Research Article

Social Determinants of Zika Virus Infection among Pregnant Women in Plateau State, Nigeria

Ayuba Bulus Dawurung[1,2], Lawal Dahiru Rogo[3], Auwal Idris Kabuga[1,5,6]*, Yusuf Mohammed[1] and Shikmwa Ayuba Dawurung[4]

[1]Department of Medical Microbiology and Parasitology, Faculty of Basic Clinical Sciences, College of Health Sciences, Bayero University, Kano, Nigeria; [2]Department of Clinical Laboratory, Institute of Human Virology, Nigeria; [3]Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, College of Health Sciences, Bayero University, Kano, Nigeria; [4]Department of Medical Laboratory Services, Jos University Teaching Hospital, Jos, Plateau State, Nigeria; [5]Department of Medical Microbiology, Aminu Kano Teaching Hospital, Kano, Nigeria; [6]Department of Medical Microbiology and Parasitology, Faculty of Basic Clinical Sciences, College of Health Sciences, Northwest University, Kano, Nigeria.

Abstract | Due to the ongoing threat of congenital Zika virus (ZIKV) disease, ZIKV infection remains a significant public health concern. Although the virus was first identified in Nigeria, there is limited current epidemiological data on risk factors in high-risk populations. This study aimed to identify the social determinants of ZIKV infection among pregnant women in Plateau State, Nigeria. A cross-sectional study was carried out with 324 pregnant women attending antenatal clinics in Plateau State. Active ZIKV infection was detected in biological samples (urine and serum) using quantitative real-time polymerase chain reaction (q-RT-PCR). Data on sociodemographic, clinical, and environmental factors were collected and analyzed through descriptive statistics and multiple logistic regression to identify independent predictors of infection. The overall prevalence of ZIKV infection was 6.8% (22/324) in urine samples and 4.8% (16/324) in serum samples. Multivariate logistic regression identified two significant independent predictors: Religion (Christianity vs. Islam; Adjusted Odds Ratio (AOR) = 0.262, P=0.035) and Educational Attainment (Non-formal vs. Tertiary education; AOR = 0.098, P=0.013). Active ZIKV circulation among pregnant women in Plateau State suggests a persistent risk for vertical transmission. The strong association between infection risk and specific sociodemographic factors (religion and education) indicates that socio-ecological determinants may play a more critical role in ZIKV exposure than traditional vector-control behavioral factors. These findings emphasize the urgent need for targeted, context-specific surveillance and public health interventions in North-Central Nigeria to protect maternal and fetal health.

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***Correspondence** | Auwal Idris Kabuga. Department of Medical Microbiology and Parasitology, Faculty of Basic Clinical Sciences, Bayero University, Kano, Nigeria; **Email:** aikabuga.mcp@buk.edu.ng

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Introduction

Social determinants are elements that support and play a part in the spread and transmission of ZIKV, along with other arboviruses (Nery Junior *et al*., 2021). Zika disease is caused primarily by the Zika virus (ZIKV), identified in 1947 in Nigeria (Moore *et al*., 1975). It is an emerging and re-emerging public health disease due to its complications in newborns through vertical transmission (Dawurung *et al*., 2025). The ZIKV belongs to the family *Flaviviridae* and is a positive-sense, single-stranded RNA virus (Moore *et al*., 1975). The primary method of human transmission for ZIKV, an arthropod-borne virus, is through the bite of an infected Aedes mosquito, especially one belonging to the subgenus Stegomyia (Cirne-Santos, 2024; Tajik *et al*., 2024). Other routes of transmission include laboratory exposure, perinatal transmission, intrauterine transfer, sexual contact, and possibly blood transfusion (CDC, 2024; Dawurung *et al*., 2025). Although ZIKV infections in the general population often do not cause any symptoms, they can cause mild ones such as fever, arthralgia, non-purulent conjunctivitis, and maculopapular rashes (Pielnaa *et al*., 2020; Dappa and Ogbonnaya, 2023).

Miscarriage, Guillain-Barré syndrome, congenital microcephaly, different brain diseases, and stillbirth are among the severe, unfavorable consequences that can result from infection during pregnancy (Beber *et al*., 2023; Dawurung *et al*., 2025; Pérez *et al*., 2025). It is regarded as a major public health issue of worldwide concern because of the congenital Zika syndrome, which is the collective name for severe fetal abnormalities and highlights its important public health relevance, especially for pregnant mothers (Nery Junior *et al*., 2021).

A potential reason for the variation in disease prevalence across the country could be the influence of social and environmental factors, which differ by region (Nery Junior *et al*., 2021).

