Original Research Article

Seroprevalence of Herpes Simplex Virus-2 Antibodies and Associated Risk Factors among Undergraduate Female Students of a Private University in Ogun State, Nigeria

ABSTRACT

Background: Herpes simplex virus-2 (HSV-2) causes genital herpes, a chronic viral infection that is sexually transmitted and often results in genital ulcer disease (GUD) worldwide.
Aim: The aim of this study was to determine the seroprevelence rate of herpes simplex virus 2 (HSV-2) IgG and IgM antibodies and the associated risk factors among undergraduate female students of Babcock University.
Methods: The serum samples of 150 consenting female participants (16-35 years) were collected randomly and screened using NADAL^{R} HSV-2 IgG/IgM Rapid Antibody Test Cassette (Bulgarian Company for Biotechnology, Sofia, Bulgaria). The demographic and clinical information of the participants were also collected using a structured questionnaire.
Results: The outcome of the study shows that out of the 150 participants screened, 5 (3.3%) were positive for HSV-2 IgG antibody, 4 (2.7%) were positive for HSV-2 IgM; while 2 (1.3%) were positive for both HSV-2 IgG and IgM antibodies. There were no significant differences in the seropositivity for HSV-2 IgG and IgM antibodies among the study participants on the basis of age distribution. With regards to clinical indication for genital herpes in relation to seropositivity of HSV-2 IgG and IgM antibodies among the study participants, none of the 7 (4.6%) who indicated vaginal itching was seropositive for either HSV-2 IgG or HSV-2 IgM or both. On the other hand, genital lesions were recorded in 0.7% HSV-2 IgG seropositive, 1.3% HSV-2 IgM seropositive and 0.7% HSV-2 both IgG and IgM seropositive. Genital ulcer was recorded among two participants who were either seropositive for HSV-2 IgG (0.7%) or HSV-2 IgM (0.7%). Only one (0.7%) participant indicated inguinal lymphadenopathy, however, the person was HSV-2 IgG/IgM seronegative. Identifiable risk factor associated with infection include: past history of sexually transmitted infections, HIV status, change of sex partners recently, and intravenous drug use.
Conclusion: The outcome of this study show that HSV-2 infection exists among undergraduate female students of Babcock University, Ilishan-Remo, Ogun State, Nigeria and therefore appropriate public health measures must therefore be taken to halt the cycle of infection within the University community. Early detection of genital herpes and prompt treatment will help prevent subsequent complications such as genital ulcer disease among young female adults

Key Words: *Herpes simplex virus-2, IgG, IgM, antibodies, Genital herpes, Risk factors*

1.0 INTRODUCTION

Herpes simplex virus-2 (HSV-2), a sexually transmitted double stranded DNA virus is the aetiologic agent of genital herpes infection and the primary cause of genital ulcer disease, a global public health concern especially among female population [1, 2]. The virus has also been identified as an important risk factor for urethritis and cervical cancer among women [3].

Infection may be transmitted through contact with HSV-2 in herpes lesions, mucosal surfaces, genital secretions, or oral secretions [2, 4]. Generally, a person can only get HSV-2 infection during genital contact with someone who has a genital HSV-2 infection. However, receiving oral sex from a person with an oral HSV-1 infection can result in getting a genital HSV-1 infection [5]. Transmission commonly occurs from contact with an infected partner who does not have visible lesions and who may not know that he or she is infected [6]. When symptoms do occur, herpes lesions typically appear as one or more vesicles, or small blisters, on or around the genitals, rectum or mouth. The average incubation period for an initial herpes infection is 4 days (range, 2 to 12) after exposure. The vesicles break and leave painful ulcers that may take two to four weeks to heal after the initial herpes infection [7, 8].

An increasing HSV-2 prevalence has been found throughout the world in recent years especially among high risk population [9]. Annual incidence of HSV2 infection is 23 million. In 2012, about 417 million (11.3%) 15-49 year-old individuals were infected with HSV2 worldwide [5, 10, 11]. Infection is more prevalent in developing countries, Nigeria inclusive. Ojinmah *et al.* [12] reported a prevalence of 77.9% among female patients attending skin and ANC clinics at University of Nigeria Teaching Hospital and Enugu State Teaching Hospital, Enugu state, Nigeria.

HSV-2 prevalence has been associated with age, gender, number of sexual partners, socioeconomic status and immunodeficiency amongst others [13]. Other prenatal risk factors of HSV2 infection are ethnicity, poverty, cocaine abuse, early sexual activity, sexual behavior and bacterial vaginosis [14-16].

HSV-2 infection is often sub-clinical; therefore, most infected persons are unaware of their infection. HSV-2 has perineal transmission during labor and may lead to fatal neonatal infections [17, 18]. HSV-2 infection has been associated with 2-3 fold increase in the risk of developing HIV infection [5]. Although HSV2 is not a life-threatening infection, it may cause fulminant hepatitis among pregnant women and persistent severe infection among immunocompromised patients and even in normal immune persons [19].

Early detection of HSV-2 infection might prevent the occurrence of genital ulcer disease and its attending complications. Howbeit, the percentage occurrence of Herpes simplex virus-2 IgM and IgG antibodies among undergraduate female students of Babcock University, Ilishan-Remo, Ogun State, Nigeria is not known. Besides, there is need to identify factors that predispose young female adults in this setting to Herpes simplex virus 2 infection. Scarcity of information in this regard therefore necessitates this study.

2.0 Materials and Methods

2.1 Study Design

This was a cross-sectional descriptive study

2.2 Study area

This cross-sectional institution based study was carried among female undergraduate students of Babcock University, Ilishan-Remo, Ogun State. Babcock University is a private Christian co-educational Nigerian university owned and operated by the Seventh-day Adventist Church in Nigeria. The university is located at Ilishan-Remo equidistant between Ibadan and Lagos with a current student population of about 10, 000.

2.3 Duration of study

This study was carried out between the months of March and May 2019.

2.4 Study population

Undergraduate female students of Babcock University were the target population. Female students within the age range of 16-35 years from different ethnic, religious and cultural background; studying different courses in various Departments. There are nine female halls in the University (Ameyo Adadevoh, Crystal, Felicia Adebisi Dada, Havilah Gold, Nyberg, Ogden, Platinum and Queen Esther). Study participants were selected from each Hall of Residence at random.

