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Prevalence of Parvovirus B19 IgG and IgM Antibodies and DNA among Blood Donors in Ibadan, Oyo State, Nigeria

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ABSTRACT

Background: Parvovirus B19 (B19V) is a significant transfusion-transmitted infection, particularly in vulnerable recipients. Despite its importance, B19V screening is not mandatory in Nigeria. This study aimed to investigate the seroprevalence of IgG and IgM antibodies to Parvovirus B19 among Nigerian blood donors, highlighting the need for routine screening.

Methods: A cross-sectional study was conducted among 200 blood donors from hospital settings between May 2016 and August 2019 in Ibadan, Nigeria. Serum samples were tested for IgG and IgM antibodies to Parvovirus B19 using enzyme-linked immunosorbent assay (ELISA). DNA was extracted from parvovirus B19 IgM samples, and PCR was performed on the extracted DNA. The results were statistically analyzed using SPSS.

Results: The seroprevalence of IgG and IgM antibodies to Parvovirus B19 was 15.5% and 7%, respectively. The result showed a slightly higher seropositivity rates for Parvovirus B19 IgG and IgM in female blood donors (20% and 7.5%, respectively) than in males (14.38% and 6.87%, respectively). DNA was detected in 4 of 14 samples (28.57%) that were positive for IgM. This indicates 2% of the 200 blood donors who participated in the study. Although not statistically significant (P> 0.05), these findings suggest a substantial risk of Parvovirus B19 transmission through blood transfusion in Nigeria.

Conclusion: This study underscores the importance of implementing routine Parvovirus B19 screening in Nigerian blood donors to enhance blood safety. Policy interventions and guidelines for B19V screening are urgently needed to protect vulnerable recipients, including pregnant women, patients with hemoglobinopathies, and immunocompromised individuals.

Keywords: Parvovirus B19, blood donors, seroprevalence, blood safety, Nigeria.

1.0 INTRODUCTION

Safe blood transfusion is an essential component of modern healthcare, particularly for the management of trauma, severe anaemia, surgical procedures, malignancies, and inherited hematological disorders. Ensuring the microbiological safety of blood and blood products is therefore a major public health priority. Although routine screening for major transfusion-transmissible infections such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) has significantly improved transfusion safety worldwide, other pathogens that can be transmitted through blood products remain insufficiently monitored in many low- and middle-income countries. One such pathogen of growing concern is Human Parvovirus B19 (B19V), which has been associated with transfusion-related infections, particularly in vulnerable patient populations [1].

Human Parvovirus B19 is a small, non-enveloped virus belonging to the Parvoviridae family. It contains a single-stranded DNA genome of approximately 5.6 kb enclosed within an icosahedral capsid composed of two structural proteins, VP1 and VP2 [2]. The virus is primarily transmitted through respiratory droplets, blood products, and vertical transmission from mother to fetus. Household transmission rates may reach approximately 50%, while occupational exposure among teachers and daycare workers ranges between 20–30% due to frequent contact with infected children [3]. Most infections are asymptomatic or present with mild nonspecific symptoms, which often leads to underrecognition of the infection in clinical settings.

Despite its typically mild clinical course in healthy individuals, B19V infection can cause a range of significant complications. These include erythema infectiosum in children, transient aplastic crisis in individuals with chronic haemolytic disorders such as sickle cell disease, persistent anaemia in immunocompromised patients, and arthropathy in adults. Maternal infection during pregnancy may lead to severe fetal outcomes, including hydrops fetalis, fetal anaemia, or miscarriage [4]. These complications are largely related to the virus's tropism for erythroid progenitor cells in the bone marrow, resulting in temporary suppression of erythropoiesis.

Parvovirus B19 is also recognized as a potential transfusion-transmissible infection. During acute infection, extremely high levels of viraemia may occur, reaching up to 10^{14} viral particles per millilitre of plasma [5]. The virus can persist in the blood during the asymptomatic phase of infection, increasing the possibility of contaminated blood donations. In addition, B19V exhibits resistance to several pathogen-inactivation processes used in the manufacture of plasma-derived products. Consequently, nucleic acid testing (NAT) for B19V is routinely employed in many high-income countries during plasma fractionation to detect highly viraemic donations before pooling [6]. However, such screening practices are rarely implemented in many developing countries due to financial and logistical constraints.

