Prevalence of Herpes Simplex Virus Type-2 IgG Antibody among pregnant women in Port-Harcourt, Nigeria

Iheanyi Omezuruike Okonko[1], Amarachi Faith Benjamin[2], Tochi Ifeoma Cookey[1], Blessing Jachinma Okonko[3], and Hope Innocent-Adiele[1]

[1]Virus Research Unit, Department of Microbiology, University of Port Harcourt, Port Harcourt, Nigeria; [2]Department of Microbiology Technology, School of Science Laboratory Technology, University of Port Harcourt, Port Harcourt, Nigeria; [3]Virology & Immunology Research Unit, Department of Applied Microbiology, Ebonyi State University, Abakaliki, Nigeria

Correspondence: Iheanyi Omezuruike Okonko PhD, Virus Research Unit, Department of Microbiology, University of Port Harcourt, Port Harcourt, Nigeria.
Tel. +2347069697309; +2348035380891.
E-mail: Iheanyi.okonko@uniport.edu.ng

Key words: Antibody, HSV-2, IgG, Seropositivity, Risk factors, Pregnant women, Nigeria.

Authors' contributions: IOO, conceptualized the study, was involved in study design, data and sample collection, laboratory analysis, and wrote the manuscript, was involved in the data analysis, and reviewed the final draft of the manuscript; TIC, contributed to the final concept of the study, analyzed the samples entered the data, was involved in the data analysis, and reviewed the final draft of the manuscript; AFB, contributed to the final concept of the study, was involved in data collection, entered the data and reviewed the final draft of the manuscript; BJO, contributed to the final concept of the study, was involved in data collection, entered the data and reviewed the final draft of the manuscript; HCI, contributed to the final concept of the study, was involved in data collection, entered the data and reviewed the final draft of the manuscript. All authors contributed equally in writing up this manuscript, editing, proofreading and approval of the final manuscript for this publication.

Conflict of interest: The authors declare no potential conflict of interest.

Funding: None.

Availability of data and materials: All relevant data are within the paper and its supporting information files.

Acknowledgments: The authors would like to acknowledge the support obtained from the management and staff of the University of Port Harcourt Teaching Hospital (UPTH), Nigeria, during the enrollment and collection of samples used in this study. The authors sincerely acknowledge the participants for their consent, cooperation, participation and support.

Received for publication: 1 September 2022.
Accepted for publication: 10 January 2023.

Publisher's note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article or claim that may be made by its manufacturer is not guaranteed or endorsed by the publisher.

Licensee PAGEPress, Italy
Microbiologia Medica 2023; 38:10829
doi:10.4081/mm.2023.10829

Summary

Background and Aims: Herpes Simplex Type 2 Viruses (HSV-2) are one of the most common viral sexually transmitted diseases worldwide, which are now a significant health concern. The most significant incidence of HSV infections occurs in women of reproductive age. Thus, the study aimed to ascertain the occurrence of HSV-2 IgG in pregnant women in Port Harcourt, Nigeria and identify the demographic profile associated with the prevalence.

Materials and Methods: A hospital-based cross-sectional survey was adopted to randomly analyze 90 pregnant women attending antenatal clinics at a tertiary hospital in Port Harcourt, Nigeria. An enzyme-linked immunosorbent assay was used to assess HSV-2 IgG antibodies in the samples obtained.

Results: Of the 90 subjects, 51.1% were HSV-2 seropositive, while 48.9% were seronegative for HSV-2 IgG antibody. No statistical association existed between the prevalence of HSV-2 IgG antibodies and the sociodemographic factors studied ($p>0.05$). Higher prevalence of HSV-2 IgG antibody mostly occurred in age 20-29 (54.2%), married (51.7%), no formal education (100.0%), unemployed and artisans (75.0%), Christians (53.1%), monogamous family type (52.0%), first trimester (62.5%), nulliparous (67.6%), abortion history (66.7%), history of Sexually Transmitted Diseases (STDs) (83.3%) and Human Immunodeficiency Virus (HIV) seropositive (100.0%).