2.5 Sample size calculation

The sample size (N) was estimated using the formula described by Charan and Biswas [20]:

$$N = Z^2PQ/d^2$$

Where;

N = required sample size,

Z = standard normal variate at 5% ($p<0.05$) error or 95% confidence interval is 1.96

P = proportion of the population with Herpes Simplex Virus 2 infection from pervious study,

Q = proportion of the population without Herpes Simplex Virus 2 infection (1- P) and

d = Absolute error margin is 0.05

$$N = \frac{1.96^2 \times 0.102 \times 0.874}{0.05^2}$$

For the calculation, a 95% confidence interval, a P value of 0.126, *i.e.,* a prevalence rate of 10.2% from previous study by Mirambo *et al.* [21], and margin of error (d) set at 0.05 will be used to determine the minimum sample size required. To minimize errors arising from the likelihood of non-compliance, 10% of the sample size will be added giving a final sample size of 150.

2.6 Sample size

A total of 150 blood specimens were collected randomly from consenting apparently healthy female undergraduate students of Babcock University, Ilishan-Remo, Ogun State.

2.7 Eligibility of subjects

2.7.1 Inclusion criteria

Consenting apparently healthy undergraduate female students of Babcock University were randomly recruited for the study.

2.7.2 Exclusion criteria

Undergraduate female students with history of anti-viral drugs or native herbal solution in the preceding two (2) weeks were excluded from the study. Also, undergraduate male students, as well as the postgraduate female and male Students of Babcock University were excluded from the study.

2.8 Consent

Informed consent was obtained from each participant. The purpose and nature of the study, as well as method of sample collection was explained to them properly. Participants were requested to voluntarily complete the consent form in their own handwriting and endorsed by their signatures as proof of willingness to provide samples for the test. They were assured of confidentiality associated with the study.

2.9 Data collection

Prior to specimen collection, demographic and clinical information were obtained from participants through administration of prepared questionnaires and personal interviews. Each questionnaire has a unique participant identification number (PIDN). The first part of the questionnaire contained the biodata of the patients e.g. Name, sex, age, educational level, religion and marital status. Second part included history of genital infection (painful urination, itchy genital, swollen genital, genital discharge etc.), risk factors (if any), personal hygiene and health care-seeking behavior. The study population was stratified by age, study level, religion, tribe and hall of residence. Response to structured questionnaire administered was used to collect data on epidemiology and demographic trends of Herpes Simplex Virus-2 infection. For the purpose of privacy, all information obtained from the participant was treated confidentially.

2.10 Specimen collection and storage

Blood specimen was collected from each participant via venous puncture using standard procedure. The collected blood specimens were conveyed to the laboratory unit of the Department of Medical Laboratory Science, Babcock University. The blood specimens were made to stand for about an hour to clot, retracted and centrifuged afterwards at 3,500 rpm for 10 minutes at room temperature. The yielded serum was transferred to another clean sterile plain bottle and analyzed immediately, otherwise, where a delay was envisaged, the sera were stored at 2-8^{0}C for up to three days. The specimen was kept at a temperature below -20^{0}C for long term storage. The frozen specimens were properly thawed and mixed before testing commences. Multiple freeze-thaw cycles of the sera were avoided. Prior to testing, frozen specimens were brought to room temperature slowly and mixed gently.

2.11 Laboratory analyses

2.11.1 Detection of serum anti-HSV-2 IgG and IgM antibodies

Serum anti-HSV-2 IgG and IgM antibodies were detected using a NADAL^R HSV-2 IgG/IgM Rapid Antibody Test Cassette supplied by Bulgarian Company for Biotechnology, Sofia, Bulgaria according to the manufacturer instruction.

2.11.2 Interpretation of Results

2.11.2.1 Positive Result

In addition to the presence of the Control “C” line, if only the IgM “M” line is developed, the test indicates the presence of IgM anti-HSV-2 in the specimen. The result is positive or reactive. In addition to the presence of the Control “C” line, if only the IgG “G” line is developed, the test indicates the presence of IgG anti-HSV-2 in the specimen. The result is positive or reactive. Also in addition to the presence of the Control “C” line, if both the “M” and the “G” lines are developed, the test indicates the presence of both IgM and IgG anti-HSV-2 in the specimen. The result is positive or reactive.

2.11.2.2 Negative Result

If only the “C” line is present, the absence of any pink color in both the test lines (M and G) indicates that no anti-HSV-2 antibodies are detected in the specimen. The result is negative or non-reactive.

2.11.2.3 Invalid Result

If no control “C” line is developed, the assay is invalid regardless of the pink color in the test bands as indicated. A total absence of color in either regions or only one color band appearing on the test region indicates procedure error and/or the test reagent as deteriorated. If this occurs, the assay will be repeated with a new device.

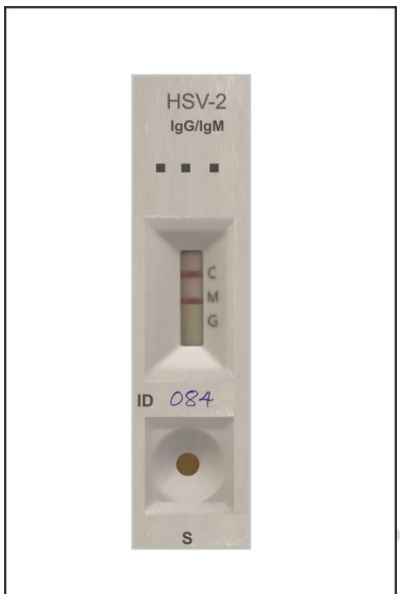

Fig. 1: HSV-2 Cassette positive for only IgM antibody.

