Research Article

Seroepidemiology of Human Parvovirus B19 Infection among Pregnant Women in Abuja, Nigeria

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Abstract | Human parvovirus B19 is a member of the family *Parvoviridae*. It can be transmitted congenitally from an infected mother to the foetus. The virus has been implicated in hydrops foetalis, spontaneous abortion, aplastic crisis and acute symmetric polyarthropathy. The present study was carried out to determine the seroprevalence of Human Parvovirus B19 IgG and IgM antibodies and to determine the risk factors associated with acquisition of the virus. A total of 326 blood samples were collected from consenting pregnant women who were attending antenatal clinic in Abuja, Nigeria. Structured questionnaire was used to obtain data on socio-demography and risk factors. The sera were obtained from samples were analyzed for IgG and IgM antibodies of human parvovirus B19 using SERION ELISA Classic Parvovirus B19 IgG/IgM kits. A total of 171 (52.5%) of women had IgG antibody to Parvovirus B19 while 31 (9.5%) were positive for IgM antibody. Demographics including age group, educational status, occupation, type of marriage, number of children, history of blood transfusion and trimester of pregnancy were statistically associated with prevalence of IgG antibody ($p \leq 0.05$). There was a significant association ($\chi^2 = 12.571$; $p = 0.028$) between age group and IgG antibody. The age group > 40 years old had the highest prevalence of IgG antibodies while the age group 21 – 25 years ($p \leq 0.05$) had the least (39.3%). Similarly, there was significant association ($\chi^2 = 39.602$; $p < 0.001$) between trimester and IgG antibody with the highest IgG antibody prevalence recorded in second trimester. Human Parvovirus B19 is prevalent in Abuja, Nigeria. Ten out of 100 pregnant women are likely to have current human parvovirus B19 infection. So, there is an urgent need to embark on mass education and enlightenment campaign to increase awareness of the general populace on the virus and its acquisition.

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Introduction

Human parvovirus B19 is non-enveloped, single-stranded DNA virus; belongs to the family Parvoviridae. Among the parvoviruses, human parvovirus B19 is the first to be pathogenic to humans; causing significant morbidity in various patient population groups (Mortimer et al., 1983; Girei et al., 2010). Parvovirus B19 replication within erythroid progenitor cells leads to apoptosis, and in

inhibition of erythropoiesis (Heegaard and Brown, 2002). Consequently, erythroblastopenia occurs due to parvovirus B19 replication, resulting in severe anaemia (Bdour, 2006). Transmission of the virus can occur through either respiratory route or transfusion of blood/blood products. Parvovirus B19 can be transmitted transplacentally from an infected mother to the foetus causing intrauterine foetal death (Noyola et al., 2004; Rostamzadeh et al., 2014).

Although parvovirus B19 can be transmitted in any trimester, the second trimester which coincides with the major development of the erythroid precursors which is the highest risk of foetal loss (Heegaard and Brown, 2002). Foetus infected with parvovirus B19, the foetal red blood cell mass increases thirty times between the 3rd and 6th month of pregnancy (Marwan and Bahtori, 2015). By the 3rd trimester, the foetus will be able to mount a more effective immune response to the virus, which may result in foetal loss at this stage of pregnancy (Sukanya et al., 2006).

Specific immunoglobulin M (IgM) antibody detection has been the core diagnostic test for acute parvovirus B19 infection, while the appearance of immunoglobulin G (IgG) antibodies is indicative of previous exposure to the virus. Though the seroprevalence of parvovirus B19 among pregnant women has been established in North-Central Nigeria, however, there is no information on the status of the disease in Abuja, the capital city of Nigeria.

There are limited data on the incidence, prevalence and correlates of B19 infection in Nigeria (Emiasegen et al., 2011). Therefore, this research serves as a seroepidemiology to study the prevalence and correlation of infection among pregnant women attending selected hospitals in Abuja, which represents important implications for foeto-maternal health policy in Nigeria.

