Serological Evidence of Past Infections of Zika Virus among Pregnant Women Attending a Tertiary Hospital in Rivers State, Nigeria

[1]Nwachukwu, D., [1]Chukwu, A. O., [2]Okonko, B. J., [1]Okerentugba, P. O. & [1]Okonko, I. O.

[1]Virus & Genomics Research Unit, Department of Microbiology, University of Port Harcourt, Choba, Nigeria.
[2]Medical Microbiology & Epidemiology Research Unit, Department of Microbiology, Madonna University Nigeria, Elele, Rivers State, Nigeria
Corresponding author's email address: David_nwachukwu@uniport.edu.ng

ABSTRACT: Pregnant women constitute a significant demographic greatly impacted by the Zika virus, posing a substantial public health challenge necessitating prompt and thorough investigation. The focus of this research is to ascertain the serological epidemiology of the Zika virus specifically among pregnant women in Rivers state, Nigeria. To achieve this, plasma samples from 93 confirmed pregnant women receiving care at the University of Port Harcourt Teaching Hospital in Rivers State were analyzed for the presence of antibodies targeting the Zika Virus utilizing an IgG ELISA assay. The findings revealed an overall prevalence rate of 63.4% (59 out of 93) in terms of ZIKV IgG-specific antibodies. Notably, the study highlighted the highest seropositivity rates among individuals aged 0-26 years (70.0%), civil servants (87.9%), single participants (71.0%), those with a primary educational background (80.0%) and those in their second trimester (45.0%). This underscores the importance of targeted interventions and heightened awareness campaigns, particularly within these demographics, to mitigate the impact of the Zika virus. Expanding on these results, it becomes evident that specific demographic factors play a crucial role in the prevalence of Zika virus antibodies. For instance, the high seropositivity rate among civil servants could be attributed to potential occupational exposures, while the prevalence among younger participants might indicate greater susceptibility or exposure in certain age groups. Moreover, the elevated prevalence among individuals with primary education underscores the importance of tailored educational initiatives to enhance awareness and prevention strategies. In conclusion, these findings shed light on the intricate dynamics of Zika virus prevalence among pregnant women in Rivers State, emphasizing the need for targeted public health interventions and further research to effectively combat this pressing issue.

[Nwachukwu, D., Chukwu, A. O., Okonko, B. J., Okerentugba, P. O. and Okonko, I. O. **Serological Evidence of Past Infections of Zika Virus among Pregnant Women Attending a Tertiary Hospital in Rivers State, Nigeria.** *Researcher* 2026;18(5):1-6]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). http://www.sciencepub.net/researcher. 01. doi:10.7537/marsrsj180526.01

Keywords: Antibodies; IgG; Zika Virus; Rivers State.

1. INTRODUCTION

The Zika Virus (ZIKV) is a mosquito-borne flavivirus primarily transmitted by Aedes species mosquitoes. First identified in Uganda in 1937, ZIKV has since spread to many parts of the world, causing significant public health concerns due to its potential to cause severe neurological complications. For instance, in recent outbreaks in South America, ZIKV has been linked to an increase in cases of Guillain-Barré syndrome, a rare neurological disorder that can result in muscle weakness and paralysis. While most ZIKV infections are asymptomatic or result in mild symptoms, the virus poses a serious risk to pregnant women. This was evident during the outbreak in Brazil, where a surge in cases of microcephaly, a condition characterized by an abnormally small head and brain, was reported in newborns whose mothers were infected with ZIKV during pregnancy. The devastating impact of ZIKV on fetal development underscores the importance of early detection and prevention strategies. ZIKV can cross the placental barrier, leading to congenital Zika syndrome, which includes a range of birth defects such as microcephaly, brain damage, and other developmental issues. In addition to physical abnormalities, children affected by congenital Zika syndrome may also experience cognitive and behavioral challenges that require long-term care and support. The vulnerability of pregnant women and the potential for severe fetal outcomes make ZIKV a critical concern in areas where the virus is endemic. Emphasizing the need for heightened awareness and preventive measures to protect this at-risk population, public health authorities have implemented mosquito control programs, educational campaigns, and prenatal screening initiatives to mitigate the impact of ZIKV on pregnant women and their babies. By raising awareness about the risks associated with ZIKV infection and promoting proactive measures such as using insect repellent, wearing protective clothing, and seeking medical advice before traveling to areas with known ZIKV transmission, individuals can play a crucial role in preventing the spread of the virus and safeguarding maternal and child health (Noorbakhsh et al., 2019; CDC, 2020; Masmejan et al., 2020; WHO, 2020).