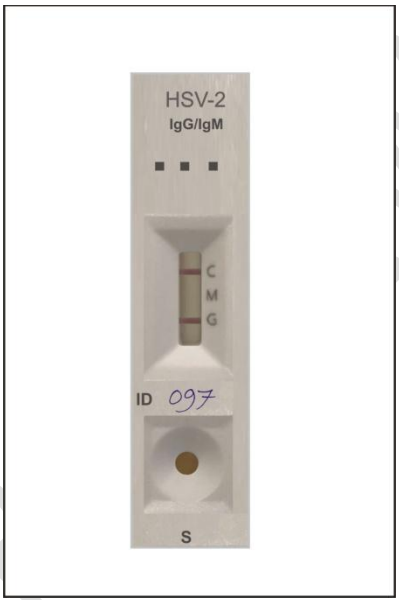

Fig. 2: HSV-2 Cassette positive for only IgG antibody

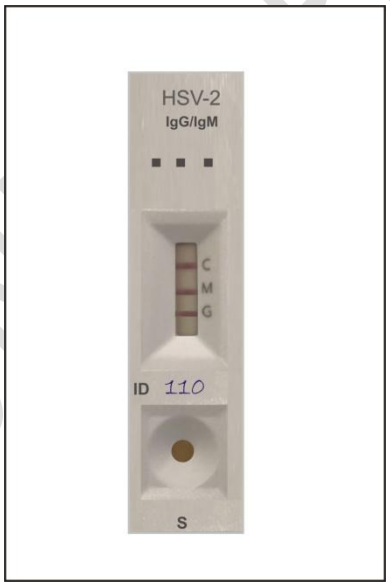

Fig. 3: HSV-2 Cassette positive for both IgM & IgG antibodies

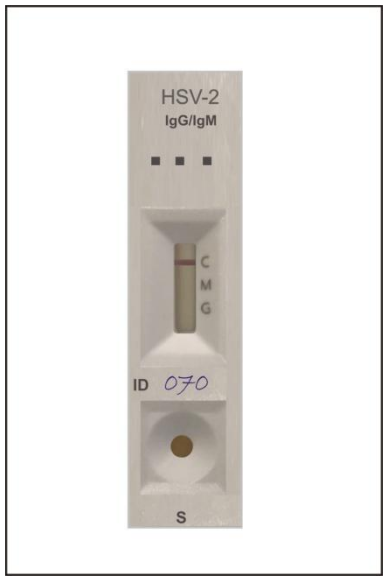

Fig. 4: HSV-2 Cassette negative for both IgM & IgG

2.12 Data Analysis

Data obtained from the serum antibody screening, as well as from the questionnaires were entered into Microsoft Excel. Statistical analysis was carried out using SPSS-18.0 (Statistical packages for social scientists version 18.0) statistical program. Chi-Square, Two-way Anova Analysis and Turkey-Kramer Multiple Comparisons Test was used to test for significant differences between the seroprevalence rate of anti-Herpes Simplex Virus-2 IgG and IgM antibodies, as well as percentage occurrence of IgG and IgM Herpes Simplex Virus 2 antibodies. Significant risk factors associated with HSV-2 was determined with simple logistic regression analysis.

3.0 RESULTS AND DISCUSSION

The present study investigated the seroprevalence of Herpes Simplex Virus-2 IgG and IgM antibodies amongst undergraduate female students of a private University in Ogun state, Nigeria. The socio-demographic characteristics of the study participants are presented in Table 1. Their age distribution is as follows: 16-20 years (101, 67.3%), 21-25 years (48, 32.0%), 26-30 years (1, 0.7%) and ≥30 years (0). On the basis of religion, 129 (86.0%) were Christians, while 21 (14%) were Muslims. There were no traditionalists amongst them. Based on tribal distribution, 89 (59.3%) of them were Yoruba, 35 (23.3%) were Igbo, while just only 1 person (0.7%) was Hausa. 25 (16.7%) were neither Igbo, Hausa nor Yoruba. Based on their study level, 22 (14.7%) were 100 level students, 19 (12.7%) were 200 level students, 37 (24.7%) were 300 level students, 57 (38.0%) were 400 level students while 15 (10.0%) were 500 level students. Based on their Hall of Residence, 24 (16.0%) reside in Crystal hall, 48 (32.0%) in FAD hall, 15 (10.0%) in Havilah Gold hall, 2 (1.3%) in Marigold hall, 10 (6.7%) in Nyberg hall, 21 (14.0%) in Ogden hall, 16 (10.7%) in Platinum hall, 7 (4.7%) in Queen Esther while 7 (4.7%) in White hall.

The prevalence rate of HSV infection among the study participants is presented in Figure 5. Out of 150 students screened, 11 (7.3%) of them were found to be seropositive for either HSV-2 IgG or IgM antibody or both, whereas the remaining 139 (92.7%) were HSV-2 seronegative. The frequency of occurrence of Herpes Simplex Virus-2 IgG antibody in relation to the Age, Study Level and Hall of Residence of the study participants is presented in Table 2. Out of the 150 participants screened, 5 (3.3%) were positive for HSV-2 IgG antibodies. There was no significant difference ($P>0.05$) in the occurrence of HSV-2 IgG antibody among the study participant on the basis of their age, study level and Hall of residence.

The frequency of occurrence of Herpes Simplex Virus-2 IgM antibody in relation to the Age, Study Level and Hall of Residence of the study participants is presented in Table 3. Out of the 150 participants examined, only 4 (2.7%) were found to be positive for HSV-2 IgM antibody. Similarly, there was no significant difference ($P>0.05$) in the occurrence of HSV-2 IgM antibody among the study participant based on their socio-demographic characteristics.

Furthermore, the frequency of co-occurrence of both Herpes Simplex Virus-2 IgG and IgM antibodies in relation to the socio demographic characteristics of the study participants is presented in Table 4. Only two (1.3%) out of the 150 participants examined tested positive to both HSV-2 IgG and IgM antibodies. There were no significant differences ($P>0.05$) in the co-occurrence of both HSV-2 IgG and IgM antibodies within and among the study participants regardless of their socio-demographic characteristics.

The percentage of single and co-occurrence of HSV-2 antibodies in relation to their non-occurrence among the study participants. is presented in Figure 6. 3.3% were seropositive for HSV-2 IgG antibody, 2.7% were seropositive for HSV-2 IgM antibody, 1.3% were seropositive for both HSV-2 IgG and IgM antibodies; whereas the remaining 92.7% were seronegative for both antibodies.

The percentage occurrence of HSV-2 symptomatic and asymptomatic infection among the study participants is presented using a Bar Chart (Figure 7). Out of the 11 (7.3%) participants who tested positive for HSV-2 antibodies, 6 (4.0%) of them were symptomatic, whereas 5 (3.3%) of them were asymptomatic.

