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Molecular detection and association of HIV and HSV-2 IgM co-infection among asymptomatic pregnant women in Port Harcourt, Nigeria

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Abstract

HSV-2 is a common human pathogen that can cause primary and recurrent infection of the mucous membrane. Genital infection with HSV-2 facilitates the acquisition of HIV, both mutually reinforcing infection. Infection with herpes simplex virus type 2 is a significant public health problem being the leading cause of genital ulcerative disease. This study aimed at Molecular investigation and association of HIV and HSV-2 IgM co-infection among asymptomatic pregnant women in Port Harcourt, Nigeria. This is a cross-sectional study conducted at the antenatal unit of the University of Port Harcourt Teaching Hospital (UPTH), River State. A total of 168 consenting pregnant women were selected. The study involved collecting socio-demographic data and laboratory determination of HSV-2 immunoglobulin M (IgM) and HIV seroprevalence using enzyme linked immunosorbent assay (DIAPRO Diagnostic Bioprobes, Milan, Italy) and ALERE determine/STAT PAK respectively. Data analysis was done using graph pad statistical package. Chi square analysis was used to determine the correlation of the infection with socio-demographic factors. The seroprevalence for HSV-2 IgM was 29.8% (50/168) of the respondents while there was no co-infection between IgM and HIV. All HIV respondents were married. Majority are trader having tertiary educational qualification and are in a monogamous relationship. With regard to IgM seropositivity age, marital status, religion and gestation period were significantly associated with IgM while educational level, occupation, type of family and parity were not significantly associated with HSV-2 IgM. There is a significant correlation between HIV seropositivity with parity and history of sexually transmitted disease while there is no significant difference between HIV prevalence with age, marital status education level occupation type of family, religion history of abortion and the prevalence of HSV-2 was high among women of childbearing age in Port Harcourt, Nigeria. Effort should be made to increase the awareness of HSV-2 and HIV infection among the childbearing populace and serological testing of pregnant women should be included as a routine test.

Keywords: HSV; HIV; prevalence; IgG; IgM; ELISA Co-infection

1. Introduction

The World Health Organization investigation revealed that the HSV occurrence shows variation between regions and population (Oksana *et al.*, 2018). It is one of the most common viral sexually transmitted disease (STD) worldwide (Apurba et al 2013). HSV has the capacity to invade Central Nervous System (CNS), replicate in neurons and establish a latent infection (Whitley & Roizman, 2009). HSV-2 is a sexually transmitted disease (Okonko et al 2023). Th e virus is a double stranded DNA virus (Paz-Bailey et al 2008., Corey et al 2008., Xiao et al 2023., Enitan et al 2023) Although HSV-2 is not a life-threatening infection, it can cause fulminant hepatitis among women that are pregnant and persistent severe infection among immunocompromised patient and even in normal immune persons (Malary *et al.*, 2016, Mugo et al 2011). Genital ulcer disease is estimated to affect 16% of women and 9% of men annually (Stone et al 2023). It is a risk factor for urethritis and cervical cancer among woman (Agyemang-Yeboah et al 2019). HSV-2, the main cause of genital herpes and genital ulcer in Nigeria and in most regions of the world has been described as a silent pandemic