It is imperative to elucidate the social and environmental determinants linked to ZIKV infection to enhance future strategies for controlling ZIKV and other emerging arboviruses in tropical regions. Specifically, we must focus on identifying these risk factors within vulnerable populations, particularly pregnant women, to develop improved prenatal care recommendations in preparation for future emerging diseases. Additionally, understanding the social determinants of ZIKV infection will aid in the implementation of effective disease prevention measures, such as vector control, targeting these high-risk and vulnerable groups. This study examines the sociodemographic and social factors associated with ZIKV infection and describes the prevalence and most common clinical characteristics of the infection in pregnant women between 2022 and 2023 in Plateau state.

Materials and Methods

Study area/population

We performed the survey in nine (n=9) public health hospitals selected randomly in the three senatorial districts of Plateau state between July 2022 and January 2023 among pregnant women who attended the General Antenatal Clinic in the selected hospitals. Plateau State is located roughly in the centre of Nigeria (PSG, 2023). The selected hospitals were General Hospital Barkin Ladi, Comprehensive Health Centre Dadin Kowa, Primary Health Centre Rayfield, General Hospital Mangu, Cottage Hospital Bokkos, Township Primary Health Centre Pankshin, General Hospital Shendam, Cottage Hospital Kwalla, and Primary Health Centre Shendam A.

Study design and sampling technique

This was a cross-sectional study. A simple random sampling technique was used after a series of group health education sessions. We recruited 324 consented pregnant women using the formula by Lwanga and Lemeshow (1991). The pregnant women who attended the antenatal clinic but denied consent were excluded.

Data collection and analysis

The qRT-PCR results, socio-demographic, and other clinical data were collected. A pretested structured questionnaire, properly labelled with each participant's unique identity, was used. The data collated were gathered and analysed using IBM® SPSS® version 27.0.1.0. Additionally, Spearman's correlation coefficients were calculated to determine the correlation between the qRT-PCR results. Bivariate binomial logistic regressions and multivariate models were performed to assess the risk factors and the symptoms associated with infection, and those with significance. We used Prevalence Ratio (PR) to measure the associations, with a 95% CI, and a p-value <0.05 was considered statistically significant.

The results for all variables were set in the form of rates (%).

Results

Socio-demographic and clinical characteristics of the participants

The socio-demographic information of the respondents in Table 1 and Figure 1 showed that, based on data from 324 respondents, the mean age was 27.10 years with a standard deviation of 5.17. The largest age group was 26-30 years, accounting for 33.6% (n = 109) of the respondents; women older than 35 years were the least represented, at 14.8% (n = 48). Most of the respondents were married, representing 94.1% (n = 305).

Table 1: *Socio-demographic and clinical characteristics of the participants.*

Variable	Frequency (n = 324)	Percentage (%)
Age group (years)		
≤20	48	14.8
21-25	90	27.8
26-30	109	33.6
31-35	59	18.2
>35	18	5.6
Mean = 27, SD = 10±5.17		
Marital status		
Married	305	94.1
Single	10	3.1
Others (separated/single mother)	9	2.8
Age of pregnancy (Trimester)		
First	56	17.3
Second	164	50.6
Third	104	32.1
Religion		
Christianity	259	79.9
Islam	65	20.1
Educational level		
Non-formal	48	14.8
Primary	37	11.4
Secondary	147	45.4
Tertiary	92	28.4
Occupation		
Business	117	36.1
Full time housewife	87	26.9
Student	40	12.3
Farmer	37	11.4
Civil servant	34	10.5
Others	9	2.8

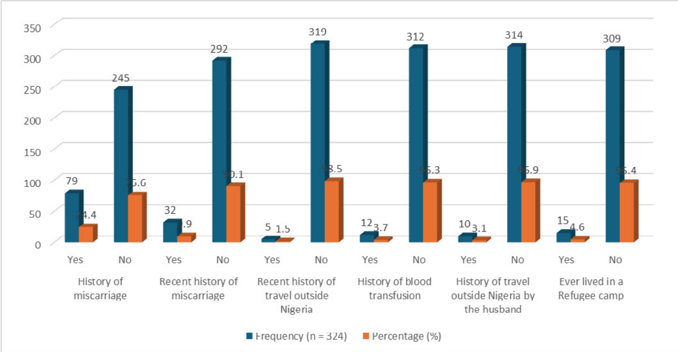

Figure 1: *Socio-demographic and clinical characteristics of the participants.*

Regarding pregnancy trimester, most respondents were in their second trimester (50.6%, n= 164), while Christianity was the predominant faith, accounting for 79.9% (n= 259) of respondents. Educational attainment showed the largest group with secondary education (45.4%, n = 147), and the least, 11.4% (n = 37), had completed primary education.