Table 1: Socio-demographic characteristics of the study participants

Characteristics	Category	Frequency (N)	Percentage (%)
Age	16-20yrs	101	67.3
	21-25yrs	48	32.0
	26-30yrs	1	0.7
	≥30 Yrs.	0	0
	Total	150	100
Marital Status	Single	1050	100
	Married	0	0
	Total	150	100
Study Level	100 Level	22	14.7
	200 Level	19	12.7
	300 Level	37	24.7
	400 Level	57	38.0
	500 Level	15	10.0
	Total	150	100
Religion	Christianity	129	86.0
	Islam	21	14.0
	Total	150	100
Tribe	Hausa	1	0.7
	Igbo	35	23.3
	Yoruba	89	59.3
	Others	25	16.7
	Total	150	100
Hall of Residence	Crystal	24	16.0
	Fad	48	32.0
	Havilah	15	10.0
	Marigold	2	1.3
	Nyberg	10	6.7
	Ogden	21	14.0
	Platinum	16	10.7
	Queen Esther	7	4.7
	White	7	4.7
	Total	150	100

The indication for genital herpes in relation to seropositivity of HSV-2 IgG and IgM antibodies among the study participants is presented using a histogram (Figure 8). None of the 7 (4.6%) participants who indicated vaginal itching was seropositive for either HSV-2 IgG or HSV-2 IgM, nor both. On the other hand, genital lesions were present in 0.7% of HSV-2 IgG seropositive individuals, 1.3% of HSV-2 IgM seropositive and 0.7% of HSV-2 IgG and IgM seropositive persons. Genital ulcer was recorded among two participants who were either seropositive for HSV-2 IgG (0.7%) or HSV-2 IgM (0.7%). Only one participant (0.7%) indicated inguinal lymphadenopathy, however, the person was HSV-2 IgG/IgM seronegative.

Table 2: Frequency of occurrence of Herpes Simplex Virus-2 IgG antibody in relation to the Age, Study Level and Hall of Residence of the study participants

Characteristics	Category	No. of serum samples examined N (%)	No. positive for HSV-2 IgG N (%)	No. negative for HSV-2 IgG N (%)	*P-Value*	Pearson Chi-Square (χ^2)
Age	16-20 years	101 (67.3)	3 (1.9)	98 (65.3)	0.100	29.274
	21-25 years	48 (32.0)	1 (0.7)	47 (31.3)	0.203	
	26-30 years	1 (0.7)	1 (0.7)	0 (0.0)	0.062	
	≥30 Years.	0 (0)	0 (0)	0 (0)		
	Total	150 (100)	5 (3.3)	145 (96.6)		
Study Level	100 Level	22 (14.7)	1 (0.7)	21 (14.0)	0.904	1.324
	200 Level	19 (12.7)	0 (0.0)	19 (12.7)	0.999	
	300 Level	37 (24.7)	1 (0.7)	36 (24.0)	0.998	
	400 Level	57 (38.0)	2 (1.3)	55 (36.7)	0.313	
	500 Level	15 (10.0)	1 (0.7)	14 (9.3)	0.518	
	Total	150 (100)	5 (3.3)	145 (96.7)		
Hall of Residence	Crystal	24 (16.0)	1 (0.7)	23 (15.3)	1.000	2.254
	Fad	48 (32.0)	2 (1.3)	46 (30.7)	0.999	
	Havilah	15 (10.0)	1 (0.7)	14 (9.3)	0.998	
	Marigold	2 (1.3)	0 (0.0)	2 (1.3)	0.998	
	Nyberg	10 (6.7)	0 (0.0)	10 (6.7)	1.000	
	Ogden	21 (14.0)	1 (0.7)	20 (13.3)	0.999	
	Platinum	16 (10.7)	0 (0.0)	16 (10.7)	0.998	
	Queen Esther	7 (4.7)	0 (0.0)	7 (4.7)	0.999	
	White	7 (4.7)	0 (0.0)	7 (4.7)	1.000	
	Total	150 (100)	5 (3.3)	145 (96.7)		

P>0.05 is considered statistically not significant.

Table 5 shows the risk factors associated with Herpes simplex virus-2 IgM and IgG antibodies seropositivity among the study participants. History of STI (OR, 0.016), HIV status (OR, 0.026), recent change of sex partners (OR, 0.022) and intravenous drug use (OR, 0.001) were found to be significantly associated with the occurrence of HSV-2 IgG and IgM antibodies among the study participants.

The results of this study differ from those of previous studies. On one hand, the frequency of occurrence of HSV-2 IgG antibody in this study is slightly higher than those reported by Mohamed *et al.* [22], who observed a prevalence rate of 3.1% and 3.2% among pregnant and non-pregnant women in Iraq. On the other hand, it is far lower than those reported by Yunusa *et al.* [13] and Naga *et al.* [23] among HIV co-infected patients in Central Nigeria (36.4%) and Eastern India (61.5%), respectively. Current data was also found to be lower than those reported by Hayatudeen *et al.* [24], and Salman *et al.* [25] among apparently healthy individuals (73.5%) in Nigeria, and Children under 5 years (56%) in Iraq, respectively, using ELISA method. Furthermore, the frequency of occurrence of HSV-2 IgM antibody as observed in this study is lower than the one reported by the same Mohamed *et al.* [22], among pregnant (21.8%) and non-pregnant (26.4%) women, using ELISA method.

