex with a non-marital, non-cohabiting partner in the past 12 months (Had sex, did not have sex), condom use at last sex in the past 12 months (used condom, did not use condom), HIV status in last pregnancy (positive, negative, and unknown), and current HIV status (positive and negative).

Conflict status: Based on our previous study,[10] participants were classified as residing in either conflict or non-conflict zones. States designated as conflict zones included Benue, Borno, Plateau, Yobe, and Zamfara.

Data Collection and Management

The NAIIS survey was carried out by a multidisciplinary team of 1,935 field staff, including team leaders, interviewers, counselors, laboratorians, and logistics personnel. Data collection was overseen by regional technical advisors and national-level supervisors. Structured electronic questionnaires were administered during face-to-face interviews conducted in respondents' homes using handheld tablets equipped with CSPro software. Household data and laboratory records were synchronized through Bluetooth and uploaded daily to secure central servers through File Transfer Protocol Secure. Biomarker data, including HIV status, were processed through the Laboratory Data Management System with rigorous quality control measures. Backup data were stored securely on encrypted USB drives at separate locations. The NAIIS dataset achieved a technical performance score of 96.3%,[11] affirming its reliability.

Data Analysis

All analyses were conducted using R software (version 4.4.3). Survey weights were applied to account for the complex sampling design, including stratification, clustering, and post-stratification adjustments. The survey package in R was utilized, specifically the "svydesign" function, to ensure accurate variance estimation and population-level inference.

Descriptive statistics were used to summarize demographic and behavioral characteristics by conflict and non-conflict zones. Categorical variables were compared using Chi-square tests and Fisher's Exact tests as appropriate, while continuous variables (non-normally distributed) were analyzed using Wilcoxon rank-sum tests. Survey-weighted logistic regression models were fitted to assess the predictors of HIV among pregnant women including conflict or non-conflict zone residence. Covariates included both socio-demographic and sexual behavior and risk factors variables. Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were generated, and a forest plot was used to visualize the regression results [Figure 1].

RESULTS

A total of 7,678 pregnant women were analyzed unweighted, with 875 (11.4%) from conflict zones and 6,803 (88.6%) from non-conflict zones. While the weighted sample comprised 3,879,192 pregnant women – 459,135 (11.8%) from conflict zones and 3,420,057 (88.2%) from non-conflict zones – the unweighted figures provide clarity on the actual number of participants assessed. The distribution of languages spoken differed significantly between the zones ($p < 0.001$). In conflict zones, Hausa was the predominant spoken language (88.5%), followed by English (10.8%). In non-conflict zones, Hausa was less pronounced as the dominant spoken language (56.7%), followed by Igbo (17.0%), Yoruba (16.8%), and English (9.6%). Religious affiliation also showed significant variation ($p < 0.001$), with a higher proportion of Muslims in conflict (70.0%) compared to non-conflict zones (58.8%). Christianity was more common in non-conflict areas (41.2%) than in conflict zones (30.0%). A larger proportion of pregnant women in conflict zones had no formal education (42.3%) compared to those in non-conflict zones (27.4%). Tertiary education was more prevalent in non-conflict (9.0%) than in conflict zones (2.8%) ($p < 0.001$).

Most women in both settings were married or cohabiting though the proportion was slightly higher in conflict (96.3%) than in non-conflict (92.3%) zones. Never-married status was more common in non-conflict areas (6.4% vs. 3.4%, $p < 0.001$). Polygynous marriages were more prevalent among women in conflict (37.2%) than those in non-conflict (31.4%) zones ($p < 0.001$). Wealth distribution also showed significant differences ($p < 0.001$), with 30.6% of pregnant women in conflict zones being in the lowest wealth quintile, compared to 21.1% in non-conflict zones. Only 3.7% of women in conflict zones were in the highest quintile, versus 17.7% in non-conflict areas.

No significant difference was observed in the average number of previous pregnancies between the two zones (4 ± 2.6 vs. 4 ± 2.4; $p = 0.31$). However, a higher proportion of pregnant women in non-conflict zones reported having sex with a non-marital, non-cohabiting partner in the past year (6.5% vs. 0.8%; $p < 0.001$). Condom use at last sex was low in both groups, with no significant difference (2.3% in conflict vs. 2.6% in non-conflict; $p = 0.52$). HIV positivity during the last pregnancy was slightly higher in conflict (0.2%) than in non-conflict (0.1%) zones although not

statistically significant (p = 0.32). Similarly, current HIV-positive status was higher among pregnant women from conflict (1.7%) compared to those from non-conflict (1.1%) (p = 0.22) zones [Table 1].