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with different countries being at different stage of the epidemic (Drisu *et al.*, 2018). An estimated 417 million people (11.3%) 15–49-year-old individual are living with HSV-2 worldwide (Looker et al 2015). The prevalence in Africa is about 31.5% of which Nigeria is one (Ayoub et al 2019). A prevalence of 77.9% was reported by Ojinmah et al among female attending skin and ante natal care (ANC)clinics at University of Nigeria Teaching Hospital. HSV causes recurrent orofacial and genital infections (Bloom *et al.*, 2010). The infection in women are primarily asymptomatic but can have the following signs; painful erythematous papules, followed by vesicles and finally erosion on the vulva, labia major and minor, vagina and cervix, lasting for mainly 8 – 10 days. However, recurrent herpes can be asymptomatic or symptomatic (Anil *et al.*, 2017). From research made so far, number of sexual partners, elderly and female gender are at higher risk. of having HSV-2 infection. Other prenatal risk factors of HSV-2 infection are early sexual activity, cocaine abuse, bacteria vaginosis, poverty, and ethnicity (Malary *et al.*, 2016). Herpes simplex virus infection is on the increase worldwide. This infection is one of the most common human disease-causing agents with a life-time latency period within neural ganglions which can be activated periodically. Both HSV-1 and HSV-2 can be spread by direct contact (Malary *et al.*, 2016). Maternal infection with HSV is very common and is associated with lifelong infection in both developed and developing countries. Maternal infection with HSV before or during childbirth can cause neonatal infection through close contact or vertical transmission. Brown *et al.*, revealed that HSV-1 has a higher risk of mother to child transmission than HSV-2. Neonatal HSV infection means an infection within 28 days of the neonatal period including intrauterine infection (also known as innate infection), birth canal infection and postnatal infection (Anil *et al.*, 2017). The risk of transmission of HSV infection from mother to newborn in maternal primary infection during pregnancy especially the third trimester can increase tenfold (Anaedobe & Ajani 2019). HSV mother to child transmission can occur in the uterus (invitro transmission) in the process of delivery (peripartum neonatal transmission) and after birth (postnatal HSV infection). However, 24.85% of mother to child transmission takes place during the process of delivery, when there is viral shedding from the genital tract, especially in secretion from the vagina (Anil *et al.*, 2017). In the case of asymptomatic infection of the mother, it is hard to recognize an HSV infection in a newborn and this can result to serious health consequences. The death rate of neonatal herpes is high even after treatment with acyclovir imposing a heavy burden on both the family and society. Treating neonatal herpes is costly which involves hospital stay, intensive care, intravenous drug therapy, laboratory test and the long-term cost of disability in case of severe neurological outcome (Anil *et al.*, 2017). HSV-2 can result to 2 – 3-fold increase in the risk of developing HIV infection. Genital herpes can lead to spontaneous abortion during pregnancy, intra uterus growth retardation, pre-term labour and maternal and neonatal HSV infection (Malary *et al.*, 2016). Although HSV infection is not a medically curable condition, medications are available to effectively treat symptoms and prevent outbreaks. Unfortunately, there are no currently approved vaccines to prevent HSV infection (Oksana *et al.*, 2018). The greatest incidence of HSV infection has been found to occur in women of reproductive age. However, little is known about detection and association of HIV and HSV-2 IgM co-infection among asymptomatic pregnant women**.** Hence, this study is aimed at detection and association of HIV and HSV-2 IgM co-infection among asymptomatic pregnant women in Port Harcourt, Rivers State, Nigeria'

2. Materials and Methods

2.1. Study Area

This study was performed using pregnant women attending the antenatal unit of the University of Port Harcourt Teaching Hospital (UPTH) Rivers State, Nigeria with its Coordinates: 4°53'23"N and 6°54'18"E.

2.2. Study Design

This is a cross-sectional study conducted at the antenatal unit of the University of Port Harcourt Teaching Hospital (UPTH) Rivers State, Nigeria. The method for this study consists of informed consent, blood withdrawal by venipuncture, screening for HSV-2 IgM and HIV. Questionnaire was used to obtain socio-demographic characteristics of the participants.

2.3. Sample size determination

The sample size for this study was determined using the established formula $N= [Z^2 (PQ)]/d^2$. Where N is the desired sample size. Z = standard normal deviation at a 95% confidence interval (which was 1.96). p = proportion of target population, q = alternate proportion (1-p), d = desired level of precision (degree of precision/significance). This was taken as 0.05. Then, the desired sample size (N) = 168

2.4. Specimen Collection and Handling

About 5mls of venous blood was collected aseptically by venipuncture into an EDTA bottles. The plasma was separated by centrifugation at room temperature at 3000rpm for ten minutes, transfer to a plain bottle and stored in aliquot in the freezer at -20° C. This was done on every visit to the antenatal clinic. Samples were clearly represented with codes in order to avoid misinterpretation of results.