Additionally, the occupational distribution showed that business owners formed the largest group at 36.1% (n=117).

While the history of miscarriage showed that most respondents, 75.6% (n=245), reported no history of miscarriage, conversely, 24.4% (n=79) of the respondents had experienced a miscarriage. Also, a vast majority, 90.1% (n=292), indicated no recent history of miscarriage, and 9.9% (n=32) reported a recent history of miscarriage. Lastly, regarding the participants' history of recent travel outside Nigeria, the data showed an overwhelming majority, 98.5% (n=319), had not recently travelled outside Nigeria. No evidence of blood transfusion in 96.3% (n=312).

Prevalence of ZIKV infection among pregnant women in Plateau State, Nigeria

The Zika virus was initially detected in urine samples and sera of the participants by q-RT-PCR. Of all the samples collected from the 324 women, 22 (6.8%) urine samples showed positive test results, and the prevalence was 4.8% (16/324) using sera.

Comparison of ZIKV infection and socio-demographic/clinical characteristics

As described in Table 2, the socio-demographic factors and clinical characteristics of the study participants and their association with the ZIKV infection in Plateau State, Nigeria. It can be deduced

Table 2: *Socio-demographic factors associated with ZIKV infection among study participants.*

Factors Number Tested	Number Tested	Number number Positive	Negative	χ^2	P value
Age group					
≤20	48	3(6.3)	45(93.8)	1.706	0.790
21-25	90	4(4.4)	86(95.6)		
26-30	109	9(8.3)	100(91.7)		
31-35	59	4(6.8)	55(93.2)		
>35	18	2(11.1)	16(88.9)		
Marital status					
Married	305	21(6.9)	284(93.1)	0.823	0.663
Single	10	1(10.0)	9(90.0)		
Others	9	0(0.0)	9(100.0)		
Trimester					
First	56	5(8.9)	51(91.1)	0.578	0.749
Second	164	11(6.7)	153(93.3)		
Third	104	6(5.8)	98(94.2)		
Type of marriage					
Monogamy	238	17(7.1)	221(92.9)	0.678	0.713
Polygamy	64	3(4.7)	61(95.3)		
Religion					
Christianity	159	16(6.2)	143(93.8)	0.765	0.382
Islam	65	6(9.2)	59(90.8)		
Educational level					
Non formal	48	2(4.2)	46(95.8)	2.039	0.564
Primary	37	2(5.4)	35(94.6)		
Secondary	147	9(6.1)	138(93.9)		
Tertiary	92	9(9.8)	83(90.2)		
Occupation					
Full time housewife	87	7(8.0)	80(92.0)	1.792	0.877
Business	117	8(6.8)	109(93.2)		
Student	40	1(2.5)	39(97.5)		
Farmer	37	3(8.1)	34(91.9)		
Civil servant	34	2(5.9)	32(94.1)		
Others	10	1(11.1)	8(88.9)		

that pregnant women 35 years and older had the highest prevalence, 11.1% (2/18), while those in the age range 21-25 years had the lowest prevalence of 4.4% (4/90). However, the difference is not statistically significant (P= 0.79). Regarding the marital status of the participants, the relationship of ZIKV among the study participants showed that the singles had the highest prevalence rate of 10% (1/10), whereas the lowest was observed in the married, with 6.9% (21/305). No prevalence was recorded in other participants, and it was not statistically significant (P= 0.66). Additionally, regarding the trimester of pregnancy, the highest prevalence was observed in the first trimester with 8.9% (5/56), and the lowest in the third trimester with 5.8% (6/104). This had a statistically insignificant difference (P = 0.75). For the relationship between ZIKV and types of marriage, the highest prevalence was observed in single mothers with 9.1% (2/22), followed by monogamy with 7.1% (17/238), and the lowest in polygamy with a prevalence of 4.7 (3/64). The difference is not statistically significant (P= 0.71). Examining the relationship between infection and religion, Participants of the Islamic faith had the highest prevalence rate of 9.2% (6/65), while participants of the Christian faith had the lowest at 6.2% (16/159). However, it is not statistically significant (P= 0.382). For educational attainment, the highest prevalence rate was among those with a tertiary education, 9.8 (9/92), while the lowest prevalence was among those with non-formal education, 4.2% (2/48). The difference is statistically insignificant (P= 0.56).