Conclusions: This study has confirmed that the prevalence of HSV-2 IgG antibodies among pregnant women in Port Harcourt, Nigeria is very high. The results indicate a considerable risk of primary or recurrent HSV infection during pregnancy, as shown by the prevalence rates. Identifying those at the highest risk is an appropriate initial step before the design of intervention strategies. Consequently, intervention strategies will be harnessed and implemented to reduce the risk of transmission to the fetus or newborn.

Introduction

Among the most common human viral infections globally are Herpes Simplex Virus (HSV) infections caused by HSV type 1 (HSV-1) and 2 (HSV-2) [1]. They are one of the most common viral Sexually Transmitted Diseases (STD) worldwide [2]. They are now

a significant health concern, confirmed by the epidemic of genital HSV and enhanced acquisition of HIV [3,4]. It is estimated that 90% of people worldwide are seropositive for HSV-1 by the fourth decade of life, especially those of lower socioeconomic groups [5].

The most significant incidence of HSV infections occurs in women of reproductive age. The risk associated with maternal virus transmission to the fetus or neonate has become a significant health concern [6-8]. Genital HSV infection in pregnant women is of particular concern because of the risk to the fetus and newborn caused by HSV-1 and HSV-2 [9].

The risk of vertical transmission of genital herpes infection to the infant when the mother develops a primary infection during the third trimester is high, even though it is common and rarely serious [10,11]. This risk increases closer to the delivery [12]. The risk of intrauterine infection is highest in pregnant women (about 50%) [13] who developed disseminated HSV infections, and 90% of those were related to HSV-2 [14]. The risk of neonatal infection also varies from 30-50% for HSV infections beginning in the last trimester, whereas first-trimester infection carries a risk of about 1% [14,15].

During the last trimester, there is no adequate time to develop antibodies to suppress viral replication before labor [14,15]. Moreover, studies on HIV-infected pregnant women showed that coinfection with HSV significantly increases the risk of perinatal HIV transmission [16,17].

Thus, the study aimed to ascertain the occurrence of HSV-2 IgG in pregnant women in Port Harcourt, Nigeria and identify the demographic profile associated with the prevalence.

Materials and Methods

Study area

The study was conducted in the antenatal clinic at the University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt, Rivers State, Nigeria. Port Harcourt City is highly congested as it is the only major city in the state. Port Harcourt features a tropical monsoon climate with long and heavy rainy seasons and very short dry seasons.

Study design

A hospital-based cross-sectional survey design was adopted for the present study, which seeks to survey the seropositivity of HSV-2 antibodies among pregnant women in Port Harcourt, Nigeria.

Sample size determination

The sample size for this study is determined using the standard formula [18].

Study population

The target population was all pregnant women attending the antenatal clinic for a routine antenatal check-up at the University of Port Harcourt Teaching Hospital (UPTH) from January 2019 to November 2019. From the study population, a total sample size of 90 pregnant women was randomly selected and enrolled in the study. The sociodemographic details relevant to the study were obtained from the clinic records. All pregnant women presenting at the antenatal clinics were included in the study. Non-pregnant women and women on any form of antibiotics/antiviral drugs were excluded from the study.

Sample collection, preparation and storage

A specimen of 5mL venous blood was aseptically drawn from the enrolled subjects into sterile EDTA tubes. The blood was allowed to separate, and the plasma was aspirated into sterile Eppendorf tubes. Plasma was stored at +2°- 8°C for up to five days after collection.

Serological analysis

Plasma was analyzed for HSV-2 IgG antibodies using the ELISA kit manufactured by DIA.PRO (Diagnostic Bioprobes, Milano, Italy). ELISA tests were performed according to the manufacturer's instructions. Results were interpreted according to the manufacturer's instructions. Samples with a concentration lower than 5 arbU/mL were considered negative for anti-HSV IgG antibodies. Samples with a concentration higher than 5 arbU/mL were considered positive for anti-HSV IgG antibodies.

Method of data analysis

The data were recorded and analyzed using a Microsoft Excel spreadsheet. The Chi-square test was employed to determine associations between seropositivity and sociodemographic factors. The level of statistical significance was set at $p \leq 0.05$.