2.5. Ethical Approval

An Ethical Approval was obtained from Institutional Review Board of the University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State

2.6. Serological Analysis

Plasma samples was tested at the Virus Research Unit, Department of Microbiology, University of Port Harcourt, for the presence of HSV-2 IgM antibodies using the ELISA kit manufactured by DIAPRO Diagnostic Bioprobes Srl via G. Carducci n° 2720099 Sesto San Giovanni (Milano)-Italy. ELISA tests were carryout according to the manufacturer's instructions. Protocol for the measurement was done according to the manufacturer's instruction and reading was done at optical density of 450nm with an EIA plate reader. The tests ran were validated and results were interpreted according to the manufacturer's instruction. Plasma samples were also analyzed for the presence of HIV antibodies using Alere Determine HIV-1/2 (Alere), Uni-Gold HIV(Trinity) and HIV1/2 STAT-PAK (Chembio) according to manufacturer's specifications.

2.7. Data Analysis

Data were analyzed using statistical package for social sciences (SPSS) version 21. Chi square analysis was used to assess correlation of the infection with socio-demographic factors.

3. Results

3.1. Seroprevalence of HSV-2 IgM and HIV Antibodies

Out of the 168 respondents investigated for HSV-2 infection, 50 (29.8%) was seropositive for HSV-2 IgM. While the prevalence rate of HIV antibodies was 9 (5.4%). Table 1 represent the socio-demographic data of the respondents.

Table 1 Socio-Demographic Characteristics of the Study Sample

Variables	No	% Frequency
Age Group		
20 – 29	52	31.0%
30 – 39	104	61.9%
40 – 49	12	7.1%
Type of family		
Monogamous	136	81.0%
Polygamous	32	19.1%
Level of Education		
Primary/None	1	0.6%
Secondary	18	10.7%
Tertiary	149	88.7%
Occupation		
Student	14	8.3%
Unemployed/housewife	27	16.1%

Trading	55	32.7%
Civil servant	59	35.1%
Artisan	5	3.0%
Business executive	8	4.8%
Religion		
Christian	154	91.7%
Islam	5	3.0%
Free thinkers	9	5.4%
History of Abortion		
Yes	71	42.3%
No	97	57.7%
Parity		
0	65	38.7%
1 – 2	74	44.1%
3 – 4	27	16.1%
Above 5	2	1.2%
Gestation Period		
1st	19	11.3%
2nd	74	44.1%
3rd	75	44.6%
STD History		
Yes	20	11.3%
No	148	88.1%
Marital Status		
Single	2	1.2%
Married	166	98.8%

3.1.1. Seroprevalence of HSV-2 IgM and HIV Antibodies

Out of the 168 respondents investigated for HSV-2 infection, 50 (29.8%) was seropositive for HSV-2 IgM. While the prevalence rate of HIV antibodies was 9 (5.4%).

Prevalence of HSV-2 IgM and HIV antibodies in relation to age

In relation to age, the seropositivity of HSV-2 IgM in 20 – 29 years, 30 – 39 years and 40 – 49years, age group is 20(38.5%), 26(25.0%) and 4(33.3%) respectively. The correlation observed between age of the respondents and HSV-2 seroprevalence was statistically significant ($^{IgM}x^2$ = 18.012 p-value = 0.042). Meanwhile, considering the respondents with HIV antibodies, no HIV antibodies was detected in respondents in age group 20 – 29 years while prevalence rate of 8(7.7%) and 1 (8.3%) was recorded for respondents in age group 30 – 39 years and 40 – 49 years respectively. However, there was no significant relationship observed between HIV seroprevalence and age of the respondents. (Table 2)

Prevalence of HSV-2 IgM antibodies in relation to marital status

However, statistically significant relationship was observed between HSV-2 IgM infection and marital status of the respondents ($^{IgM}x^2$ = 17.341, p-value = 0.012) while there was no significant difference between HIV infection and

marital status of the respondents (x^2 = 10.35, p-value = 0.051). Meanwhile HSV-2 IgM prevalence rate of 50 (28.1%) was observed among married respondents and none of the singles is currently suffering from HSV-2 IgM infection. Furthermore, a prevalence rate of 9 (5.4%) was documented for married respondent living with HIV antibodies and none of the single were infected with HIV. (Table 2)