The relationship of ZIKV with the participant's occupation suggested that "other" categories e.g, civil servants, and artisans, had the highest prevalence rate, 11.1% (1/9), whereas students had the lowest prevalence rate of 2.5% (1/40). The difference was statistically not significant.

Logistic/multiple regression analysis of socio-demographic factors associated with ZIKV infection among pregnant women

The unadjusted odds ratios (OR) for the relationship between sociodemographic characteristics and ZIKV infection are shown in Table 3. None of the variables had a statistically significant correlation with ZIKV infection, which aligns with the chi-square results. Every category's P-value was above 0.05. For example, an OR of 1.601 indicated that individuals in the first trimester of pregnancy had a 1.6 times higher risk of infection than those in the third trimester (the reference group); however, this difference was not statistically significant (P=0.455). Similarly, being a student was associated with an OR of 0.205, suggesting a lower risk of infection compared to other groups; however, this was also not statistically significant (P=0.280). The lack of significant associations in this unadjusted model indicates that no single sociodemographic factor is a strong predictor of ZIKV infection in this group.

Table 3: *Logistic/multiple regression analysis of socio-demographic factors associated with ZIKV Infection among pregnant women.*

Factor	Category	Crude OR	95% CI (Crude)	P-value (Crude)	Adjusted OR (AOR)	95% CI (Adjusted)	P-value (Adjusted)
Age group	≤20	0.533	0.082-3.488	0.533	0.45	0.051-3.944	0.471
	21–25	0.372	0.063-2.205	0.372	0.316	0.043-2.343	0.26
	26–30	0.72	0.142-3.640	0.72	0.722	0.123-4.247	0.718
	31–35	0.582	0.097-3.472	0.582	0.536	0.077-3.735	0.529
	>35	1	-	-	1	-	-
Trimester	First	1.601	0.466-5.501	0.455	2.676	0.667-10.733	0.165
	Second	1.174	0.421-3.278	0.759	1.209	0.405-3.605	0.734
	Third	1	-	-	1	-	-
Type of marriage	Monogamy	0.769	0.166-3.570	0.738	0.421	0.075-2.365	0.326
	Polygamy	0.492	0.077-3.156	0.454	0.176	0.020-1.518	0.114
	Single mother	1	-	-	1	-	-
Religion	Christianity	0.647	0.243-1.726	0.385	0.262	0.076-0.912	0.035*
	Islam	1	-	-	1	-	-
Educational level	Non-formal	0.401	0.083-1.935	0.255	0.098	0.016-0.613	0.013*
	Primary	0.527	0.108-2.564	0.427	0.189	0.032-1.134	0.068
	Secondary	0.601	0.230-1.576	0.301	0.317	0.100-1.009	0.052
	Tertiary	1	-	-	1	-	-
Occupation	Full-time housewife	0.7	0.076-6.431	0.753	0.692	0.063-7.576	0.763
	Business	0.587	0.065-5.296	0.635	0.467	0.046-4.784	0.521
	Student	0.205	0.012-3.633	0.28	0.071	0.003-1.619	0.097
	Farmer	0.706	0.065-7.708	0.775	1.11	0.088-13.970	0.936
	Civil servant	0.5	0.040-6.229	0.59	0.207	0.014-3.057	0.252
	Others	1	-	-	1	-	-

*OR = Crude (unadjusted) Odds Ratio; AOR= Adjusted Odds Ratio , *p < 0.05 (statistically significant).*

The findings of a multivariate logistic regression study that determined the relationship between different socio-demographic characteristics and pregnant women's risk of contracting the Zika virus (ZIKV) are shown in Table 3. Each factor's adjusted odds ratio (AOR), 95% confidence interval (CI), and associated P-value are provided by the analysis. By adjusting for the impact of other factors in the model, this statistical method enables the evaluation of the independent contribution of each socio-demographic component to the probability of contracting ZIKV. According to the data, there is no statistically significant correlation between ZIKV infection and age group. All other age groups (≤20 years, 21-25 years, 26-30 years, and 31-35 years) had an ORs below 1, indicating a decreased but non-significant risk of infection, in contrast to the reference group of women aged older than 35 years (AOR = 1). There is no statistical difference.

As with age, there was no statistically significant correlation between ZIKV infection and the trimester of pregnancy. In contrast to the third trimester (reference group, AOR= 1), pregnant women in the first trimester had an AOR of 2.676 (95% CI: 0.667–10.733), which may indicate greater risks; nevertheless, this finding was not statistically significant (P= 0.165). Additionally, there was no discernible correlation in the second trimester. There is no correlation found between the kind of marriage and the likelihood of contracting ZIKV. When compared to single mothers (reference group, AOR = 1), both monogamous and polygamous women had AORs smaller than 1, although these differences were not statistically significant (P > 0.05).