Materials and Methods

The study was conducted at Abuja the capital city of Nigeria located in the North-Central Nigeria; with a population of 778,567. This study was a cross-sectional study with samples collected from 326 patients in 3 hospitals in Gwarimpa, Kubwa and Asokoro from pregnant women attending the antenatal clinics in selected hospitals in Abuja Metropolis. The study population included pregnant women attending antenatal clinics in selected hospitals in Abuja Metropolis.

Before sample collection; clinical information, sociodemographic data and information on risk factors were considered and correlated with the viral infection.

Five millilitres (5ml) of venous blood was aseptically collected from each subject by a clinician into EDTA vacutainer tubes. Plasma was separated into eppendorf tubes after centrifugation then stored at -20°C till needed for analysis (Ghazi, 2007). The samples were then transported to the Microbiology Laboratory in Ahmadu Bello University, Zaria on ice packs.

Haematologic assessment was done to determine the packed cell volume, haemoglobin concentration, blood group and genotype of each patient. Anaemia was defined according to the World Health Organization criteria as a haemoglobin concentration below 12 g/dL in women while severe anaemia was defined as a haemoglobin concentration below 7 g/dL (WHO, 2011).

Detection of IgG and IgM antibodies to parvovirus B19 was carried out using SERION ELISA classic Parvovirus B19 IgG/IgM kits (Virion\Serion, Germany) following the manufacturer's instructions.

Briefly, samples were diluted 1 in 101 in sample diluent. 100 µl from each prepared samples or ready to use controls, was pipetted into appropriate wells and incubated for 60 minutes at 37°C. Wells were then washed 4 times with 300 µl of washing solution. After washing, plates were firmly tapped against an absorbent paper towel. 100µl of IgG or IgM enzyme conjugate (alkaline phosphatase) was added into the wells immediately and incubated for 30 minutes at 37°C. Washing step was repeated and 100µl of substrate was then added and incubated for 30 minutes at 37°C in an incubator. One hundred microlilitres (100µl) of stop solution was added into all wells. Finally, results were read within 60 minutes with an ELISA plate reader at 405nm wavelength.

Pearson Chi-square test was used to assess the association between categorical variables. A p-value of ≤ 0.05 was considered significant.

Results and Discussion

A total of 326 pregnant women were screened in the study. Overall, 171 (52.6%) were positive for parvovirus B19 IgG antibody and 31 (9.5%) had IgM antibody (Table 1). The parvovirus B19 IgG antibody was highest (77.8%) among pregnant women who were ≥ 36 years old. On the other hand, the IgM antibody, on the other hand, was the highest (33.3%) at age between 36 – 40 years old. Statistically significant association (IgG: χ^2 = 12.571; p = 0.028; IgM: χ^2 = 18.386; p = 0.002) between prevalence of human Parvovirus B19 and age. The educational status of the study subjects was significantly associated (IgG: χ^2 = 32.674; p < 0.001) with human Parvovirus B19 IgG. Based on IgM, the infection was not associated with educational status (χ^2 = 6.689; p = 0.083). Of the women that had tertiary education, 91.9% of them were positive to IgG followed by those women that did not specify their level of education (78.62%). Similarly, the women's occupation was significantly associated (χ^2 = 39.602; p < 0.001) with IgG while it was not associated (χ^2 = 2.819; p = 0.589) with IgM. Women who were traders had the highest prevalence (90.5%) of IgG while teachers had the least (39.2%). Type of marriage and number of children were significantly associated (p < 0.05) with IgG but not associated (p > 0.05) with the IgM (Table 2).

Table 1: *Distribution of samples based on location.*

Location	No. of sample	Number of positive sample (%)	
		IgG	IgM
Gwarinpa	193	55(28.5)	10(5.2)
Kubwa	72	64(88.9)	10(10.9)
Asokoro	61	52(85.2)	11(18.0)
Total	326	171(52.5)	31(9.5)