Prevalence of HSV-2 IgM and HIV Antibodies in Relation to Educational level

With regard to prevalence of HSV-2 IgM the respondents with none/primary school level are not currently suffering from infection while the prevalence rate of respondents with secondary and tertiary level of education was 3 (16.7%) and 45 (30.2%) respectively indicating they are currently suffering from HSV-2 infection. However, there was no significant difference between HSV-2 IgM infection and educational level of the respondents ($^{IgM}x^2$ = 17.341, p-value = 0.051). However, highest prevalence rate of 4 (22.2%) was recorded for respondents living with HIV and lowest prevalence rate of 5 (3.4%) was observed for HIV respondents with tertiary level of education. There is no statistically significant relationship was observed between HIV infection and level of education (x^2 = 3.426, p-value = 0.086). (Table 2)

Prevalence of HSV-2 IgM and HIV Antibodies in Relation to Occupation

The highest HSV-2 IgM seroprevalence of 19 (34.5%) was observed among the respondents that are traders and lowest HSV-2 IgM seroprevalence 1 (12.5%) was found among the business executive. The relationship observed between occupation of the respondents and IgM seroprevalence is statistically not significant (x^2 = 4.510, p-value = 0.091)

However, for HIV respondents, 1 (20%) was observed among the artisans with no HIV antibodies detected among respondents that are students and civil servants. There was no significant difference observed between occupation of the respondents and HIV prevalence (x^2 = 3.219, p-value = 0.093). (Table 2)

Seroprevalence of HSV-2 IgM and HIV Antibodies in Relation to Type of Family

The prevalence rate of HSV-2 IgM for monogamy and polygamy are 37 (25.3%) and 13 (38.2%) respectively. However, there is no statistically significant difference between type of family of the respondents and IgM prevalence (x^2 = 3.521, p-value = 0.073). However, for HIV respondents, a prevalence rate for monogamy and polygamy are 8 (5.9%) and 1 (3.1%) respectively. The relationship observed between type of family of the respondents and HIV seroprevalence was not significantly strong (x^2 = 4.571, p-value = 0.087). (Table 2)

Prevalence of HSV-2 IgM and HIV Antibodies in Relation to Religion

The seropositivity of HSV-2 IgM for Christians is 47(30.5%), Islam (Muslim) 3(60.0%) and no prevalence rate was recorded for free thinker's respondents. There is no significant difference between HSV-2 infection and religion of respondents ($^{IgM}x^2$ = 15.02, p-value = 0.031). A seropositivity of 9(5.8%) was documented for HIV respondents that are Christians meanwhile no HIV antibodies was detected on respondents that are Muslim and free thinkers respectively. Statistically, significant relationship was observed between HIV infection and religion of respondents (x^2 = 10.081, p-value = 0.049). (Table 2)

Seroprevalence of HSV-2 IgM and HIV Antibodies in Relation to History of Abortion

The seropositivity of HSV-2 IgM of respondents with and without history of abortion is 29(40.8%) and 21(21.6%) respectively. There is no significant relationship between HSV-2 IgM infection and history of abortion of the respondents (x^2 = 5.291, p-value = 0.0821). However, the prevalence of HIV respondents with and without history of abortion are 4 (5.6%) and 5 (5.2%) respectively. Meanwhile, there is no significant relationships between HIV infection and history of abortion (x^2 = 6.731, p-value = 0.085). (Table 2)

Seroprevalence of HSV-2 IgM and HIV Antibodies in Relation to Parity

The seropositivity of HSV-2 IgM of the respondents with the same number of children as mentioned above is 19(29.2%), 25(33.8%), 5(18.5%) and 1(50.0%) respectively. There is no significant difference between HSV-2 IgM infection and parity of the respondents (x^2 = 6.030, p-value = 0.251). However, highest prevalence of 5(6.8%) was recorded for HIV respondents with 1 – 2 children while no HIV antibodies was detected in respondents with five children and above. However, there is no significant relationship between HIV infection and parity of the respondents (x^2 = 6.521, p-value = 0.0782). (Table 2)