The epidemiology of B19V varies considerably across geographic regions. In Europe and North America, IgG seroprevalence among adults ranges from approximately 40% to 80%, reflecting widespread exposure over time. In Africa, studies report considerable variability, with IgG seroprevalence rates ranging from approximately 20% to over 60% among blood donors and other populations [7]. Studies conducted in countries such as the Democratic Republic of Congo and Zambia have reported detectable IgM antibodies in blood donors, indicating ongoing viral circulation and a potential risk of transfusion-transmitted infection [8]. In Nigeria, available data are limited, although some studies have demonstrated evidence of B19V infection among blood donors and patients with sickle cell disease [9]. Despite these findings, routine screening for B19V is not currently included in blood safety protocols in most Nigerian transfusion services.

Understanding the prevalence of Parvovirus B19 among blood donors is important for evaluating potential risks within the blood supply and informing transfusion safety policies. Epidemiological data can help guide surveillance strategies and support evidence-based decisions regarding additional screening measures in high-risk settings. However, studies investigating B19V infection in resource-limited settings often face several limitations, including cross-sectional designs, relatively small sample sizes, and limited access to molecular diagnostic tools.

Therefore, this study aimed to determine the prevalence of Parvovirus B19 infection and associated risk factors among blood donors in Nigeria, to generate data that may contribute to improved transfusion safety and public health policy.

2.0 METHODOLOGY

2.1 Study Design

In this Cross-sectional study, hospitals were carefully

selected to ensure a descriptive, observational view of the population during the study period. Purposive sampling was used for the study. Willingness to participate in the study by giving consent was used as a selection criterion.

2.2 Participants

A total of 200 blood samples were collected from blood donors who completed the self-administered questionnaire. All participants were recruited from hospital settings. The sampling period was between May 2016 and August 2019. All samples from blood donors were routinely tested for HIV, hepatitis B virus surface antigen (HBsAg), hepatitis C virus (HCV), Human T-Lymphotropic virus (HTLV), and *Treponema pallidum*. Study participants were voluntary blood donors who met the following inclusion criteria: 1) individuals ≥18 years of age; 2) individuals who agreed to participate in the study and gave written informed consent; 3) individuals who tested negative for HIV, HCV, HTLV, *T. pallidum*, and HBsAg.

2.3 Ethics

Ethical approval was obtained from the Oyo State Ministry of Health Ethics Committee. Written consent was obtained from the management of each hospital. Informed consent forms was duly signed by each study participant after sensitization about the infection. Only consenting individuals were included in the study, and those who did not agree to participate were excluded.

2.4 Serologic Testing

All serum samples were screened for B19V IgG and IgM antibodies after being brought to room temperature and subjected to the testing procedure as provided by the company. Enzyme-Linked Immunosorbent Assay (ELISA), which employs the qualitative enzyme immunoassay technique to detect the presence of B19V IgG and IgM antibodies in human serum (Melsin Medical Co., Limited, China), was used to assay for their presence in the sera. The ELISA kit was also brought to room temperature. All assays were performed and interpreted according to the manufacturer's instructions.

2.5 Real-time polymerase chain reaction

All samples that tested positive for B19V IgM by the ELISA technique were analyzed for B19V DNA by real-time PCR. DNA was extracted using the Quick-DNA Miniprep Plus kit produced by ZYMO Research, California, USA, according to the manufacturer's instructions. Real-time PCR assay was used to detect DNA in 20 µl reactions. Luna® Universal qPCR Master Mix Protocol (M3003) was used to detect the presence of Human Parvovirus B19 in the extracted DNA using Human Parvovirus B19-specific primers. Briefly, A mix of 10 µl Luna Universal qPCR Master Mix, 0.5 µl Forward primer (HPAVOF)AAAGGAGGGAGACAGCTCTA (10uM), and Reverse primer (10 µM) (HPAVOR) GGGCCCAC-TTTGTGGTAATA (10 µM) was made up to 15 µl with Nuclease-free Water to which 5 µl of the DNA Template was added. This was then run with the profile: Initial Denaturation at 95°C for 60 seconds, followed by Denaturation at 95 °C for 40-45 seconds, 15 seconds Extension, plate reading at 60°C for 30 seconds, and termination at 72°C for 10 minutes. Amplification was conducted using the CFX96TM real-time system from Bio-Rad following the manufacturer's manual.

2.6 Questionnaire

An interview questionnaire was administered to each participant at the time of enrolment. This questionnaire captured demographic data, occupation, the number of times blood is donated per year, history of blood transfusion, alcohol use, and smoking, among others. The consent of each participant was sought by explaining what the study is about and allowing them to decide whether to participate voluntarily. Each participant was interviewed to complete the questionnaire, and the information received was well documented and kept confidential.