Table 3: Frequency of occurrence of Herpes Simplex Virus-2 IgM antibody in relation to the Age, Study Level and Hall of Residence of the study participants

Characteristics	Category	No. of serum samples examined N (%)	No. Positive for HSV-2 IgM N (%)	No. Negative for HSV-2 IgM N (%)	*P-Value*	Pearson Chi-Square (χ^2)
Age	16-20yrs	101 (67.3)	4 (2.7)	97 (64.6)	0.997	1.994
	21-25yrs	48 (32.0)	0 (0.0)	48 (32.0)	0.100	
	26-30yrs	1 (0.7)	0 (0.0)	1 (0.7)	0.100	
	≥30 Yrs.	0 (0)	0 (0)	0 (0)		
	Total	150 (100)	4 (2.7)	146 (97.3)		
Study Level	100 Level	22 (14.7)	2 (1.3)	20 (13.3)	1.000	4.613
	200 Level	19 (12.7)	0 (0.0)	19 (12.7)	0.998	
	300 Level	37 (24.7)	1 (0.7)	36 (24.0)	0.999	
	400 Level	57 (38.0)	1 (0.7)	56 (37.3)	0.998	
	500 Level	15 (10.0)	0 (0.0)	15 (10.0)	0.998	
	Total	150 (100)	4 (2.7)	146 (97.3)		
Hall of Residence	Crystal	24 (16.0)	1 (0.7)	23 (15.3)	1.000	10.338
	Fad	48 (32.0)	0 (0.0)	48 (32.0)	1.000	
	Havilah	15 (10.0)	0 (0.0)	15 (10.0)	1.000	
	Marigold	2 (1.3)	0 (0.0)	2 (1.3)	1.000	
	Nyberg	10 (6.7)	0 (0.0)	10 (6.7)	0.999	
	Ogden	21 (14.0)	2 (1.3)	19 (12.7)	1.000	
	Platinum	16 (10.7)	0 (0.0)	16 (10.7)	0.999	
	Queen Esther	7 (4.7)	1 (0.7)	6 (4.0)	1.000	
	White	7 (4.7)	0 (0.0)	7 (4.7)	1.000	
	Total	150 (100)	4 (2.7)	146 (97.3)		

P>0.05 is considered statistically not significant.

Still, it is far lower than those reported by Naga *et al.* [23], Hayatudeen *et al.* [24], and Salman *et al.* [25] among HIV co-infected patients (34.6%) in Eastern India, apparently healthy individuals (46.1%) in Nigeria, and Children under 5 years (20.37%) in Iraq, respectively, using the same ELISA method.

Also, the frequency of co-occurrence of both HSV-2 IgG and IgM antibodies in this current study (1.3%) is extremely lower than the 31.5% reported by Agyemang-Yeboah *et al.* [3] among women attending routine cervix care clinic in Ghana. The differences in the prevalence rates reported in this study and those of other previous studies might be due to differences in the sensitivity and precision of the diagnostic methods employed, cultural/socio-economic status, as well as the geographical locations of the study participants.

On the basis of age distribution, the outcome of this study shows that the prevalence of HSV-2 infection was non-significantly (P>0.05) higher among participants 16-20 years old than other age groups examined. This study differs from other previous studies that reported high prevalence rate of HSV-2 IgG and IgM antibodies mostly among under 5 years children [25] and in the elderly [26].

Table 4: Frequency of co-occurrence of Herpes Simplex Virus-2 IgG and IgM antibodies in relation to the Age, Study Level and Hall of Residence of the study participants

Characteristics	Category	No. of serum samples examined N (%)	No. positive for both HSV-2 IgG & IgM N (%)	No. Negative for both HSV-2 IgG & IgM N (%)	*P-Value*	Pearson Chi-Square (χ^2)
Age	16-20yrs	101 (67.3)	1 (0.7)	100 (66.6)	1.000	0.309
	21-25yrs	48 (32.0)	1 (0.6)	47 (31.3)	1.000	
	26-30yrs	1 (0.7)	0 (0)	1 (0.7)	0.999	
	≥30 Yrs.	0 (0)	0 (0)	0 (0)		
	Total	150 (100)	2 (1.3)	148 (98.7)		
Study Level	100 Level	22 (14.7)	1 (0.7)	21 (14.0)	1.000	2.762
	200 Level	19 (12.7)	0 (0)	19 (12.7)	0.999	
	300 Level	37 (24.7)	0 (0)	37 (24.7)	1.000	
	400 Level	57 (38.0)	1 (0.6)	56 (37.3)	1.000	
	500 Level	15 (10.0)	0 (0)	15 (10.0)	1.000	
	Total	150 (100)	2 (1.3)	148 (98.7)		
Hall of Residence	Crystal	24 (16.0)	1 (0.6)	23 (15.3)	1.000	6.208
	Fad	48 (32.0)	0 (0)	48 (32.0)	0.999	
	Havilah	15 (10.0)	1 (0.6)	14 (9.3)	0.999	
	Marigold	2 (1.3)	0 (0)	2(1.3)	0.999	
	Nyberg	10 (6.7)	0 (0)	10(6.7)	1.000	
	Ogden	21 (14.0)	0 (0)	21(14.0)	0.999	
	Platinum	16 (10.7)	0 (0)	16(10.7)	0.999	
	Queen Esther	7 (4.7)	0 (0)	7(4.7)	0.999	
	White	7 (4.7)	0 (0)	7(4.7)	1.000	
	Total	150 (100)	2 (1.33)	148 (98.7)		

P>0.05 is considered statistically not significant.

In most developing countries, HSV-1 antibody is found in 18% to 35% of children by the age of 5 years and 90% of the population have it by the age of 30. However, detection of HSV-2 antibody before puberty is less common since direct sexual transmission is the major mode of spread for HSV-2. Approximately 15% to 30% of sexually active adults in industrialized countries have HSV-2 antibodies, depending on the number of sexual partners. This current study cannot prove whether HSV-2 antibodies are more prevalent in children, young adult or elderly as it focused mainly on young adults (the undergraduate female students), of which most of them are in their mid-teens, early twenties and one (1) in her late twenties. This age range is the period of greatest sexual activity. Undergraduate female students in this group tend to engage in frequent sexual intercourse in exchange for money and exam scores and are therefore prone to sexually transmitted diseases including HSV-2 infection.

The risk factors associated with occurrence of HSV-2 IgG and IgM antibodies identified in this study include: lack of knowledge/awareness, increasing numbers of sexual partners, recent change in sex partners, engagement in unprotected sex, history of sexually transmitted infections, and HIV status amongst others. This agrees with the work of Hayatudeen *et al.* [24], who also reported similar risk factors.