Prevalence of HSV-2 IgM and HIV Antibodies in Relation to Gestation Period

The seroprevalence of HSV-2 IgM of the respondents in the first, second and third trimesters are 9(45%), 19(22.9%) and 22(28.6%) respectively. There is no significant difference between HSV-2 IgM infection and gestation period of the respondents (x^2 = 5.580, p-value = 0.402). Furthermore, highest prevalence of 6(8.1%) was recorded for respondents living with HIV antibodies in the second trimester and the lowest prevalence 2(2.7%) was documented in the third trimester HIV respondents. There is no significant correlation n between HIV infection and gestation period of the respondents (x^2 = 5.621, p-value = 0.063). (Table 2)

Prevalence of HSV-2 IgM and HIV Antibodies in Relation to History of Sexually Transmitted Disease

The seropositivity of HSV-2 IgM of the respondents with and with no history of sexually transmitted diseases is 11(55.0%) and 39(26.4%) respectively. There is no significant correlation between HSV-2 IgM infection and sexually transmitted diseases of the respondents (x^2 = 6.210, p-value = 0.072). Meanwhile the prevalence rate of respondents living with HIV antibodies with and with no history of sexually transmitted disease are respectively 1(5%) and 8(5.4%). There is no significant correlation between HIV infection and sexually transmitted diseases of the respondents (x^2 = 6.073, p-value = 0.431). (Table 2)

Table 2 Demographic factors associated with HSV-2 IgM and HIV antibodies

Variables	**No tested (%)**	**IgM+ve**	**X^2**	**p-value**	**HIV+ve**	**X^2**	**P-value**
Age group							
20 – 29	52(31.0)	20(38.5)	18.01	0.042	0	8.061	0.094
30 – 39	104(61.9)	26(25.0)			8(7.7)		
40 – 49	12(7.1)	4(33.3)			1(8.3)		
Marital Status							
Single	2(1.2)	0	17.341	0.012	0	10.352	0.051
Married	166(98.8)	50(30.1)			9(5.4)		
Educational Level							
None/primary	1(0.6)	0	12.063	0.051	0	3.426	0.086
Secondary	18(10.7)	3(16.7)			4(22.2)		
Tertiary	149(88.7)	45(30.2)			5(3.4)		
Occupation							
Student	14(8.3)	3(21.4)	4.510	0.091	0	3.219	0.093
Unemployed	27(16.1)	9(33.3)			2(7.4)		
Trading	55(32.7)	19(34.5)			5(9.1)		
Civil servant	59(35.1)	17(28.8)			0		
Artisan	5(3.0)	1(20)			1(20)		
Business executive	8(4.8)	1(12.5)			1(12.5)		
Type of Family							
Monogamy	136(81.0)	37(27.2)	3.521	0.073	8(5.9)	4.751	0.087
Polygamy	32(19.1)	13(40.6)			1(3.1)		
Religion							
Christian	154(91.7)	47(30.5)	15.02	0.031	9(5.8)	10.081	0.049
Islam (Muslim)	5(3.0)	3(60)			0		

Free thinkers	9(5.4)				0		
History of Abortion							
Yes	71(42.3)	29(40.8)	5.291	0.0821	4(5.6)	6.731	0.085
No	97(57.7)	21(21.6)			5(5.2)		
Parity							
0	65(38.7)	19(29.2)	6.030	0.251	3(4.6)	6.521	0.0782
1 – 2	74(44.1)	25(33.8)			5(6.8)		
3 – 4	27(16.1)	5(18.5)			1(3.7)		
≥ 5	2(1.2)	1(50)			0		
Gestation							
1st	19(11.3)	9(47.4)	5.580	0.402	1(5.3)	5.621	0.063
2nd	74(44.1)	19(25.7)			6(8.1)		
3rd	75(44.6)	22(29.3)			2(2.7)		
STD History							
Yes	20(11.3)	11(55.0)	6.210	0.072	1(5.0)	6.073	0431
No	148(88.1)	39(26.4)			8(5.4)		