One factor that turned out to be statistically significant was religion. Compared with women who practiced Islam (reference group), those who practiced Christianity had a substantially lower risk of contracting ZIKV (AOR= 0.262, 95% CI: 0.076–

0.912, P = 0.035). After controlling for other variables, the data indicate that pregnant Christian women in this cohort had almost 74% lower risk of contracting ZIKV than their Muslim counterparts. Educational attainment also showed a significant association with ZIKV infection. Compared with women with tertiary education (reference group), those with non-formal education had significantly lower odds of infection (AOR = 0.098, 95% CI: 0.016–0.613, P = 0.013). This indicates that women with non-formal education had approximately 90% lower odds of ZIKV infection. While primary and secondary education also showed AORs below 1, suggesting lower odds, these associations were not statistically significant at the conventional 0.05 level (P= 0.068 and P= 0.052, respectively).

No statistically significant correlation between occupation and ZIKV infection was found compared to the 'Others' category (reference group, AOR = 1), all occupational groups, including full-time housewife, business, student, farmer, and public servant, displayed P-values larger than 0.05 (reference group, AOR = 1). According to the results of the multiple logistic regression analysis, the only sociodemographic factors that were statistically significant predictors of ZIKV infection among pregnant women in this study population were religion (specifically, Christianity vs. Islam) and educational attainment (non-formal vs. tertiary education). Age group, pregnant trimester, marital status, and certain vocations did not show a significant independent connection with the risk of contracting ZIKV.

Comparison of risk factors and ZIKV infection among Pregnant Women in Plateau State

The multivariate analysis of environmental and behavioral risk variables is shown in Table 4. Using the chi-square test, no statistically significant correlations were found between ZIKV infection and frequency of mosquito bites, wearing protective clothes, removing bushes, proximity to a forest or shrub, clearing drainages, or traveling to the forest for firewood. With values ranging from 0.192 to 0.952, all p-values were well over the 0.05 cutoff. For example, the correlation between illness and shrub removal had a p = 0.854. Given that ZIKV is a vector-borne illness, it is unexpected that there is no statistically significant correlation.

Table 4: *Association between risk factors and ZIKV infection among study participants.*

Risk factors	Result		χ^2	P value
	Positive	Negative		
Proximity to stagnant water/drainage				
Very close	3(10.0)	27(90.0)	1.504	0.826
Close	4(4.9)	78(95.1)		
Far	8(7.8)	95(92.2)		
Very far	4(8.0)	46(92.0)		
No	3(5.1)	56(94.9)		
Clearing all drainages and avoid stagnant water				
Yes	13(6.3)	195(93.8)	0.268	0.605
No	9(7.8)	107(92.2)		
Proximity to forest/bush				
Very close	1(5.0)	19(85.0)	2.102	0.551
Close	2(3.1)	63(96.9)		
Far	11(7.6)	134(92.4)		
Very far	8(8.5)	86(91.5)		
Going to the forest in search of firewood				
Yes	5(5.3)	89(94.7)	0.453	0.501
No	17(7.4)	213(92.6)		
Wearing protective clothing to cover your entire body before going to the forest/bush				
Yes	11(6.9)	149(93.1)	0.004	0.952
No	11(6.7)	153(93.3)		
Clearing all bushes in your surrounding and avoid visiting forest				
Yes	16(6.6)	225(93.4)	0.034	0.854
No	6(7.2)	77(92.8)		
Frequency of Mosquito bite				
Very	4(5.6)	68(94.4)	1.921	0.383
Minimal	9(5.6)	152(94.4)		
Less	9(9.9)	82(90.1)		
Covering body properly with thick clothes in the evening and night to avoid mosquito bite				
Yes	11(5.4)	193(94.6)	1.701	0.192
No	11(9.2)	109(90.8)		

Logistic/multiple regression analysis of risk factors associated with ZIKV infection among pregnant women

The unadjusted and adjusted logistic regression analyses for the behavioral and environmental risk variables are shown in Table 5. Neither the crude nor the adjusted models found any statistically significant correlations between these characteristics and ZIKV infection, which is in line with the chi-square results. The p-values for every variable in the modified model (6b) were higher than 0.05. For instance, the AOR for not wearing protective clothes was 1.429 (P=0.483)

Table 5: *Logistic/multiple regression analysis of risk factors associated with ZIKV Infection among pregnant women.*