2.7 Statistical Analysis

The statistical analysis was performed using SPSS 18.0 software package (IBM, Armonk, New York, USA). P values less than 0.05 were considered statistically significant. Logistic regression was used to analyze the association between Parvovirus B19 seropositivity and potential risk factors. Analysis was performed using the full model, including all potential risk factors.

3.0 RESULTS

A total of 200 healthy blood donors met the inclusion criteria and were enrolled in the study. Demographic characteristics of the 200 healthy blood donors are shown in Table 2. The mean age of the participants in this study was 38.1 years (median age 37 years; range 18 to 65 years). Most participants were male 163(81.5%), aged 31–45 years, non-laborers (businessmen or employees), and had a college education or above.

3.1 Seroprevalence of Parvovirus B19 IgG and IgM antibodies

Of 200 blood donors, 38 (19%) samples were seropositive

for Parvovirus B19 antibodies; 31 (15.5%) donors tested seropositive for IgG antibody, 14 (7%) were positive for IgM antibody, while 8 (4%) tested positive for both IgM and IgG. The remaining 6 (3%) samples that were positive for IgM did not test positive for IgG, indicating recent infections. The seroprevalence of IgG and IgM Parvovirus B19 antibodies were 15.5% and 7%, respectively (Table 1).

Table 1. Seroprevalence of Parvovirus B19 IgG and IgM

Seroprevalence	Positive (%)	Negative (%)
Overall prevalence	38(19)	162(81)
Parvovirus B19 IgG	31(15.5)	169(84.5)
Parvovirus B19 IgM	14(7)	186(93)
Parvovirus B19 IgM/IgG	8(4)	192(96)

Seroprevalence of Parvovirus B19 IgG antibodies was significantly higher among male donors, whereas no significant difference was observed in the prevalence of IgM Parvovirus B19 among the male and female donors (P=0.811). Statistical analysis also showed no significant difference in the seroprevalence of Parvovirus B19 antibodies across age groups (Table 2).

3.3 Risk Factors of being Parvovirus B19 seropositive

In the univariate analysis, some variables were found to be associated with Parvovirus B19 IgG seropositivity, including smoking, alcohol consumption, history of surgery, sexually active, condom use, and history of blood transfusion (Table 3). Other demographic and behavioral characteristics of the blood donors were not associated with Parvovirus B19 infection.

4.0 DISCUSSION

Transfusion of safe blood and blood products is crucial for preventing the spread of disease and saving lives. However, interventions have reduced the burden of transmissible infections such as HIV, Hepatitis B, and Hepatitis C. Parvovirus B19 continues to pose a risk in the context of blood transfusion. In this study, the 7% IgM prevalence observed among blood donors aligns closely with the 7.1% reported by Awolesi *et al.* [10] in Lagos, where blood donors at a tertiary hospital's blood bank were examined. A similar prevalence of 7.53% was reported by

Table 2. Univariate analysis of the variables associated with parvovirus B19 seroprevalence

Variables	Seropositive	Seronegative	Total	X^2	P-value
Gender (199)					
Male	28 (17.5)	132 (82.5)	160 (100.0)	0.644	0.4223
Female	9 (23.1)	30 (76.9)	39(100.0)		
Age (193)					
18–29	10 (16.9)	49 (83.1)	59 (100.0)	1.056	0.0901
30-39	15 (19.5)	62 (80.5)	77 (100.0)		
40-49	8 (18.6)	35 (81.4)	43 (100.0)		
50-59	3 (27.3)	8 (72.7)	11 (100.0)		
>60	1 (33.3)	2(66.7)	3 (100.0)		
Educational Level (195)					
University and above	26 (17.1)	126 (82.9)	152 (100.0)	0.841	0.3591
Less than University	10 (23.3)	33 (76.7)	43 (100.0)		
Occupation(189)					
Businessman/employee	28 (17.6)	131(82.4)	159 (100.0)	1.343	0.2465
Student/unemployed	8 (26.7)	22 (73.3)	30 (100.0)		
Family type(195)					
Monogamy	28(16.7)	140 (83.3)	168 (100.0)	0.499	0.4799
Polygamy	6 (22.2)	21 (77.8)	27 (100.0)		

3.2 Real-Time PCR

A total of 14 IgM-positive samples from 200 blood donor samples were tested using real-time PCR assays; 4 (28.57%) of the IgM-positive samples tested positive. This indicates 2% of the 200 blood donors who participated in the study.