Results

Analysis of the total study population

The total number of pregnant women included in this study was 90. The socio-demographic data for these samples were stratified and are shown in Table 1. The age ranges from 20-49 years. The age group 30-39 years constituted the most significant population, making up 66.7%. Married pregnant women predominated the study constituting 98.9%. Tertiary education also predominated (85.6%) while a significant percentage of 34.4% of them were traders. A higher percentage of 90.0% were Christians. A higher percentage of 83.3% were married to a monogamous family. Forty-four (48.9%) of them were in their second trimester. A higher percentage of 42.2% fell within 1-2 parity, 66.7% had no history of abortion, and a higher percentage of 93.3% had no history of STDs. Then, a lower percentage of 3.3% were HIV seropositive (Table 1).

Prevalence of HSV-2 IgG antibody

Of the 90 pregnant women tested, 46 (51.1%) were seropositive, and 44 (48.9%) were seronegative (Table 1).

Prevalence of HSV-2 IgG antibody concerning age

The prevalence of HSV-2 IgG antibodies with age is shown in Figure S1. Concerning age, all three age groups were reactive, with the highest prevalence occurred in ages 20-29 years (54.2%). There was, however, no significant relationship (X^2=0.856, df=2, p=0.651) existed between age and HSV-2 prevalence (Figure S1).

Prevalence of HSV-2 IgG antibody concerning marital status

Figure S2 shows the seropositivity rate of HSV-2 IgG antibodies according to marital status. Only 46 married women tested seropositive (51.7%). Marital status was not significantly associated (X^2=1.057, df=1, p=0.304) with HSV prevalence (Table 1).

Prevalence of HSV-2 IgG antibody concerning educational background

The level of education of the pregnant women attending antenatal care had no significant relationship (X^2=2.406, df=2, p=0.300) existed with HSV-IgG prevalence. A higher prevalence occurred with no formal education (100.0%) than in other categories, as

shown in Figure S3.

Prevalence of HSV-2 IgG antibody concerning occupational status

Figure S4 shows the seropositivity rate of HSV-2 IgG antibody according to occupation. The unemployed, pregnant women and artisans (75.0%) had a higher prevalence than other occupational groups. Statistically, there was no significant relationship (X^2=6.88, df=5, p=0.23) existed between occupation and HSV-2 prevalence (Table 1).

Prevalence of HSV-2 IgG antibody concerning religion

Higher HSV-2 IgG prevalence occurred in Christians (53.1%) than in those with no religion (33.3%), as highlighted in Figure S5. However, no significant association (X^2=1.264, df=1, p=0.261) occurred between religion and IgG prevalence (Table 1).

Prevalence of HSV-2 IgG antibody concerning family type

Higher HSV-2 IgG prevalence occurred in pregnant women with a monogamous family type (52.0%) than polygamous family type (46.7%), as shown in Figure S6. However, no significant association (X^2=0.142, df=1, p=0.706) existed between the family type and HSV-2 prevalence.

Prevalence of HSV-2 IgG antibody concerning gestation period

Higher HSV-2 IgG prevalence occurred in pregnant women in their first trimester (62.5%) than other trimesters, as shown in Figure S7. However, no significant association (X^2=0.652, df=2, p=0.72) existed between the gestation period and HSV-2 prevalence.

Prevalence of HSV-2 IgG antibody concerning parity

Higher HSV-2 IgG prevalence occurred in nulliparous pregnant women (67.6%) than those with 3-4 and 1-2 parity had a prevalence rate of 55.6% and 34.2%, respectively, as shown in Figure S8. Significant association (X^2=8.21, df=2, p=0.016) existed between the parity and HSV-2 prevalence.

Prevalence of HSV-2 IgG antibody concerning the history of abortion

Higher HSV-2 IgG prevalence occurred in pregnant women with a history of abortion (66.7%) than those without a history (43.3%), as shown in Figure S9. Significant association (X^2=4.358, df=1, p=0.04) existed between the history of abortion and HSV-2 prevalence.

Prevalence of HSV-2 IgG antibody concerning the history of Sexually Transmitted Diseases

Higher HSV-2 IgG prevalence occurred in pregnant women with a history of STDs (83.3%) than those without a history (48.8%), as

Table 1. The Prevalence of HSV-2 IgG antibody concerning the sociodemographic characteristics of the pregnant women.