3.2. HSV-2 IgM and Co-infection with HIV

Out of the 168 respondents screened for HIV antibodies in the study, 9 were found to be HIV positive. Among the 50 respondents detected to be HSV-IgM seropositive, no co-infection between $^{HIV}/_{IgM}$, was detected. All HIV positive respondents 9(100%) are Christians with $^{4}/_{9}$ (44.4%) having history of abortion. A large number of the respondents $^{5}/_{9}$ (55.6%) have 1 – 2 children. Furthermore, $^{6}/_{9}$ (66.7%) are in their second trimester period with $^{1}/_{9}$ (11.1%) having history of sexually transmitted diseases.

Table 3 HIV and HSV-2 IgM co-infection in relation to various demographic variables

Variables	**No tested (%)**	**HIV +ve (%)**	**IgM +ve (%)**	**$^{HIV}/_{IgM}$(%)**
Age group				
20 – 29	52(31.0)	0	20(38.5)	0
30 – 39	104(61.9)	8(7.7)	26(25.0)	0
40 – 49	12(7.1)	1(8.3)	4(33.3)	0
Marital Status				
Single	2(0.2)	0	0	0
Married	166(98.8)	9(5.4)	50(30.1)	0
Educational Level				
None/primary	1(0.6)	0	0	0
Secondary	118(10.7)	4(22.2)	3(16.7)	0
Tertiary	149(88.7)	5(3.4)	45(30.2)	0
Occupation				

Student	14(8.3)	0	3(21.4)	0
Unemployed	27(16.1)	2(7.4)	9(33.3)	0
Trading	55(32.7)	5(9.1)	19(34.5)	0
Civil servant	59(35.1)	0	17(28.8)	0
Artisan	5(3.0)	1(20)	1(20)	0
Business executive	8(4.8)	1(12.5)	1(12.5)	0
Type of Family				
Monogamy	136981.0)	8(5.9)	37(27.2)	0
Polygamy	32(19.1)	1(3.1)	13(40.6)	0
Religion				
Christian	154(91.7)	9(5.8)	47(30.5)	0
Islam (Muslim)	5(3.0)	0	3(60.0)	0
None	9(5.4)	0	0	0
History of Abortion				
Yes	71(42.3)	4(5.6)	29(40.8)	0
No	97(57.7)	5(5.2)	21(21.6)	0
Parity				
0	65(38.7)	3(4.6)	19(29.2)	0
1 – 2	74(44.1)	5(6.8)	25(33.8)	0
3 – 4	27(16.1)	1(3.7)	5(18.5)	0
≥ 5	2(1.2)0	0	1(50.0)	0
Gestation				
1st	19(11.3)	1(5.3)	9(47.4)	0
2nd	74(44.1)	6(8.1)	1	0
3rd	75(44.6)	2(2.7)	22(29.3)	0
STD History				
Yes	20(11.3)	1(5.0)	11(55.0)	0
No	148(88.1)	8(5.4)	39(26.4)	0

4. Discussion

Herpes simplex virus (HSV) causes a common sexually transmitted infection (STI) and the prevalence of this infection has increased significantly over the last two decades in many developed and developing countries. Very high infection levels have been documented in the developing world of which Nigeria belongs.

This study showed a prevalence rate of HSV-2 IgM 29.8%. Detectable HSV-2 IgM antibodies is an indication of current or recent infection. The seropositivity in this study was higher than 15.7% observed by Tada and Khandelwal, 2012 among patient with sexually transmitted diseases and 3.2% documented by Aljumaili *et al.*, 2013 in women with bad obstetric history. However, Sahu *et al.*, 2019 reported a prevalence of 2% after screening 402 cases of pregnant women in Odisha, India Okonko, 2015 in Rivers State, South South Nigeria observed a prevalence of 2.8%.