Multivariable analysis revealed that for pregnant women, residence in a conflict zone was associated with nearly twice the odds of HIV positivity compared to non-conflict zones, and the association showed a trend toward statistical significance (AOR = 1.93; CI: 0.98–3.82; p = 0.057). Increasing maternal age was significantly associated with a higher likelihood of HIV positivity, with each additional year of maternal age corresponding to a 6% increased likelihood of HIV positivity (AOR = 1.06; CI: 1.02–1.10; p = 0.002).

Educational level showed that women with only primary education had nearly 3 times the adjusted odds of being HIV-positive compared to those with tertiary education (AOR = 2.95; 95% CI: 0.84–10.4), although the association did not reach statistical significance (p = 0.092). Wealth status showed a significant association with HIV positivity among pregnant women. Compared to women in the highest wealth quintile, pregnant women in the middle (AOR = 4.10; CI: 1.31–12.8; p = 0.015) and fourth quintiles (AOR = 3.80; CI: 1.23–11.8; p = 0.021) had more than threefold likelihood of being HIV-positive.

Having sex with a non-marital, non-cohabiting partner in the past 12 months was associated with a nearly threefold higher likelihood of HIV positivity among pregnant women (AOR = 2.96; CI: 1.07–8.22; p = 0.037). Other factors including marital status, type of marital union, number of previous pregnancies, and condom use at last sex were not good predictors of HIV status among pregnant women [Table 2].

DISCUSSION

In this study, we found that pregnant women residing in conflict zones of Nigeria had nearly twice the likelihood of being HIV-positive compared to those in non-conflict regions, though this association slightly missed conventional alpha level of significance. Our result also revealed that increasing maternal age, lower levels of education, lower wealth quintile (Middle and Fourth), and engagement in HIV high-risk behaviors, specifically sex with non-marital, non-cohabiting partners, were important factors influencing the risk of HIV infection among pregnant women. These findings closely concord with the hypothesis that social, economic, and behavioral factors continue to drive HIV transmission risk among women of reproductive age, particularly in conflict-affected regions.

To the best of our knowledge, this study is among the few to use nationally representative data to describe the differential risk of HIV among pregnant women residing in conflict and non-conflict regions. Although previous studies had documented the link between conflict and increased vulnerability to HIV due to the destruction of essential medical infrastructure, disruption of healthcare initiatives, impeding immunization efforts, and creation of severe shortages of healthcare workers and medications,[12,13] our study adds additional insights by identifying specific socio-economic and behavioral risk factors within this vulnerable subgroup. The association between the lower wealth quintile (Middle and Fourth) and higher risk of HIV infection among pregnant women aligns with reports from previous studies which demonstrated that individuals in the upper wealth quintile were less than half as likely than those in the lower wealth quintile to have low HIV-related knowledge (p < 0.001).[14] This suggests that economic vulnerability limits access to HIV preventive and treatment services, while simultaneously increasing high-risk behaviors like transactional sex. Furthermore, the lower wealth quintile had been associated with reduced condom use. Research has shown that households in the fourth wealth quintile had significantly greater odds of inconsistent condom use and never using condoms (p < 0.001). Similarly, the association between increasing maternal age and with higher risk of HIV infection can be largely attributed to cumulative exposure over time. As individuals age, they have a longer period of potential exposure to HIV through various transmission routes.[15]

Our result revealed that sex with non-marital, non-cohabiting partners significantly increased the likelihood of HIV infection. This highlights the importance of behavioral risk as a major driver of HIV transmission, even in antenatal populations. In support of this, it is well documented in the literature that having multiple sexual partners significantly increases the risk of HIV transmission.[16] Interestingly, condom use at the last sex was low in both conflict and non-conflict zones and was not found to be associated with HIV status. This could reflect broader cultural or gender-based barriers to negotiating safer sex practices, particularly within marital unions, irrespective of conflict status. Another notable finding was the lack of statistically significant difference in HIV prevalence between conflict and non-conflict zones (1.7% vs. 1.1%, p = 0.2), despite a trend reported in previous studies toward a higher rate in the general population in conflict zones.[17] This may be partially explained by underreporting, stigma, or differential access to testing services in conflict-affected areas.

In a bivariate analysis, we observed that pregnant women resident of non-conflict zone had more favorable

Table 1: Sociodemographic and behavioral characteristics of respondents by conflict zone status.