Factor / Practice	Category	Crude OR	95% CI (Crude)	P-value (Crude)	Adjusted OR (AOR)	95% CI (Adjusted)
Proximity to stagnant water/ drainage	Very close	2.074	0.392-10.962	0.39	4.488	0.669-30.122
	Close	0.957	0.206-4.447	0.956	0.971	0.195-4.831
	Far	1.572	0.400-6.170	0.517	1.536	0.367-6.426
	Very far	1.623	0.346-7.624	0.539	1.444	0.283-7.383
	No	1	-	-	1	-
Clearing all drainages and avoid stagnant water	Yes	0.793	0.328-1.915	0.605	0.642	0.241-1.714
	No	1	-	-	1	-
Proximity to forest/bush	Very close	0.566	0.067-4.796	0.601	0.307	0.026-3.623
	Close	0.341	0.070-1.662	0.183	0.274	0.046-1.619
	Far	0.882	0.341-2.282	0.796	0.9	0.313-2.586
	Very far	1	-	-	1	-
Going to the forest in search of firewood	Yes	0.704	0.252-1.966	0.503	0.76	0.251-2.308
	No	1	-	-	1	-
Wearing protective clothing before going to forest/bush	No	1.027	0.432-2.440	0.952	1.429	0.527-3.874
	Yes	1	-	-	1	-
Clearing all bushes and avoid visiting forest	Yes	0.913	0.345-2.415	0.854	1.131	0.359-3.559
	No	1	-	-	1	-
Frequency of mosquito bites	Very frequent	0.536	0.158-1.817	0.317	0.473	0.125-1.797
	Minimal	0.539	0.206-1.412	0.209	0.433	0.151-1.237
	Less	1	-	-	1	-
Covering body properly with thick clothes in evening/night	Yes	0.565	0.237-1.345	0.197	0.444	0.160-1.228
	No	1	-	-	1	-

Notes: OR = Crude (unadjusted) Odds Ratio; AOR = Adjusted Odds Ratio

while the AOR for living "very close" to stagnant water was 4.488 (P=0.122). Although certain odds ratios (such as the AOR of 4.488) indicated a possible association, the non-significant p-values and broad confidence intervals (such as 0.669-30.122) show that these results are not statistically significant.

Comparison of clinical presentation and ZIKV infection among pregnant women in Plateau State, Nigeria

The bivariate analysis of ZIKV infection status and clinical manifestations recorded during the past one week is shown in Table 6. Being ZIKV positive and having a history of rash during the previous weeks were found to be extremely significantly correlated ($\chi^2 = 7.469$, $P = 0.006$). In contrast to 5.7% of individuals who did not report a rash, 20% of those who did were ZIKV positive, according to the findings. Given that a maculopapular rash is regarded as one of the most distinctive signs of ZIKV, this discovery is in line with the clinical profile of the virus.

Table 6: *Association between clinical presentation and spread of ZIKV infection.*

Clinical presentation	Result		χ^2	P value
	Positive	Negative		
History of fever in the past 7 days				
Yes	4(5.0)	76(95.0)	0.538	0.463
No	18(7.4)	226(92.6)		
History of conjunctivitis in the past 7 days				
Yes	1(4.0)	24(96.0)	0.333	0.564
No	21(7.0)	278(93.0)		
History of headache in the past 7 days				
Yes	10(7.9)	116(92.1)	0.428	0.513
No	12(6.1)	186(93.9)		
Experience weakness of the body/joint pain in the past 7 days				
Yes	7(8.1)	79(91.9)	0.337	0.562
No	15(6.3)	223(93.7)		
History of rash in the past 7 days				
Yes	5(20.0)	20(80.0)	7.469	0.006*
No	17(5.7)	282(94.3)		

**Statistically significant.*

Table 7: *Logistic/multiple regression analysis of clinical presentations associated with ZIKV infection spread.*

Clinical presentation	Crude OR	95% CI (Crude)	P-value (Crude)	Adjusted OR (AOR)	95% CI (Adjusted)	P-value (Adjusted)
History of fever in the past 7 days						
Yes	0.661	0.217-2.013	0.466	0.431	0.118-1.568	0.201
No	1	-	-	1	-	-
History of conjunctivitis in the past 7 days						
Yes	0.552	0.071-4.280	0.569	0.202	0.021-1.934	0.165
No	1	-	-	1	-	-
History of headache in the past 7 days						
Yes	1.336	0.559-3.191	0.514	1.239	0.404-3.795	0.708
No	1	-	-	1	-	-
Experience weakness of the body / joint pain in the past 7 days						
Yes	1.317	0.518-3.349	0.563	1.411	0.423-4.707	0.575
No	1	-	-	1	-	-
History of rash in the past 7 days						
Yes	4.147	1.387-12.402	0.011*	6.673	1.866-23.870	0.004*
No	1	-	-	1	-	-