4.1. Age

In this study, the highest prevalence of HSV infection was found among the 30 – 39 years age group while the lowest prevalence was observed among the 20 – 29 years age group. This may be due to the higher tendency of acquiring the infection with increasing cumulative years of sexual exposure. This finding is consistent with similar report among pregnant women where a large number of those observed to be seropositive for HSV-2 where above 30 years of age (Anaedobe & Ajani 2019). However, age was significantly associated with occurrence of HSV-2 antibodies. This is in agreement with report by Kale *et al.*, 2014. In terms of HSV-2 IgM, the highest prevalence in age ranging from 20 – 29 is in agreement with study and report by Okonko and Cookey 2015 that suggested that this age group is prone to HSV infection. However, there was a significant association between age and prevalence of IgM. This contradict the report by Samson *et al.*, 2020. With regard to HIV, there was no significant correlation between age and prevalence of HIV. This contradicted the report by Okerentugha *et al.*, 2015 and Frank Peterside *et al.*, 2012 which deduced that age is significant associated with prevalence of HIV.

4.2. Marital Status

In this study, there was a higher seroprevalence of 59.6% among the married while no HSV-2 infection was detected among the single. This contradicted the report by Agabi, were higher prevalence of HSV-2 infection was observed among singles compared to married individuals (Agabi *et al.*, 2010) (Okonko & Cookey, 2015). With regard to HSV-2 IgM infection, only the married was observed to be undergoing current infection while there was no current infection among the singles. This deviate from report by Okonko where the highest prevalence was recorded among the single. This study shows significant association between marital status with prevalence of IgM. This agrees with report by Okonko and Cookey 2015. In terms of HIV, there was no significant difference between marital status with HIV prevalence. This report is in agreement with the study performed by Okerentugba *et al.*, 2015.

4.3. Education

The seroprevalence of HSV-2 infection was observed to increase with increasing educational qualification similar to report by Xu *et al* in the United States of America and Aljumaili *et al* in Iraq. Large number of the respondents (88.7%) with tertiary education may be because the study was a tertiary hospital-based and was carried out in an urban centre. Increasing level of education was noticed to be inversely related to HSV-2 infection. This may be explained by the fact that a higher level of education is associated with greater enlightenment of the infection, its route of transmission and prevention indicating the positive influence of education and public awareness on the carrier rate of HSV-2 infection. Lack of proper education might give rise to ignorance of acquisition and prevention of HSV (Okonko & Cookey 2015). However, there was no significant association between educational level of the respondents and prevalence of IgM. This study agrees with report by Okonko and Cookey 2015 study that educational level is significantly associated with prevalence of IgM. Concerning HIV, this study showed no significant difference between educational level of respondents with prevalence of HIV. This agrees with report by Okerentugba *et al.*, 2015 that educational level is significantly associated with HIV prevalence.

4.4. Occupation

A low prevalence of 12.5% was observed among business executive and highest prevalence was observed among traders**.** There was no significant correlation between occupation of the respondents with prevalence of IgM. This is in agreement with study reported by Okonko & Cookey 2015. In terms of HIV, there was no significant difference observed between the occupation of respondents with the prevalence of HIV. This contradicts the report by Okerentugba *et al.*, 2015 that occupation was significantly associated with the prevalence of HIV.

4.5. Type of Family

The high prevalence observed among the respondents in a polygamous relationship may be attributed to extramarital relationship by spouse. The low prevalence in monogamy may be due to earlier marriage associated with shorter period between premarital sexual debut and marriage associated with lower vulnerability. However, there was no significant association between type of family with prevalence of IgM. For HIV respondents, there was no significant correlation between family types with the prevalence of HIV.

4.6. Religion

Concerning HSV-2 IgM, the lower prevalence observed among Muslim compared to Christian might be as a result of their religion practice that is strongly against immoral life style Aljumaili *et al.*, 2013. However, the variation in prevalence of the religion was statistically associated with HSV-2 infection. However, in HIV, this study showed a

significant difference between religion of respondents with HIV prevalence. This agrees with report by Okerentugba *et al.*, 2015.

4.7. History of Abortion

Concerning IgM, there was no significant different found between history of abortion with prevalence of IgM. However, for HIV, there was no significant correlation between history of abortion with prevalence of HIV.