The distribution of the infection in relation to some risk factors and symptoms of parvovirus B19 infection. It was interesting that blood transfusion was significantly associated (χ^2 = 64.486; p < 0.001) with IgG. Those that do not have history of blood transfusion had the highest prevalence of the infection (86.7%) while women who have had transfusion once had IgG prevalence of 36.6%. Sixty-four (58.7%) out of the 109 pregnant women in their second trimester were positive for Parvovirus B19 IgG antibody. Forty-six (48.4%) out of the 95 pregnant women in their first trimester were positive for Parvovirus B19 IgG. There was significant association (χ^2 = 39.602; p < 0.001) between prevalence of IgG antibody to Parvovirus B19 and trimester. Symptoms assessed include history of pregnancy complication, miscarriages, body rash and joint pains. There was no association (p > 0.05) between the symptoms and the prevalence

Table 2: *Prevalence of parvovirus B19 infection in relation to demographics.*

Parameters	No. Of sample	Number of positive sample (%)	
		IgG	IgM
Age group			
16 – 20	28	17(60.7)	0(0.0)
21 – 25	84	33(39.3)	8(9.5)
26 – 30	132	73(55.3)	15(11.4)
31 – 35	63	33(52.4)	2(3.2)
36 – 40	18	14(77.8)	6(33.3)
> 40	1	1(100.0)	0(0.0)
Statistics		χ^2 = 12.571; p = 0.028*	χ^2 = 18.386; p = 0.002**
Educational status			
Primary	48	25(52.1)	5(10.4)
Secondary	227	101(44.5)	18(7.9)
Tertiary	37	34(91.9)	4(10.8)
Others	14	11(78.6)	4(28.6)
Statistics		χ^2 = 32.674; p < 0.001**	χ^2 = 6.689; p = 0.083
Occupation			
Housewife	121	64(52.9)	10(8.3)
Teacher	148	58(39.2)	14(9.5)
Civil servant	9	8(88.9)	2(22.2)
Traders	42	38(90.5)	5(11.9)
Others	6	3(50.0)	0(0.0)
Statistics		χ^2 = 39.602; p < 0.001**	χ^2 = 2.819; p = 0.589
Type of marriage			
Monogamy	221	133(60.2)	21(9.5)
Polygamy	105	38(36.2)	10(9.5)
Statistics		χ^2 = 16.427; p < 0.001**	χ^2 = 0.000; p = 0.995
Number of children			
One	130	66(50.8)	11(8.5)
Two	56	34(60.7)	3(5.4)
Three	11	9(81.8)	3(27.3)
Others	93	37(39.8)	8(8.6)
None	36	25(69.4)	6(16.7)
Statistics		χ^2 = 15.635; p = 0.004**	χ^2 = 7.554; p = 0.109

*: *statistical significant at p ≤ 0.05;* **: *statistical significant at p ≤ 0.01.*

of human Parvovirus B19 infection. Similarly, the prevalence of the infection using IgM was not associated with the risk factors ($p > 0.05$).

Table 3: *Distribution of the infection in relation to risk factors and symptoms.*

Parameters	No. of sample	Number of positive sample (%)	
		IgG	IgM
Blood transfusion			
Once	194	71(36.6)	13(6.7)
Twice	36	17(47.2)	3(8.3)
Thrice	6	5(83.3)	1(16.7)
None	90	78(86.7)	14(15.6)
Statistics		$\chi^2 = 64.486$; $p < 0.001$**	$\chi^2 = 6.017$; $p = 0.111$
Trimester			
First	95	46(48.4)	5(5.3)
Second	109	64(58.7)	14(12.8)
Third	122	61(50.0)	12(9.8)
Statistics		$\chi^2 = 39.602$; $p < 0.001$**	$\chi^2 = 3.414$; $p = 0.181$
History of pregnancy complication			
Yes	60	36(60.0)	5(8.3)
No	266	135(50.8)	26(9.8)
Statistics		$\chi^2 = 1.679$; $p = 0.195$	$\chi^2 = 0.118$; $p = 0.731$
Miscarriage			
Yes	80	43(53.8)	6(7.5)
No	246	128(52.0)	25(10.2)
Statistics		$\chi^2 = 0.071$; $p = 0.789$	$\chi^2 = 0.497$; $p = 0.481$
Body rash			
Yes	27	15(55.6)	4(14.8)
No	299	156(52.2)	27(9.0)
Statistics		$\chi^2 = 0.114$; $p = 0.736$	$\chi^2 = 0.963$; $p = 0.326$
Joint pains			
Yes	86	44(51.2)	10(11.6)
No	240	127(52.9)	21(8.8)
Statistics		$\chi^2 = 0.078$; $p = 0.780$	$\chi^2 = 0.609$; $p = 0.435$