2. MATERIALS AND METHODS

2.1. Study Design

This study utilized a cross-sectional approach, involving the collection and analysis of samples using Zika virus IgG ELISA kits.

2.2. Study Area

The research was conducted in Rivers State, situated in the Niger Delta region of Southern Nigeria, specifically at the University of Port Harcourt in Port Harcourt city.

2.3. Sample Size Estimation

The sample size was calculated using the formula provided by MacFarlane (1997), Niang et al. (2006), and Awando et al. (2013): N = [Z^2(pq)] / d^2, resulting in a total sample size of 73.

2.4. Population for the Study

A total of 93 confirmed pregnant women's samples, numbered 1-93, were systematically collected and stored. These samples were gathered from the University of Port Harcourt, Rivers State, Nigeria. Collection was carried out by trained medical laboratory professionals, and the samples were transported to the Virus & Genomics Research Unit within the Department of Microbiology at the University of Port Harcourt (UNIPORT) for laboratory analysis. Clinical history, behavioral patterns, and demographic information were also recorded.

2.5. Sample and Sampling Techniques

The study employed a stratified sampling technique to select participants. A total of 93 HIV-infected individuals were randomly selected from the study population. The focus was on a hospital-based study targeting HIV-positive individuals receiving care at the facility in Port Harcourt. Each participant was assigned a unique identifier recorded on their patient card, with the assistance of laboratory staff. In addition to blood samples, demographic data, behavioral patterns, and clinical histories were collected. Data were categorized into age groups (0-26 years, 27-32 years, and 33-70 years), education levels, marital status (single or married), and occupation. Statistical analysis was performed using the chi-square test, with data processed using WPS version 12.2.

2.6. Inclusion/Exclusion Criteria

To be eligible for inclusion in the study, participants were required to fulfill several criteria. The study focused exclusively on female participants, with no restrictions on age. Eligibility also required that individuals had resided in Rivers State for a minimum of five years. Both married and single women were considered, and participation was open to individuals regardless of their employment status. A confirmed pregnancy was a necessary condition for inclusion, as was hospital admission, since blood samples—specifically at least 3.0 milliliters of EDTA plasma—were collected from hospitalized patients. Anyone who failed to meet these criteria was excluded from the study to ensure a consistent and appropriate study population.

2.7. Sample Collection

Five milliliters of venous blood were drawn from each participant using venepuncture. The blood was placed in EDTA bottles and centrifuged at 3000 rpm for five minutes to separate the plasma. The plasma was stored at -20°C until testing. ELISA kits for IgG antibodies were used to detect Zika Virus antibodies in the plasma samples. The ELISA technique is a reliable method for detecting specific antibodies.

2.8. Nature/Source of Data

Data included both quantitative and qualitative information from participants at the University of Port Harcourt. Quantitative methods were used to gather data.

2.9. Serological Analysis

ELISA techniques were used to test samples according to the manufacturer's instructions for Zika virus IgG tests. Plasma collected in EDTA tubes was analyzed using an ELISA reader, model ELx800, measuring absorbance at 450nm and 630nm. Data analysis included the Chi-square test to assess associations between categorical variables and descriptive statistics to summarize demographic factors like age range and gender.

2.10. Data Analysis

Socio-demographic information, including age, occupation, marital status, and education level, along with clinical characteristics like gestation period, was collected from hospital records. After validation, data were entered into WPS spreadsheet version 12.2 for analysis. The data were categorized and organized to present overall IgG prevalence and evaluate prevalence based on each characteristic. Chi-square tests were used to explore relationships between characteristics and seroprevalence rates. Further analyses identified specific categories within risk factors that showed increased vulnerability, contributing to the observed seroprevalence rates.

2.11. Ethical Approval

The study received ethical approval from the University of Port Harcourt Research Ethics Committee, ensuring adherence to ethical standards for medical research involving identifiable human subjects and their data.

3. RESULTS

3.1. Socio-demographical and Clinical Characteristics of Study Participants

The categorical data detailing the socio-demographical and clinical characteristics of the study participants have been systematically organized and are presented in Tables 1 and 2, respectively.

3.2. Overall IgG Assay Results

The study reported an overall 63.4% seropositivity for IgG, as indicated in Table 1.