Table 5: The risk factors associated with Herpes simplex virus-2 IgM and IgG antibodies seropositivity among the study participants

Characteristics	Responses	Number of participants	HSV-2 IgG Positivity N (%)	HSV-2 IgM Positivity N (%)	HSV-2 IgM & IgG Positivity N (%)	Odd Ratio (OR)
Knowledge of HSV-2	Yes	62 (41.3)	1 (0.66)	1 (0.675)	1 (0.65)	0.621
	No	88 (58.7)	4 (2.64)	3 (2.025)	1 (0.65)	
	Total	150 (100)	5 (3.3)	4 (2.7)	2 (1.3)	
History of STI	Yes	17(11.3)	5(3.3)	4(2.7)	2(1.3)	0.016*
	No	133(88.7)	0(0)	0(0)	0(0)	
	Total	150(100)	5 (3.3)	4(2.7)	2(1.3)	
HIV Status	Positive	4(2.7)	0(0)	2(1.35)	2(1.3)	0.026*
	Negative	128(85.3)	4(2.64)	2(1.35)	0(0)	
	Not known	18(12)	1(0.66)	0(0)	0(0)	
	Total	150(100)	5(3.3)	4(2.7)	2(1.3)	
Sharing of underwear	Yes	5(3.3)	0(0)	0(0)	1(0.65)	0.72763
	No	145(96.7)	5(3.3)	4(2.7)	1(0.65)	
	Total	150(100)	5(3.3)	4(2.7)	2(1.3)	
Sharing of sanitary facilities	Yes	52(34.7)	4(2.64)	1(0.675)	2(1.3)	2.125
	No	98(65.3)	1(0.66)	3(2.025)	0(0)	
	Total	150(100)	5(3.3)	4(2.7)	2(1.3)	
Engage in unprotected sex	Yes	20	1(0.66)	0(0)	1(0.65)	0.857
	No	130	4(2.64)	4(2.7)	1(0.65)	
	Total	150(100)	5(3.3)	4(2.7)	2(1.3)	
Number of sexual partners	None	106(70.7)	0(0)	2(1.35)	0	27.178
	1-2	38(25.3)	5(3.3)	1(0.675)	0(0)	
	3-5	6(4)	0(0)	1(0.675)	2(1.3)	
	Total	150(100)	5(3.3)	4(2.7)	2(1.3)	
Changed sex partners recently	Yes	11(7.3)	4(2.64)	0(0)	1(0.65)	0.022*
	No	139(92.7)	1(0.66)	4(2.7)	1(0.65)	
	Total	150(100)	5(3.3)	4(2.7)	2(1.3)	
Number of sexual intercourse per week	None	136(90.7)	4(2.64)	4(2.7)	1(0.65)	3.907
	1-2	11(7.3)	1(0.66)	0(0)	1(0.65)	
	3-5	3(2)	0(0)	0(0)	0(0)	
	Total	150(100)	5(3.3)	4(2.7)	2(1.3)	
Medical check-up/lab test	Less often	114(76)	4(2.64)	4(2.7)	2(1.3)	0.978
	Often	27(18)	0(0)	0(0)	0(0)	
	More often	9(6)	1(0.66)	0(0)	0(0)	
	Total	150(100)	5(3.3)	4(2.7)	2(1.3)	

**OR <0.05 is considered statistically significance.*

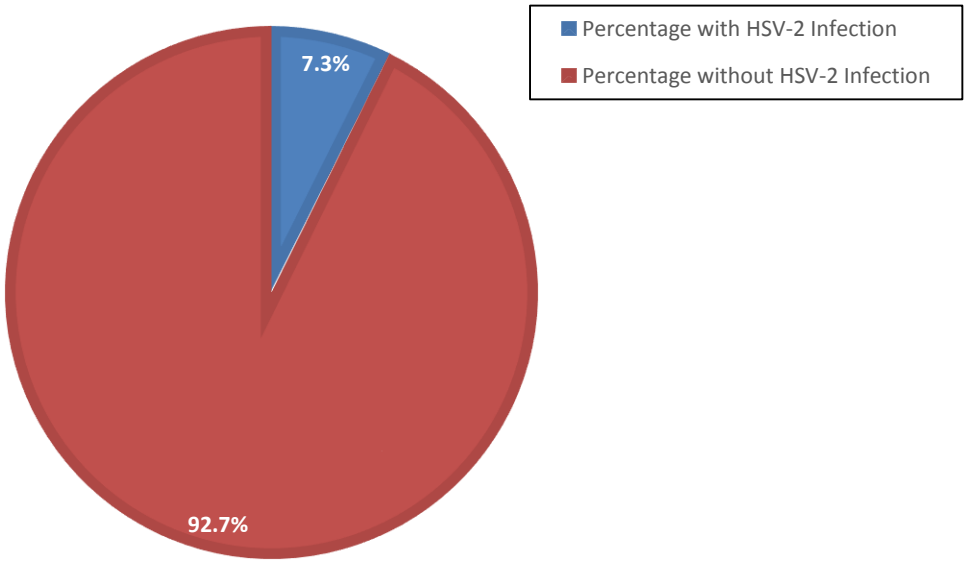

Fig. 5: Pie chart showing prevalence rate of HSV-2 infection among the study participants

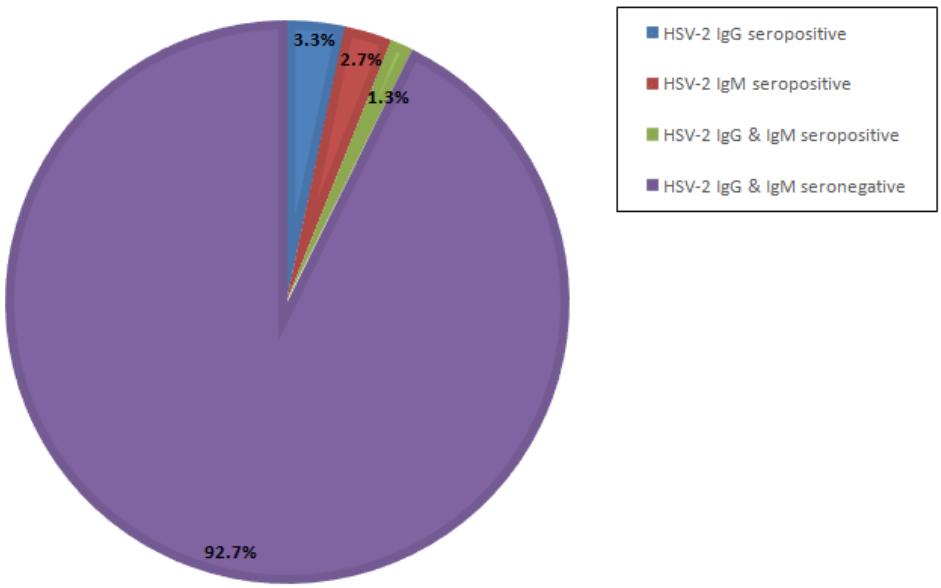

Fig. 6: Pie chart showing the percentage occurrence of HSV-2 antibodies among the study participants

Knowledge and information is very vital to disease prevention and control in epidemiology. The percentage of participants not aware of HSV-2 and the infection it causes was quite high, hence the need for more public awareness among the study participants in this regard.