Notes*: OR= Crude (unadjusted) Odds Ratio; AOR= Adjusted Odds Ratio (from multiple logistic regression); *Statistically significant (p < 0.05).*

Fever, conjunctivitis, headache, and joint pain/ body weakness, on the other hand, did not exhibit a statistically significant correlation with ZIKV infection. For these symptoms, the corresponding p-values were 0.463, 0.564, 0.513, and 0.562.

Logistic/multiple regression analysis of clinical presentation and ZIKV infection among pregnant women in Plateau State, Nigeria

Table 7 supported and validated the chi-square analysis's conclusions. With an OR of 4.147 (P=0.011), the unadjusted logistic regression demonstrates a statistically significant correlation between a history of rash and ZIKV infection. The statistical significance of the 95% CI of 1.387–12.402 is confirmed by the absence of 1. This suggests that the likelihood of being ZIKV positive was 4-fold among those who had a recent history of rash.

The strongest evidence is shown in the multiple logistic regression analysis (Table 7). A history of rash continued to be a highly significant and independent predictor of ZIKV infection even after controlling for the presence of other clinical symptoms.

The 95% CI was 1.866-23.870, and the adjusted odds ratio (AOR) was 6.673 (P=0.004). According to this strong correlation, those who have recently developed a rash are almost seven times more likely to have ZIKV.

Discussion

This study identified that young pregnant women were in the highest positivity age groups (21-25 years). Similar results were found in a survey of ZIKV in Puerto Rico, where the incidence rate decreased in older women, and those most affected were pregnant women between 20–29 years old (Lozier *et al*., 2015). This agrees to study reported by Saidu and Eghafona (2022), which reported 21-29 years. This could be because it is the most active age group in the population studied. The lowest prevalence recorded is in the age group >35. Although ZIKV infection is not specific to any age group, research has shown that everyone is at risk of being infected (Saidu and Eghafona, 2022). Looking at marital status, the highest prevalence rate was observed in married people, followed by singles, and no prevalence rate was recorded in others (P= 0.663). This agrees with the study reported by Anejo-Okopi *et al*. (2020) in Jos. This may be because most of the pregnant women who attended antenatal care are married. The prevalence of ZIKV infection in pregnant women in antenatal care clinics was investigated by Phatihattakorn *et al*. (2021) during the rainy season from May to October 2019 at Siriraj Hospital, Bangkok, Thailand. A total of 650 pregnant women (39.42% first, 52.26% second, and 7.36% third trimester) were evaluated for the seroprevalence of ZIKV among pregnant women in Thailand. In a study by Adekola *et al*. (2023), the highest prevalence was reported in the second trimester, followed by the third trimester, with the lowest in the first trimester. This finding agrees with this study, which recorded the highest prevalence in the second semester, although it shows no statistical significance (P= 0.749). Regarding the type of marriage, the study recorded the highest prevalence among those who practice monogamy, followed by polygamy, with single mothers having the lowest prevalence, though this was not statistically significant (P= 0.713).

Although education has been associated with better knowledge and infection control practices regarding infectious diseases (Desjardins *et al*., 2020), most people with current and past exposure to ZIKV had a tertiary education. This agrees with the findings of this study, though statistically not significant (P=0.564 and AOR=1). This finding is not in agreement with previous reports in Salvador in Brazil, and the Philippines, where a positive relationship was found between the level of education and the prevalence of ZIKV infection (Maharajan *et al*., 2020; Nery *et al*., 2021). This also agrees with studies conducted by Otu *et al*. (2020) in Southeast Nigeria, Kolawole *et al*. (2020) in Ilorin, Anejo-Okopi *et al*. (2020) in Jos, and Adekola *et al*. (2023) in Zaria and Sagamu. This contrasts with the research conducted by Sani *et al*. (2022) in Dutse, Jigawa State. This discrepancy may be attributed to the fact that this group is well-informed and exposed, which may suggest a better health-seeking attitude. The prevalence of ZIKV infection among pregnant women, based on the participants' occupation, was evaluated. The business class showed the highest prevalence rate, which also showed no statistical significance (P= 0.877), while the lowest prevalence came from students and other occupations. The business class moves frequently, increasing the possibility of infection during their activities.