3.3. ZIKV IgG Seroprevalence Concerning Socio-demographic Characteristics

The age group 0-26 exhibited the highest ZIKV IgG prevalence (70.0%), while the age group 33-70 displayed the lowest (59.4%) (Table 1). Among Occupation, ZIKV prevalence in tailors (40.0%) were the lowest while civil servants (87.9%) were the lowest (Table 1). Married participants showed the lower IgG seropositivity rates (59.7%) compared to single participants (71.0%) (Table 1). In terms of educational status, individuals with primary education had the highest seropositivity (80.0%), while those with tertiary education had the lowest (58.1%) (Table 1).

Table 1: IgG Results Concerning Socio-demographic Characteristics of Study Participants

Variables	Categories	No. Tested (%)	No. Positive (%)
Age Group (Years)	0-26	30 (32.3)	21 (70.0)
	27-32	31(33.3)	19 (61.3)
	33-70	32(34.4)	19 (59.4)
Occupation	Caterers	7 (7.5)	4 (57.1)
	Civil Servant	33 (35.5)	29 (87.9)
	Nurse	5 (5.4)	3 (60.0)
	Tailor	5 (5.4)	2 (40.0)
	Trader	22(23.7)	14 (63.6)
	Education	9 (9.7)	4 (44.4)
	Unemployed	13 (14.0)	5 (62.5)
Marital Status	Single	31 (33.3)	22 (71.0)
	Married	62 (66.7)	37 (59.7)
Educational Status	Primary	5 (5.4)	4 (80.0)
	Secondary	25 (26.9)	16 (64.0)
	Tertiary	43 (46.2)	25 (58.1)
	None	20 (21.5)	14 (70.0)
Overall		**93 (100.0)**	**59 63.4)**

3.4. ZIKV IgG Seroprevalence Concerning Clinical Characteristics

The findings of the IgG serological test on the clinical features of participants in the study are presented in Tables 2 and 3. Among 42 pregnant women (44.1%) who participated in the study, 42 were tested for IgG antibodies. Data analysis based on gestational stage found that 6.5% of the participants were in the first trimester, 21.5% in the second trimester, and 16.1% in the third trimester. The rates of positivity for IgG between trimesters differed: 33.3% (2 out of 6) in the first trimester, 45.0% (9 out of 20) in the second trimester, and 40.0% (6 out of 15) in the third trimester. In all, 40.5% (17 out of 42) of the participants were positive for IgG antibodies.

Table 2: IgG Results Concerning Clinical Characteristics of Study Participants

Variable	Categories	No. Tested (%)	No. Positive (%)
Gestation Period (Trimester)	First	6 (6.5)	2 (33.3)
	Second	20 (21.5)	9 (45.0)
	Third	15 (16.1)	6 (7.5)
Overall		**42(44.1)**	**17(40.5)**

3.5. Statistical Relationship between ZIKV IgG Seroprevalence and Socio-demographic/Clinical Characteristics

Contrary to these trend findings, the statistical analysis (Table 3) revealed that none of the clinical and socio-demographic variables explored had a statistically significant correlation with IgG positivity. The age group p-value was 0.655, and therefore IgG seropositivity was not significantly correlated with age.
Occupation (p = 0.088), marital status (p = 0.287), and educational status (p = 0.685) were not significantly correlated with IgG status.

In addition, the gestational period (trimester) also failed to give a statistically significant result (p = 0.869), even though higher IgG positivity was observed in the second trimester.

Such findings suggest that while IgG seropositivity was observed in all those participants who belonged to all trimesters, as well as socio-demographic groups, none of these factors indicated a statistically significant association with the presence of IgG antibody in this study population.

Table 3: IgG Statistical Analysis Results

Characteristics	Categories	P-Value	Significance
Age Group (Years)	0-26	0.655	Not Significant
	27-32		
	33-70		
Occupation	Caterers	0.088	Not Significant
	Civil Servant		
	Nurse		
	Tailor		
	Trader		
	Education		
	Unemployed		
Marital Status	Single	0.287	Not Significant
	Married		
Educational Status	Primary	0.685	Not Significant
	Secondary		
	Tertiary		
	None		
Gestation Period (Trimester)	1st	0.869	Not Significant
	2nd		
	3rd		

4. DISCUSSION

This study revealed that 63.4% of the 93 pregnant women tested positive for ZIKV IgG-specific antibodies, highlighting the considerable prevalence of the virus in this population. Notably, this prevalence rate of 78.2% for IgG in this study exceeds the rates reported in previous studies on pregnant women conducted by Anejo-Okopi et al. (2020) in Jos, Plateau State, within North Central Nigeria (14.4%) and Mac et al. (2023) in 3 regional zones in Nigeria - Southern, Central and Northern- (19.2%). Asebe et al. (2021) in a study carried out in Gambella Region, South West Ethiopia reported a 27.3% seroprevalence. Furthermore, it differs from the rate of 49.0% reported in a previous study in the French Polynesia by Aubry et al. (2017).