Furthermore, all the participants who were sero-positive for either HSV-2 IgG and/or HSV-2 IgM antibodies had history of STI. Also, the 4 participants with positive HIV status were either sero-positive for either HSV-2 IgM or both HSV-2 IgM and IgG antibodies. This is in agreement with the works of Yunusa *et al.* [13] and Naga *et al.* [23].

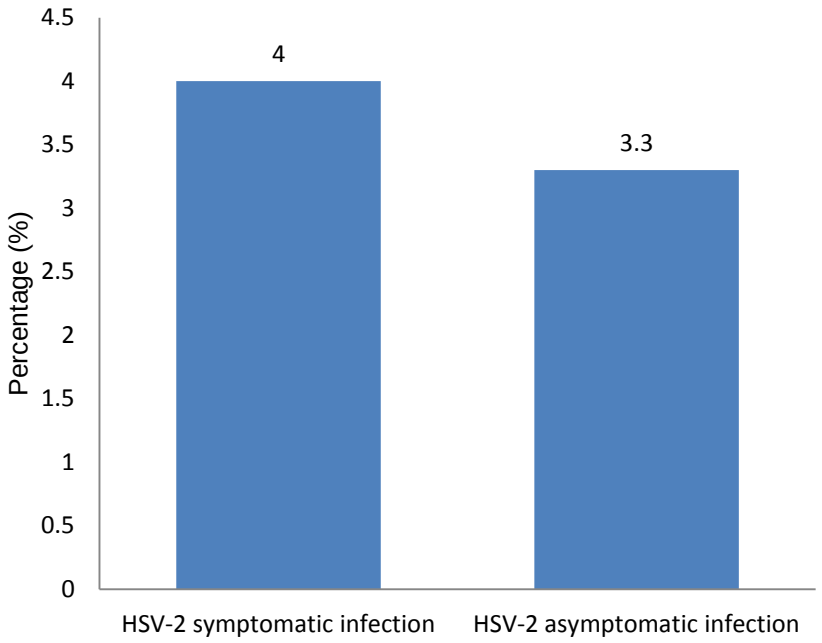

Figure 7: Bar chart showing percentage occurrence of HSV-2 symptomatic and asymptomatic infection among the study participants

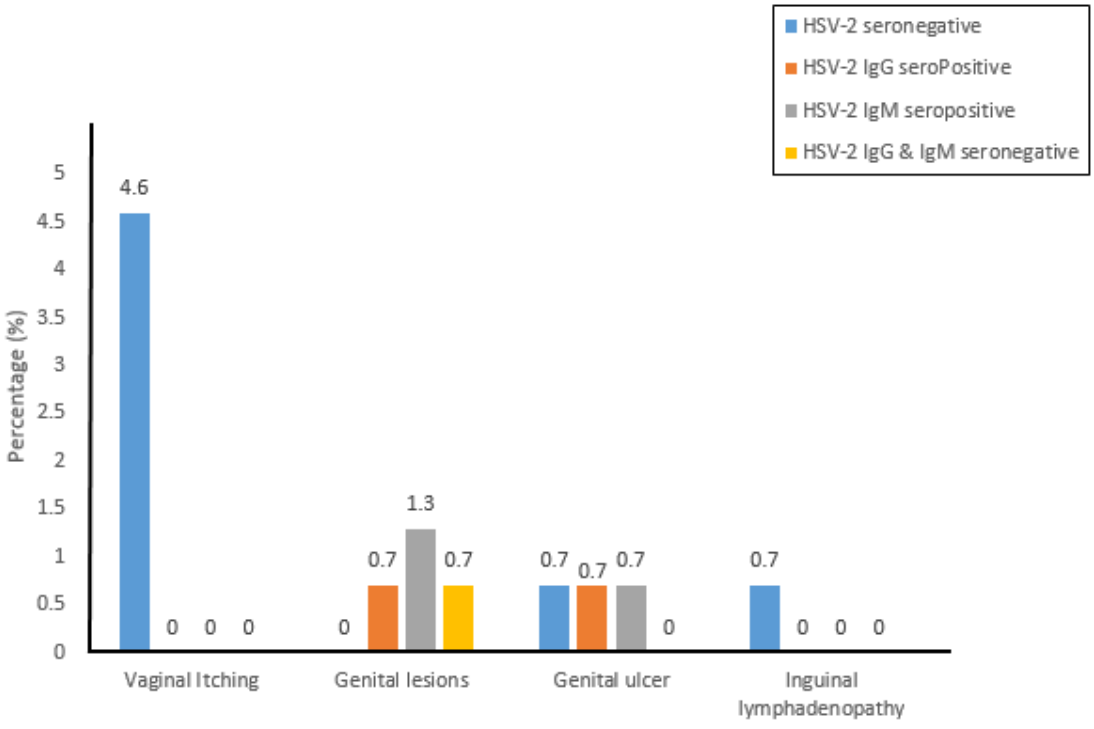

Figure 8: Histogram showing indications for genital herpes in relation to the percentage of study participants seropositive for HSV-2 IgG and IgM antibodies

Once an individual suffers from one form of STI or the other, the chances of re-occurrence in the future is high, not only by the same primary pathogen, but as well as by other secondary invaders. HIV infection in particular is characterized by progressive and continuous impairment of the immune system function, with varying rates of progression among patients depending on whether the individual is on medication or not. Highly active antiretroviral treatments (HAARTs) have been shown to be effective in arresting immune system impairment and prevention of disease progression, yet the incidence of opportunistic infections (OIs) doesn't seem to cease. OIs can occur in about 40% of people living with HIV, with a CD4 count less than 200 cells/mm^3 and high plasma HIV RNA loads. Organisms that cause OIs are frequently present in the body but are generally kept under control by a healthy immune system [27-29].