Kumar *et al.* [11] in India. However, these figures surpass the 1.3% prevalence noted by Iheanacho [12] at a Lagos State teaching hospital and the 1% reported by Doyle [13] among American blood donors.

On the other hand, Ayolabi *et al.* [14] observed a significantly higher prevalence of IgM, at 37.6%, among

Table 3. Analysis of the variables associated with Parvovirus B19 seroprevalence

Variables	Seropositive	Seronegative	Total	X^2	P-value
History of surgery (196)					
Yes	1 (10.0)	9 (90.0)	10(100.0)	0.594	0.4409
No	37 (19.9)	149 (80.1)	186 (100.0)		
Multiple sexual partners (199)					
Yes	2 (50.0)	2 (50.0)	4 (100.0)	2.534	0.1121
No	36 (18.5)	159 (81.5)	195(100.0)		
Condom usage (196)					
Yes	1 (50.0)	1 (50.0)	2 (100.0)	0.003	0.9563
No	37 (19.1)	157 (80.9)	194(100.0)		
Smoking (190)					
Yes	1 (25.0)	3(75.0)	4 (100.0)	0.079	0.7787
No	36 (19.4)	150 (80.6)	186 (100.0)		
Alcohol consumption (135)					
Yes	3 (30.0)	7 (70.0)	10 (100.0)	0.236	0.6271
No	29 (23.2)	96 (76.8)	125 (100.0)		
Sexually active (200)					
Yes	36 (19.9)	152(80.1)	188 (100.0)	0.045	0.8320
No	2 (16.7)	10(83.3)	12 (100.0)		
Blood transfusion (199)					
Yes	0 (0.0)	2 (100.0)	2 (100.0)	0.477	0.4898
No	38 (19.3)	159(80.7)	197 (100.0)		
History of Donation (196)					
Yes	10 (9.0)	101(91.0)	111(100.0)	4.896	0.0269
No	17 (20.0)	68 (80.0)	185 (100.0)		

healthy asymptomatic blood donors in Lagos. Kalolekesha *et al.* [15] similarly reported a prevalence of 15.6% among blood donors at Kitwe Central Hospital in Zambia. Abdelrahman *et al.* [16] documented prevalence rates of 2.1% for IgM and 60.3% for IgG among blood donors of various nationalities residing in Qatar. The elevated prevalence of IgM in these studies indicates a transfusion risk for recipients without prior exposure to Parvovirus B19. Transfusions from donors with acute or recent Parvovirus B19 infections (IgM-positive) may transmit the virus, potentially causing severe complications in immunocompromised or non-immune recipients.

This study found slightly higher seropositivity rates for Parvovirus B19 IgG and IgM in female blood donors (20% and 7.5%, respectively) than in males (14.38% and 6.87%, respectively). However, the differences were not statistically significant, consistent with findings from Viswanathan *et al.* [17], who reported similar patterns in India. Furthermore, there was no statistically significant variation in IgG prevalence based on age, alcohol consumption, or smoking. Likewise, IgM antibody distribution did not significantly differ across age groups among blood donors, suggesting uniform exposure risk across demographics.

The detection of a 7% seroprevalence of Parvovirus B19 IgM antibodies among blood donors in Ibadan indicates ongoing or recent infection within the donor population at the time of sampling. Since IgM antibodies represent acute or recent exposure, this finding suggests active viral circulation in the community rather than past immunity. Parvovirus B19 epidemiology is strongly influenced by periodic outbreaks that typically recur every 3–4 years as susceptible individuals accumulate in the population. During outbreak periods, infection rates increase markedly, often extending beyond children—the primary reservoir—to adults, including healthy blood donors [18]. The 7% IgM prevalence observed in this study may therefore reflect sampling during or shortly after a localized outbreak phase in Ibadan. Evidence from blood donor surveillance studies globally demonstrates that outbreaks can significantly elevate detection rates, sometimes increasing viral positivity several-fold compared with baseline periods [19].

Seasonal variation also provides an important explanation for the observed seroprevalence. Parvovirus B19 transmission occurs year-round but shows distinct seasonal peaks, with the highest activity generally reported in late winter, spring, and early summer [20]. These seasonal increases are largely attributed to enhanced respiratory transmission in crowded environments such as schools, workplaces, and households, which facilitate viral spread. Increased exposure among children during peak seasons often precedes secondary transmission to adults, including blood donors, thereby elevating IgM seropositivity rates in the general population [21]. Although classical seasonal patterns are well described in temperate regions, tropical settings such as southwestern Nigeria may exhibit modified seasonal dynamics influenced by rainfall, humidity, and social behavior. Periods associated with increased indoor congregation—such as rainy seasons or school terms—may enhance viral transmission similarly to winter clustering in temperate climates.