The highest seropositivity was observed in several key demographic groups, suggesting that certain factors may influence exposure and susceptibility to the virus. For example, the age group of 0-26 years showed a seropositivity rate of 70.0%, indicating that younger pregnant women may be at greater risk, potentially due to lifestyle factors, social interactions, or biological vulnerabilities. This finding is in contrast with Anejo-Okopi et al. (2020), who reported a higher seropositivity rate among individuals between 31-50 years (35.3%) in Jos, Plateau state, Nigeria. Asebe et al. (2021) reported a ZIKV seropositivity of 40.3% withing participants aged 18-30 in Southern Ethiopia. Aubry et al. (2017) reported that children aged 6-16 exhibited the greatest seropositivity for Zika virus infections (66.0%) within the French Polynesia. Choyrum et al. (2022) reported a 30.1% seroprevalence among pregnant women aged >23-25 in Thailand. According to Langerak et al. (2019), participants aged ≥60 years exhibited the greatest seropositivity at 74.6%. Marchi et al. (2020) reported a 21.2% seropositivity among people aged 18-29 years.

Civil servants exhibited the highest seropositivity rate at 87.9%, which could point to occupational exposure as a significant risk factor. This demographic's increased exposure may be linked to their work environments or the nature of their daily activities, suggesting the necessity for workplace interventions and education to reduce the risk of ZIKV transmission.

Single participants also showed a high seropositivity rate of 71.0%, which might reflect differences in social behavior, healthcare access, or other socio-economic factors compared to their married counterparts. The study further identified individuals with a primary educational background as having an 80.0% seropositivity rate, indicating a potential gap in awareness and preventive practices among this group. These findings highlight the importance of educational interventions tailored to individuals with lower educational attainment to improve their understanding of ZIKV risks and prevention.

The analysis also revealed that women in their second trimester had a 45.0% seropositivity rate, suggesting that the stage of pregnancy may influence the likelihood of ZIKV infection, in line with Shaibu et al. (2021) reported that pregnant women in their 2nd trimester (13-27 weeks) exhibited the greatest seroprevalence (3.4%) but there was no statistical relationship between the positive and negative values (p = 0.146), Anejo-Okopi et al. (2020) reported that participants in their 3rd trimester (10.8%) showed greater ZIKV seropositivity, however this was not a significant risk factor (p = 0.622). Choyrum et al. (2022) reported the highest seroprevalence of zika virus IgG antibodies at a gestational age of >28 weeks (26.4%, p = 0.72). Phatihattakorn et al. (2021) reported that, while not significant (p = 0.14), participants in their 1st trimesters showcased the greatest seroprevalence (34.63%). This finding emphasizes the need for continuous monitoring and protective measures throughout pregnancy, with a particular focus on the second trimester when the risk appears significant.

5. CONCLUSION

The study on the IgG seroprevalence of Zika virus among pregnant women in Rivers State, Nigeria, has revealed a significant prevalence of ZIKV-specific antibodies, with 63.4% of the tested population showing seropositivity. The findings underscore the heightened risk of Zika virus exposure among specific demographic groups, including younger women, civil servants, single individuals, and those with a primary level of education. The study also highlights the importance of the second trimester as a critical period for monitoring and intervention. These results point to the need for targeted public health strategies to mitigate the impact of ZIKV, particularly among vulnerable populations. The high seropositivity rates in certain groups suggest that tailored educational campaigns, workplace interventions, and continuous surveillance are essential to reducing ZIKV transmission and protecting maternal and fetal health. Further research is warranted to explore the underlying factors contributing to these disparities and to develop more effective prevention and control measures against the Zika virus in this region.

REFERENCES

Anejo-Okopi, J., Gotom, D. Y., Chiehiura, N. A., Okojokwu, O. J., Amanyi, D. O., Egbere, J. O., Adetunji, J., Ujah, O. I., & Audu, O. (2020). The Seroprevalence of Zika Virus Infection among HIV Positive and HIV Negative Pregnant Women in Jos, Nigeria. *Hosts and Viruses*, *7*(6).