In most people with healthy immune systems for instance, HSV-2 is usually latent (inactive). The virus resides in latently infected ganglia in a non-replicating state, persisting indefinitely in the infected host. However, Provocative stimuli such as stress, trauma, exposure to ultraviolet light or sunlight, other infections, or suppression of the immune system, (such as by HIV), can reactivate the latent virus and symptoms can return [23]. The virus follows axons back to the peripheral site, and replication proceeds at the skin or mucous membranes. Latency has been documented as one of the main strategies by which HSV-2 circumvents or evades the host defense system. Still, it has been observed that antiviral agents do not eradicate the virus in its latent state [28].

The low prevalence rate reported in this current study against previous studies may be partly due to the fact most of the study participants examined were virgins, as 70.7% of them indicated that they have no sex partners, while 90.7% of them indicated they don't engage in sexual intercourse. Abstinence has been well documented as an 100% effective control and preventive measure against all forms of sexually transmitted infections (STIs) including HSV-2 infection. On the assumption that the information provided by the participants regarding their sexual life and activities were sincerely correct and authentic, it is suggestive that non-veneral means of transmission be considered in addition to venereal means, especially among sexually non-experienced girls as 7 out of the 52 participants who indicated that they Share sanitary facilities were positive for either HSV-2 IgG or IgM Ab or both. Also one person out of the 5 who indicated that they share underwear was positive for both HSV-2 IgG or IgM Ab. Nevertheless, evidence of non-venereal transmission of HSV-2 requires further investigation.

Another plausible reason for the low prevalence rate reported in this current study may be partly due to the fact that majority of the study participants (86.7%) do not engage in unprotected sex and even among the remaining 13.3% participants who indicated that they engage in unprotected sex, only one person was positive for HSV-2 IgG Ab, while another was positive for both HSV-2 IgG and IgM Abs. The use of barriers such as condoms is also another effective control and preventive measure against all forms of sexually transmitted infections (STIs) including HSV-2 infection. Although not as effective as the former, the use of protective barriers has also been reported to prevent sexual transmission of infectious agents including HSV-2.

Furthermore, the results obtained from the study corroborate the claim that there is a relationship between the occurrence of HSV-2 IgG and IgM antibodies and indications for genital herpes (genital lesions and genital ulcer). This agrees with the work of Matthew *et al.* [30] who reported genital ulcer among 61.9% of pregnant women seropositive for HSV-2. On one hand, these indications are consistent with HSV-2 infection. Primary genital herpes infections can be severe, with illness lasting about 3 weeks. However, an initial HSV-2 infection in a person already immune to HSV-1 tends to be less severe. Some experts opined that prior infection with HSV-1 may provide some protection against or shorten the duration of symptoms and lesions from subsequent infection with HSV-2 as a result of some degree of cross-protection [31, 32].

On the other hand, the lack of occurrence of HSV-2 antibody sero-positivity among those who indicated they that they have vaginal itching exempts HSV-2 as the culprit of their condition, therefore other aetiological agents like Candida spp., *Trichomonas vaginalis* and *Gardnerella vaginalis* should be queried in their case. Similarly, complain of genital ulcer among HSV-2 sero-negative individuals among the study participants should prompt one to suspect and probe for *Treponema pallidum, Haemophilus ducreyi,*

Klebsiella granulomatis, and *Chlamydia trachomatis (serovars L1, L2, L3)* as possible causative agents, however, such investigations are outside the scope of this study.

Contrary to the earlier report that many people with HSV-2 infection are asymptomatic or have small, unnoticed genital lesions, the outcome of this study reveal that percentage of study participants with symptomatic HSV-2 infection (4.0%), were slightly higher than those who were asymptomatic (3.3%). Nevertheless, it's worthy to mention here that recurrences of genital herpetic infections are common and whether symptomatic or asymptomatic, a person shedding virus can transmit the infection to sexual partners. Individuals with genital herpes should therefore be counseled that asymptomatic shedding is frequent and that the risk of transmission can be reduced by antiviral therapy and condom usage [33, 34].

Finally, this discussion will not be complete without a remark on the implications of the results obtained in this study. Immunologically speaking, antibody production is one of the body's responses to the presence of infectious agents, including viruses like HSV-2. The detection of anti-HSV-2 antibodies in the patient's serum is an indication that the individual must have been exposed to the said pathogen at one time or the other. Immunoglobulin M (IgM) and Immunoglobulin G (IgG) are two major antibodies of great interest with regard to host humoral response to HSV-2 infection. Generally speaking, IgM and IgG antibodies are produced as a result of primary (first 1-7 days) and secondary (7-21 days) immune response to infectious agents, respectively. IgM disappears within 2-3 weeks of infection and is replaced by IgG which intend to persist longer in the patient's blood proving lasting immunity. The detection of only anti-HSV-2 IgM antibody in patient's serum suggests that the individual has current HSV-2 infection, while detection of only anti-HSV-2 IgG antibody suggests recent or previous HSV-2 infection. On the other hand, the detection of both anti-HSV-2 IgM and IgG antibodies suggests current as well as recent and previous infection. Meanwhile, the non-detection of both anti-HSV-2 IgM and IgG antibodies denotes absence of HSV-2 infection and that the individual is susceptible to HSV-2 infection and should therefore take necessary precautions against exposure in the future [8].

4.0 CONCLUSION

The outcome of this study show that HSV-2 infection exists among undergraduate female students of Babcock University, Ilishan-Remo, Ogun State, Nigeria and therefore appropriate public health measures must therefore be taken to halt the cycle of infection within the University community. Early detection of genital herpes and prompt treatment will help prevent subsequent complications such as genital ulcer disease among young female adults.

CONSENT

All authors declare that 'written' informed consent was obtained from the participants with assurance of anonymity and confidentiality before the commencement of the study.

ETHICAL APPROVAL

Ethical approval for the study was obtained from the Babcock University Health Research Ethics Committee (BUHREC) with ethical approval registration number: BUHREC310/19.

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