Sociodemographic characteristics	Groups	No. tested (%)	No. positive for HSV-2 IgG	Chi-square analysis
Age	20-29	24 (26.7)	13 (54.2)	X^2=0.856, df=2, p=0.651
	30-39	60 (66.7)	31 (51.7)	
	40-49	6 (6.7)	2 (33.3)	
Marital status	Married	89 (98.9)	46 (51.7)	X^2=1.057, df=1, p=0.304
	Single	1 (1.1)	0 (0.0)	
Educational status	None	1 (1.1)	1 (100.0)	X^2=2.406, df=2, p=0.300
	Secondary	12 (13.3)	8 (66.7)	
	Tertiary	77 (85.6)	37 (48.1)	
Occupational status	Student	9 (10.0)	2 (22.2)	X^2=6.88, df=5, p=0.23
	Unemployed	12 (13.3)	9 (75.0)	
	Civil servants	29 (32.2)	15 (51.7)	
	Trading	31 (34.4)	15 (48.4)	
	Artisans	4 (4.4)	3 (75.0)	
	Business executive	5 (5.6)	3 (60.0)	
Religion	Christianity	81 (90.0)	43 (53.1)	X^2=1.264, df=1, p=0.261
	None	9 (10.0)	3 (33.3)	
Family type	Monogamous	75 (83.3)	39 (52.0)	X^2=0.142, df=1, p=0.706
	Polygamous	15 (16.7)	7 (46.7)	
Gestation period	1st trimester	8 (8.9)	5 (62.5)	X^2=0.652, df=2, p=0.72
	2nd trimester	44 (48.9)	23 (52.3)	
	3rd trimester	38 (42.2)	18 (47.4)	
Parity	0	34 (37.8)	23 (67.6)	X^2=8.21, df=2, p=0.016*
	1-2	38 (42.2)	13 (34.2)	
	3-4	18 (20.0)	10 (55.6)	
History of abortion	Yes	30 (33.3)	20 (66.7)	X^2=4.358, df=1, p=0.04*
	No	60 (66.7)	26 (43.3)	
History of STDs	Yes	6 (6.7)	5 (83.3)	X^2=2.67, df=1, p=0.10
	No	84 (93.3)	41 (48.8)	
HIV status	Seropositive	3 (3.3)	3 (100.0)	X^2=2.97, df=1, p=0.08
	Seronegative	87 (96.7)	43 (49.4)	
Total		**90 (100.0)**	**46 (51.1)**	

*Significant (p<0.05).

shown in Figure S10. However, no significant association (X^2=2.67, df=1, p=0.10) existed between the history of STDs and HSV-2 prevalence.

Prevalence of HSV-2 IgG antibody concerning Human Immunodeficiency Virus status

Higher HSV-2 IgG prevalence occurred in HIV-positive pregnant women (100.0%) than in HIV-seronegative status (49.4%). However, no significant association (X^2=2.97, df=1, p=0.08) existed between HIV-serostatus and HSV-2 prevalence (Figure S11).

Discussion

Genital HSV infection in pregnant women is of particular concern because of the risk to the fetus and newborn caused by HSV-1 and HSV-2. Therefore, assessing HSV infection in pregnant women will help adequately manage the infection and be helpful for epidemiological purposes. This study was conducted to determine the prevalence of HSV-2 IgG antibody in pregnant women in Port Harcourt, Nigeria and identify the factors associated with the prevalence. High infection levels have been documented in the developing world, of which Nigeria is part.

This study revealed a high prevalence (51.1%) among pregnant women in Port Harcourt, Nigeria. Most women may have been exposed before pregnancy. This indicates the likelihood of HSV spread among sexually active women. This high rate is in concordance with various studies performed. Prevalence ranging from 30 to 80% has occurred among women in sub-Saharan Africa [19]. Corey and Handsfield [20] reported varying rates of 60-90% in South Africa. In Nigeria, Agabi *et al.* [21] observed an 87.0% prevalence in Jos. Okonko and Cookey [22] observed a 99.4% prevalence in Port Harcourt, Nigeria.