Asebe, G., Michlmayr, D., Mamo, G., Abegaz, W. E., Endale, A., Medhin, G., Larrick, J. W., & Legesse, M. (2021). Seroprevalence of Yellow fever, Chikungunya, and Zika virus at a community level in the Gambella Region, South West Ethiopia. *PLOS ONE*, *16*(7), e0253953.

Aubry, M., Teissier, A., Huart, M., Merceron, S., Vanhomwegen, J., Roche, C., Vial, A., Teururai, S., Sicard, S., Paulous, S., Desprès, P., Manuguerra, J., Mallet, H., Musso, D., Deparis, X., & Cao-Lormeau, V. (2017). Zika Virus seroprevalence, French Polynesia, 2014–2015. *Emerging Infectious Diseases*, *23*(4), 669–672.

Awando, J. A., Ongus, J. R., Ouma, C. A., & Mwau, M. (2013). Seroprevalence of Zika virus among febrile patients visiting selected Hospitals in the Western Region of Kenya, 2010/2011. *African Journal of Health Sciences*, *26*(4), 248–271.

Centers for Disease Control and Prevention (CDC). (2022). Zika

Choyrum, S., Wangsaeng, N., Nechba, A., Salvadori, N., Saisom, R., Achalapong, J., Putiyanun, C., Sabsanong, P., Sangsawang, S., Ayudhaya, O. P. N., Jourdain, G., Ngo-Giang-Huong, N., & Khamduang, W. (2022). Zika Virus Immunoglobulin G Seroprevalence among Young Adults Living with HIV or without HIV in Thailand from 1997 to 2017. *Viruses*, *14*(2), 368.

Langerak, T., Brinkman, T., Mumtaz, N., Arron, G., Hermelijn, S., Baldewsingh, G., Wongsokarijo, M., Resida, L., Rockx, B., Koopmans, M., Van Gorp, E. C. M., & Vreden, S. (2019). Zika virus seroprevalence in urban and rural areas of Suriname, 2017. *The Journal of Infectious Diseases*, *220*(1), 28–31.

Mac, P. A., Tadele, M., Airiohuodion, P. E., Nisansala, T., Zubair, S., Aigohbahi, J., Anyaike, C., Velayudha, R., Kroeger, A., & Panning, M. (2023). Dengue and zika seropositivity, burden, endemicity, and cocirculation antibodies in Nigeria. *Annals of Medicine*, *55*(1), 652–662.

Macfarlane, S. B. (1997). Conducting a Descriptive Survey: 2. Choosing a Sampling Strategy. *Tropical Doctor*, *27*(1), 14–21.

Marchi, S., Viviani, S., Montomoli, E., Tang, Y., Boccuto, A., Vicenti, I., Zazzi, M., Sow, S. O., Diallo, A., Idoko, O. T., Bhat, N., & Trombetta, C. M. (2020). Zika Virus in West Africa: A Seroepidemiological Study between 2007 and 2012. *Viruses*, *12*(6), 641.

Masmejan, S., Musso, D., Vouga, M., Pomar, L., Dashraath, P., Stojanov, M., Panchaud, A., & Baud, D. (2020). Zika virus. *Pathogens*, *9*(11), 898.

Noorbakhsh, F., Abdolmohammadi, K., Fatahi, Y., Dalili, H., Rasoolinejad, M., Rezaei, F., Salehi-Vaziri, M., Shafiei-Jandaghi, N. Z., Gooshki, E. S., Zaim, M., & Nicknam, M. H. (2019). Zika Virus Infection, Basic and Clinical Aspects: A Review Article. *Iranian journal of public health*, *48*(1), 20–31.

Phatihattakorn, C., Wongsa, A., Pongpan, K., Anuwuthinawin, S., Mungmanthong, S., Wongprasert, M., & Tassaneetrithep, B. (2021). Seroprevalence of Zika virus in pregnant women from central Thailand. *PLOS ONE*, *16*(9), e0257205.

Shaibu, J. O., Okwuraiwe, A., Jakkari, A., Dennis, A. B., Akinyemi, K. O., Li, J., Audu, R., & Oyefolu, A. O. (2021). Sero-molecular Prevalence of Zika Virus among Pregnant Women Attending Some Public Hospitals in Lagos State, Nigeria. *European Journal of Medical and Health Sciences*, *3*(5), 77–82.

World Health Organization. (2020).WHO guidelines for the prevention of sexual transmission of Zika virus.