The association between clinical presentation and the spread of infection was also evaluated in those who responded with no history of fever in the past week and showed the highest prevalence rate. A history of fever in the past week did not show a significant association with ZIKV infection (P= 0.463). Similarly, a history of conjunctivitis in the past week and those with no history of conjunctivitis did not significantly correlate with ZIKV infection (P= 0.564). History of headache in the past week also did not show a significant association with ZIKV infection (P = 0.513).

Again, weakness of the body and joint pain in the past week revealed that the respondents with no history of having the highest prevalence rate do not significantly correlate with ZIKV infection (P=0.562). In contrast, a history of rash in the past week showed a significant association with ZIKV infection (P= 0.006, with crude OR=1/ P=0.011 and AOR=1/ P=0.004). This is in concurrence with Maharajan *et al*. (2020), who found that ZIKV-positive participants reported fever (14%), rash (17%), and other nonspecific symptoms at a higher rate during pregnancy than ZIKV-negative participants. This is like previous studies, which reported that around 80% of ZIKV-infected individuals were asymptomatic and that among those who reported symptoms, the principal complaints were rash, fever, arthralgia, myalgia, fatigue, headache, and conjunctivitis (Karimi *et al*., 2017).

Furthermore, in the multivariate analysis, we found that women who reported rash during their pregnancy were 68% more likely to have a positive ZIKV infection. Again, this is consistent with prior literature. For example, among symptomatic cases during a ZIKV outbreak on Yap Island, rash was the most reported complaint (90% of cases), alongside arthritis and arthralgia (65% of cases) (Duffy *et al*., 2009). In contrast, Atai *et al*. (2025) reported a high prevalence in those with headache, though headache was not statistically associated with ZIKV. The most common symptom of the ZIKV is rash (maculopapular rash); the study revealed that those with no history had the highest prevalence. This could be suggestive of malaria or fever induced by other agents in pregnant women. Some individuals may have unexplained febrile illness, which suggests the circulation of the ZIKV in Nigeria (Kuivanen, 2017; Agbajelola et al., 2025). These findings suggest that while fever, conjunctivitis, headache, and weakness of body/joint pain may not independently predict ZIKV infection, the presence of rash significantly increases the likelihood of infection. This underscores the importance of considering multiple symptoms and conducting comprehensive diagnostic assessments for accurate ZIKV diagnosis and management.

Conclusions and Recommendations

With a prevalence rate of 6.8%, this study offers strong proof that the ZIKV is still circulating among pregnant women in Plateau State, Nigeria. Importantly, our molecular study revealed that ZIKV infection in this susceptible group is not linked to often-mentioned environmental or individual behavioral factors (such as being close to stagnant water or removing bushes). Rather, the greatest predictors were independent sociodemographic markers: educational attainment (non-formal schooling is linked to about a 90% lower risk compared to a tertiary degree) and religion (Christianity is associated with a 74% lower risk compared to Islam).

From the outcome of this study, we therefore recommend that public health strategies must be improved to go beyond generic messaging and concentrate on targeted interventions that address the socioeconomic and structural factors influencing vector exposure and awareness within subpopulations, effectively reducing the risk of ZIKV infection and preventing associated severe congenital outcomes.

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Novelty Statement

This manuscript presents a recent history of rash as a significant clinical predictor, increasing the odds of infection by nearly sevenfold. It also shows that socio-demographic markers, particularly education and religion, are stronger independent predictors of infection than conventional environmental or behavioural vector-control factors.

Author's Contribution

Conceptualization, ABD, DLR, AIK, and YM. Methodology, ABD, DLR and SAD. Software, ABD and DLR. Validation, ABD, DLR, YM, and AIK. Formal analysis, ABD, AIK, and DLR. Investigation, ABD, SAD and DLR. Resources, ABD and SAD. Data curation, ABD, and SAD. Writing original draft preparation, ABD, YM, SAD. Writing review and editing, ABD, SAD, DLR, AIK and YM. Visualization, ABD. Supervision, DLR, AIK and YM. Project administration, ABD and SAD. All authors have read and agreed to the published version of the manuscript.

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Ethical approval

We obtained ethical approval for the study from the Plateau State Hospitals Management Board (No. HMB/ADM/772/1/173) and the Plateau State Ministry of Health Research and Ethical Committee (No. MOH/MIS/209/VOL.T/X). All pregnant women who were eligible and participated in the study read through and signed the free and informed consent form before the collection of socio-demographic, clinical data, and biological samples.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors declared that there is no conflict of interest.

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