4.8. Parity

The effect of elevating number of previous pregnancies on seropositivity may not be direct but may be a reflection of increasing sexual activity duration which itself is a risk factor for HSV seropositivity. This study showed that the variation in prevalence was statistically not associated with HSV infection. This contradicted study by Rothore *et al.*, 2010 who reported that parity was significantly related to HSV infection. for respondents with HIV, there was no significant correlation between parity and prevalence of HIV. This deviated from a report by Frank Peterside *et al.*, 2012 who reported that parity is significantly associated with HIV prevalence.

4.9. Gestation

HSV-2 infection is common among women of reproductive age and it can be contracted and transmitted to the foetus during pregnancy and the newborn. Herpes simplex virus is the major cause of neonatal infection which can lead to death or long-term disabilities. The risk of transmission of maternal-fetal-neonatal herpes simplex can be reduced by performing a treatment with antiviral medication or resorting to a caesarean section in some specific cases. (Aljumaili *et al.*, 2013) HSV contracted in the course of pregnancy is connected with spontaneous abortion and has the highest occurrence in first trimesters (Okonko & Cookey 2015).

This study showed that the prevalence of HSV-2 seropositivity gradually rose with increase in trimester period of pregnancy. Most of the respondents were recruited within their second and third trimesters of their pregnancy. This is in agreement with similar study performed by Kalu *et al.*, 2014. In terms of HSV-2 IgM, the high prevalence rate 22(29.3%) observed among the respondent in their third trimester is an indication they are undergoing recent infection and were therefore at a higher risk of neonatal transmission while the 9(47.4%) of the respondents acquiring the infection at their first trimester period are at the risk of miscarriage because HSV gotten at early pregnancy is connected with spontaneous abortion (Malkin *et al.*, 2002). Concerning HIV, gestation period of the respondents was found to be significantly associated with HIV infection.

4.10. Sexually Transmitted Diseases (STD)

Herpes simplex virus infection caused by herpes simplex virus type 1 and 2 (HSV-2 and HSV-2) are some of the most common viral sexually transmitted diseases (STD) worldwide (Xu *et al.*, 2006).

In terms of HSV-2 IgM, the prevalence rate is higher in respondents with history of sexually transmitted diseases than respondents with no history of sexually transmitted disease. This could be attributed to early exposure to sexual intercourse. Kalu *et al.,* 2014 reported in his study that early exposure to sexual intercourse result to increase risk of sexually transmitted infection during adolescence while the lower seropositivity observed among the respondents with no history of sexually transmitted diseases may be as a result of proper hygiene and faithful family relationship (Aljumaili *et al.*, 2013). With regard to HIV, this study showed that sexually transmitted diseases are significantly associated with the prevalence of HIV.

4.11. Co-infection of HSV-2 and HIV

This study indicates that HSV-2/HIV co-infection were common among the respondents. Co-infection with HSV-2 and HIV among pregnant women may increase the risk of maternal-to-fetal transmission of HIV by as much as 25% (Anaedobe *et al.*, 2019). From this study, there was no co-infection between HSV-2 IgM and HIV

5. Conclusion

The results obtained in the study indicate there is a high prevalence of HSV-2 antibodies among pregnant women in Port Harcourt, Rivers State, Nigeria. This observation necessitates the need for serological evaluation in all the pregnant women for HSV antibodies for early diagnosis and treatment to prevent vertical transmission leading to congenital infections in the foetus. Identifying those at highest risk is a pertinent initial step before the design of intervention

strategies. Consequently, intervention strategies will be harnessed and implemented to reduce the risk of transmission to the foetus or newborn.

Recommendations

As a result of the findings from this study conducted in Port Harcourt, Rivers State, Nigeria, the following recommendations are made;

- Pregnant women should be educated on the risks of neonatal herpes, particularly since they are likely to have the strongest motivation for avoiding infection from partners.
- Pregnant women should be routinely screened for HSV-2 during antenatal care
- Infants of mothers with herpes infection should be screened and followed up

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare no form of conflict of interest in this study.

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