The presence of acute infection markers among apparently healthy donors has important transfusion safety implications. Blood donors are typically asymptomatic during viremia, yet Parvovirus B19 can be transmitted through transfusion, posing significant risks to vulnerable

recipients such as pregnant women, sickle cell disease patients, and immunocompromised individuals. Elevated IgM prevalence during outbreaks or seasonal peaks therefore increases the likelihood that contaminated blood enters the transfusion pool if routine screening is not implemented.

Out of 200 blood donors tested, only 4 (2%) were positive for Parvovirus B19 DNA, a result consistent with the 1.4% reported in the Middle East and North Africa by Abdelrahman *et al.* [16]. This prevalence is notably higher than the 0.47% identified in Turkey by Aylin *et al.* [22], the 0.013% reported in Germany by Healy *et al.* [23], and the 0.006% observed in the Dutch cohort studied by Kooistra *et al.* [24]. These disparities highlight significant regional differences, suggesting that Parvovirus B19 prevalence varies markedly based on geographic and population-specific factors.

A 2% positivity rate for Parvovirus B19 DNA among blood donors, although relatively low in prevalence, has important transfusion safety implications. During acute infection, Parvovirus B19 can reach extremely high viral loads, often exceeding 10^{12} viral copies/mL of blood, even in asymptomatic individuals [25]. Therefore, a 2% DNA positivity rate may represent donors in the early viraemic phase when infectivity is highest. The potential for high viral loads during asymptomatic viraemia increases the likelihood of transmission, while immunocompromised recipients face a significant risk of severe haematological complications. The presence of Parvovirus B19 DNA in donor blood is of particular concern for immunocompromised transfusion recipients, who lack adequate immune responses to clear the virus effectively. These findings underscore the need for enhanced surveillance, consideration of nucleic acid testing in high-risk settings, and targeted screening strategies for blood intended for vulnerable patient populations.

Considering some risk factors, such as alcohol consumption and smoking, among six samples from smokers, none tested positive for IgG or IgM. In comparison, two out of ten samples from individuals with a history of alcohol consumption tested positive for both antibodies. These findings indicate no association, as the results were not statistically significant. There was a zz Transmission could occur between donors if equipment or surfaces are not properly sterilized. Emerging nations generally report higher prevalence rates of blood-borne infections such as HBV compared to developed countries. Factors contributing to this discrepancy include inadequate blood screening, poor injection safety practices, high-risk sexual behaviors, and socio-cultural practices involving unsterilized instruments for tattooing, scarification, and circumcision. Variability in diagnostic tools or detection markers further influences prevalence rates. Even within the same region, prevalence rates have varied across populations, as noted by Broliden *et al.* [26] and Buseri *et al.* [27]. Kalolekesha *et al.* [15] reported a 15.6% prevalence of acute Parvovirus B19 infections among blood donors at Kitwe Central Hospital. These findings underscore the potential for blood-borne transmission of Parvovirus B19, emphasizing the need for rigorous screening protocols to ensure the safety of blood and blood products. This research highlights the importance of understanding Parvovirus B19 among blood donors. Our research reveals a notable prevalence of B19V IgM antibodies. Indicating recent infections. While PCR detection rates were lower, this may be attributed to differences in assay sensitivity, viral load, or replication dynamics. IgM antibodies are produced early in the infection, often within 3-4 days.

They can persist for several weeks or even months, leading to persistent IgM antibodies in individuals previously exposed to Parvovirus B19, even if they are not currently infected [9]. Real-time PCR, on the other hand, detects the virus itself, which may be cleared quickly by the immune system [28]. PCR will most likely detect the virus during the acute phase of infection, whereas IgM antibodies may remain detectable even after the virus has cleared.

This study had several limitations. The relatively small sample size may limit the generalizability of the findings. Hospital-based sampling could introduce selection bias. The long sampling period may have influenced prevalence estimates. In addition, PCR testing was performed only on IgM-positive samples, potentially underestimating the true prevalence of Parvovirus B19 DNA.

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Conflicts of Interest

The authors declare that there is no conflict of interests.

Authors' Contributions

AI conceived and designed the study, contributed to data collection, data analysis tools, analysis of data and manuscript writing. **OOO** supervised the study and contributed to manuscript writing. All authors approved the final copy of the manuscript.

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