Characteristic	Conflict zone	Non-conflict zone	*p*-value
Age (years), mean (SD)	6.4	7.1	0.005[1]
Language spoken by respondent, *n* (%)			
English	10.8	9.6	<0.001[3]
Hausa	216,130 (88.5)	56.7	
Yoruba	0.4	16.8	
Igbo	0.2	17.0	
Other	0.0	0.0	
(Missing)	214,877	808,035	
Religion, *n* (%)			
Islam	70.0	58.8	<0.001[2]
Christianity	30.0	41.2	
Level of education, *n* (%)			
No Education	42.3	27.4	<0.001[2]
Primary	15.7	17.7	
secondary	27.1	34.8	
Tertiary	2.8	9.0	
Others	12.1	11.2	
(Missing)	0	4,584	
Marital status, *n* (%)			
Never Married	3.4	6.4	<0.001[2]
Married or living together	96.3	92.3	
Others	0.2	1.3	
(Missing)	356	2,888	
Type of marital union, *n* (%)			
In polygynous union	37.2	31.4	<0.001[2]
Not in polygynous union	59.1	60.9	
Not currently in union	3.7	7.8	
(Missing)	581	20,628	
Wealth quintile, *n* (%)			
Lowest	30.6	21.1	<0.001[2]
Second	28.8	22.8	
Middle	23.2	19.7	
Fourth	13.7	18.7	
Highest	3.7	17.7	
Number of previous pregnancies, Mean (SD)	4 (2.6)	2.4	0.3[1]
(Missing)	2,080	7,197	
Sex with non-marital, non-cohabiting partner in past 12 months, *n* (%)			
Had sex with non-marital, non-cohabitating partner	0.8	6.5	<0.001[2]
Did not have sex with non-marital, non-cohabitating partner	99.2	93.5	
(Missing)	0	2,781	
Condom used at last sex in past 12 months, *n* (%)			
Used condom	2.3	2.6	0.5[2]
Did not use condom	98	97	
(Missing)	3,466	53,584	

(Contd...)

Table 1: *(Continued).*

Characteristic	Conflict zone	Non-conflict zone	*p*-value
HIV status last pregnancy, *n* (%)			
HIV-positive during last pregnancy/labor	0.2	0.1	0.3[2]
HIV-negative during last pregnancy/labor	16.5	19.0	
HIV status unknown during last pregnancy/labor	83.3	80.9	
(Missing)	3,054	25,518	
Current HIV Status, *n* (%)			
HIV-positive	1.7	1.1	0.2[2]
HIV-negative	98.3	98.9	
(Missing)	36,289	352,891	

[1]Wilcoxon rank-sum tests, [2]Pearson's Chi-square Test, [3]Fishers Test. HIV: Human immunodeficiency virus, SD: Standard deviation

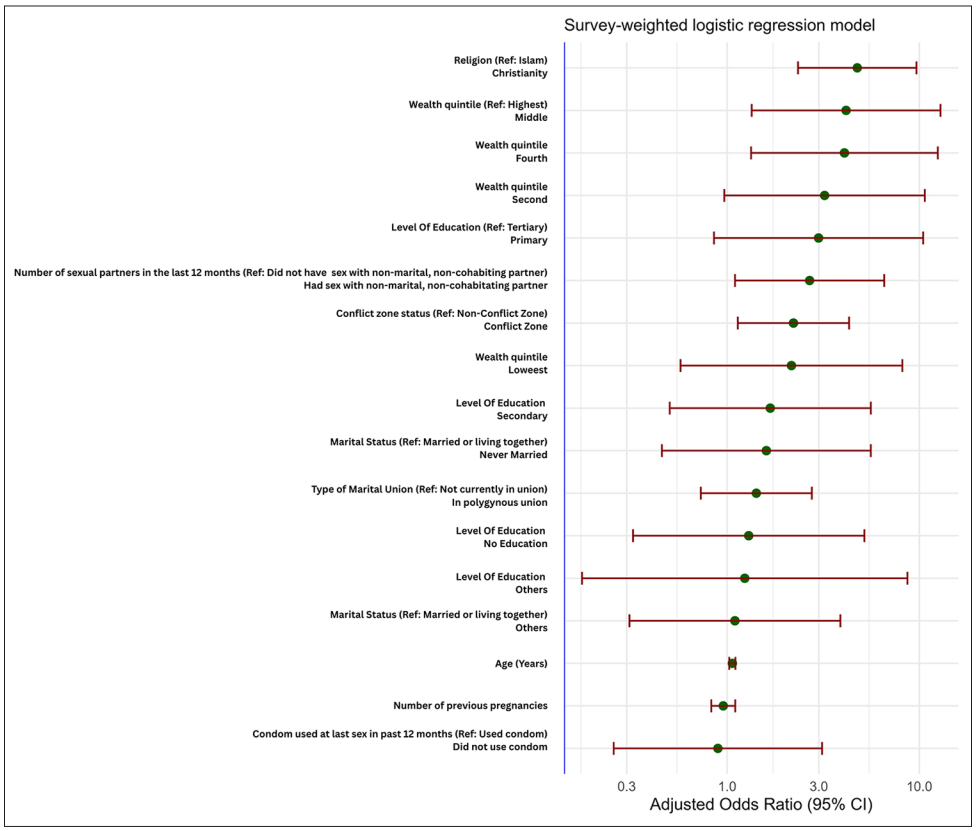

Figure 1: Adjusted odds ratios for factors associated with human immunodeficiency virus status among pregnant women aged 15–49 in Nigeria.

educational status, than those in conflict zones. While the bivariate analysis indicated significant differences in the level of education distributions ($p < 0.001$), a multivariable regression model revealed that these differences did not translate into significant adjusted odds of HIV infection among pregnant women after controlling for confounders. This finding was unanticipated and contrary to what we expected based on the literature, with several published studies showing that a low level of education is associated with a higher risk of HIV infection.[18] This might be due to strong social or cultural norms and gender inequalities limiting female education. As such, it affects the relationship between education and the risk of HIV infection.