*: *statistical significant at $p \leq 0.05$*;**: *statistical significant at $p \leq 0.01$.*

Human parvovirus B19 had been reported in a number of previous studies in developing countries with varying prevalence rates ranging between 30 and 60% (Elnifro et al., 2009). However, there is dearth of prevalence investigations in some of the developing countries. This study, to the best of our knowledge, is the first seroepidemiologic study on human parvovirus B19 infection in Abuja, Nigeria. The prevalence of the infection was high (52.5% for IgG antibody) which results indicates that the prevalence of parvovirus B19 infection was the highest among women who were ≥ 26 years old. In those women, gradually increasing prevalence values were observed reaching a maximum of 100% in the pregnant women aged > 40 years old. In Africa, prevalence of human parvovirus B19 were 58.4%, 55.0% and 25.7% were found in Malawi, Mauritius and Nigeria respectively (Maksheed et al., 1999; Emiasegen et al., 2011). The implication of IgM seropositivity in pregnant women is the occurrence of spontaneous abortion and stillbirth as established by Rahbar et al. (2014).

In this study, it was observed that higher educational levels predispose to HPVB19 infection. This is in disagreement with previous studies which was reported that education compensates the effect of poverty on health, irrespective of availability of health facilities (Kishore et al., 2010). The highest prevalence in the present study was observed among those with tertiary education and lowest among those with secondary education.

History of pregnancy complication, miscarriage, body rash and joint pains showed no statistical significant association with prevalence of human parvovirus B19 infection in this study. The highest prevalence was observed among those who have never had blood transfusion which is in consonance with the works of Ujo et al. (2012) and Jegede et al. (2014). In the current study, 9.5% of the pregnant women tested were positive for parvovirus B19 IgM. Out of these, 5 (5.3%) were in their first trimester, 14 (12.8%) in the second trimester while 12 (9.8%) were in their third trimester which is similar to the findings of Keikha et al. (2006), Elnifro et al. (2009), and Abiodun et al. (2013). Parvovirus B19 infection in pregnant women in the second trimester can result in hydrops foetalis and foetal loss, foetal anaemia, spontaneous abortion, and stillbirth. In our study, 12.8% of the pregnant women had evidence of recent infection in their second trimester thereby indicating that high number of women who were subjected for the study were at risk and having unfavourable birth outcome.

Conclusion and Recommendations

This study showed that parvovirus B19 infection is prevalent in Abuja, Nigeria, with seroprevalence of 52.5% (IgG) and 9.5% (IgM). Considering

the potential role of this virus inn abortion and foetal death, the study emphasizes the pertinence of parvovirus B19 infection in pregnant women. Vaccination of non-immune pregnant women could be an effective method of preventing foetal infection with B19. However, the cost-effectiveness of this strategy in the general population is uncertain. There is an urgent need to launch an awareness program for pregnant women to improve their knowledge of the exposure risks of pregnant women to parvovirus B19.

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Authors' Contribution

Ocheme Julius Okojokwu, Maryam Bisola Adebayo and Joseph Aje Anejo-Okopi conceived and designed the study; Maryam Bisola Adebayo, Ocheme Julius Okojokwu, Bashiru Shafa Abubakar and Ibrahim Abubakar Yusuf performed the experiments; Ocheme Julius Okojokwu, Bashiru Shafa Abubakar and Ibrahim Abubakar Yusuf analyzed the data. Manuscript draft, reading, corrections and editing were done by Ocheme Julius Okojokwu, Maryam Bisola Adebayo, Bashiru Shafa Abubakar, Ibrahim Abubakar Yusuf and Joseph Aje Anejo-Okopi. All the authors consensually agreed to the final manuscript.

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