Table 2: Factors associated with HIV infection among pregnant women.

Characteristic	AOR	95% CI	*p*-value
Conflict zone status			
Non-conflict zone	—	—	
Conflict zone	1.93	0.98, 3.82	0.057
Age	1.06	1.02, 1.10	0.002
Religion			
Islam	—	—	
Christianity	4.76	2.32, 9.76	<0.001
Level of education			
Tertiary	—	—	
No Education	1.28	0.32, 5.18	0.7
Primary	2.95	0.84, 10.4	0.092
Secondary	1.59	0.47, 5.33	0.5
Others	1.20	0.17, 8.54	0.9
Marital Status			
Married or living together	—	—	
Never Married	1.54	0.43, 5.54	0.5
Others	1.06	0.29, 3.80	>0.9
Type of marital union			
Not currently in union	—	—	
In polygynous union	1.44	0.74, 2.82	0.3
Wealth quintile			
Highest	—	—	
Lowest	2.17	0.57, 8.28	0.3
Second	3.23	0.96, 10.9	0.057
Middle	4.10	1.31, 12.8	0.015
Fourth	3.80	1.23, 11.8	0.021
Number of previous pregnancies	0.86	0.39, 1.91	0.7
Number of sexual partners in the last 12 months			
Did not have sex with non-marital, non-cohabitating partner	—	—	
Had sex with non-marital, non-cohabitating partner	2.96	1.07, 8.22	0.037
Condom used at last sex in past 12 months			
Used condom	—	—	
Did not use condom	0.85	0.24, 2.94	0.8

CI: Confidence interval, AOR: Adjusted odds ratio, HIV: Human immunodeficiency virus

Limitations

Longitudinal cohort studies could better outline the causal relationships between HIV among pregnant women and the outlined predictive factors. In addition, the lack of data on certain potential confounders, such as the partner's HIV status and history of sexually transmitted infections, limits a comprehensive explanation for the results of our analysis. Nonetheless, the use of a large, weighted sample and robust multivariable adjustment strengthens the validity of our findings.

CONCLUSION AND GLOBAL HEALTH IMPLICATIONS

This study highlights the complex interplay among conflict, socio-economic disadvantage, sexual behavior, and HIV risk among pregnant women in Nigeria. Interventions tailored toward high-risk subgroups, particularly pregnant women in conflict zones, those who are poverty-stricken, with limited education, and those engaging in non-marital sexual activity, are urgently needed. Policies that integrate HIV prevention with maternal health services, while addressing the social

barriers in fragile, conflict-affected settings, will be essential in reducing the HIV burden among pregnant women in Nigeria and similar contexts.

Key Messages

1) This study highlights that pregnant women in conflict-affected regions of Nigeria face nearly double the risk of HIV infection compared to those in non-conflict zones. 2)Key factors driving HIV risk include lower wealth status, limited education, increasing maternal age, and high-risk sexual behaviors, particularly sex with non-marital, non-cohabiting partners. 3) The findings underscore the urgent need for targeted interventions addressing structural inequalities, economic disparities, and sexual health education to mitigate HIV transmission among pregnant women, especially in conflict settings.

COMPLIANCE WITH ETHICAL STANDARDS

Conflicts of Interest: Dr. Salihu, Dr. Umar, and Ms. Dongarwar are members of the editorial board of the journal. **Financial Disclosure**: Nothing to declare. **Funding/Support:** The study received funding from the President's Emergency Plan for AIDS Relief (PEPFAR), the US Centers for Disease Control and Prevention, and the Global Fund for AIDS, TB, and Malaria. **Ethics Approval:** The research/study approved by the Institutional Review Board at Centers for Disease Control (CDC) in Atlanta, GA, USA (protocol #7103), the Institutional Review Board of the University of Maryland, Baltimore, and the Nigerian National Health Research Ethics Committee, number NAIIS 2018, dated NAIIS 2018. **Declaration of Patient Consent**: The authors certify that they have obtained all appropriate patient consent. **Use of Artificial Intelligence (AI)-Assisted Technology for Manuscript Preparation:** The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI. **Disclaimer:** None.

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