Ghazi *et al.* [23] detected high seropositivity of 90.9% and 27.1% for HSV-1 and HSV-2 IgG antibodies, respectively, in Saudi Arabia. Also, Sauerbrei *et al.* [24] reported 82.0% and 18.0%, respectively. In the United States, Xu *et al*. [2] reported 72.0%. The 55.1% reported here is higher than figures obtained by some other authors. It is higher than the 29.08% obtained by Apurba *et al.* [25] and 18.6% reported by Sadiq *et al*. [26]. However, it is lower than the 87.0% in Jos [20] and the 99.4% in Port Harcourt, Nigeria [22].

All the variables appeared to be statistically insignificant (p>0.05), with the prevalence of HSV-2 IgG antibodies among the pregnant women investigated. This finding is similar to that of Obeid [27] in Saudi Arabia who observed the same for age and occupation. It is comparable to Okonko and Cookey [22], who observed the same for all the variables in their study. Although, another study by Rezaei-Chaparpordi *et al.* [28] reported a significant correlation between age, marital status, occupation and HSV prevalence.

HSV prevalence increased consistently across the age spectrum or plateaued after age 30 [30]. HSV seropositivity decreased in older women (>40 years) [30]. However, in the present study, a total prevalence rate of 54.2% was observed in pregnant women from ages 20-29 years, 51.7% in ages 30-39 years, with a slight decrease in ages 40-49 years (33.3%). This observation differs from what was observed by Apurba *et al.* [25] and Okonko and Cookey [22], who reported a higher HSV seropositivity in ages 26-30.

A higher prevalence occurred among married than singles (51.7% versus 0.0%). This observation is cognizant of Rezaei-Chaparpordi *et al.* [28] in Iran. This finding disagrees with Agabi *et al.* [21] and Okonko and Cookey [22]. This observation indicates that the married pregnant women included in this study should have had a greater lifetime of sexual activity or been more infected in early childhood than the single.

The level of education had no significant relationship with HSV-2 prevalence. This study revealed a higher prevalence for those with no formal educational status (100%) than those with secondary and tertiary education. Our finding agrees with Malkin *et al.* [31] and Okonko and Cookey [22], who found a higher HSV-1 infection in people of low education in France and Nigeria, respectively. Rezaei-Chaparpordi *et al.* [28] also observed an increase in the prevalence of HSV with a decrease in the level of education. Obeid [27] also observed that education was not significantly associated with HSV-2 IgG. Deductions from the present study inferred that a higher risk of HSV is associated with a lower level of education. This observation might be that a lower level of education was an indicator of low socioeconomic status, which was a risk factor for HSV infection. Low education may lead to lower knowledge of HSV and prevention. Also, education on the importance of diagnosis, treatment and prevention may help control the spread of HSV-2 infection.

A higher prevalence occurred among unemployed and artisans compared to others. In the same vein, a lower prevalence occurred in pregnant women that were students and traders. This finding disagrees with previous studies by some other studies. In the Okonko and Cookey [22] study, a lower prevalence occurred in pregnant women who were unemployed compared to others. This finding might be that a lower occupation level was an indicator of low socioeconomic status, a risk factor for HSV infection. This observation correlates favorably with Apurba *et al.* [25] and Sadiq *et al.* [26]. The absence of a significant relationship between education, occupation and HSV prevalence in this study compares favorably with a review conducted in 2004 [18].

In this study, pregnant women who were Christians (53.1%) had higher seropositive for HSV-2 than no religion. Also, pregnant women with monogamous family type had a higher prevalence (52.0%) than the polygamous (46.7%). Compared to others, a high prevalence occurred for pregnant women in their first trimester. This finding suggests that these women were at a higher risk as HSV infection acquired during pregnancy is associated with spontaneous abortion [22,31], which occurs highest in the first trimester and the risk of neonatal transmission occurs in the third trimester.

The present study showed a significant association (p=0.016) between parity and HSV-2 prevalence. Nulliparous pregnant women had a higher prevalence (67.6%) than 3-4 and 1-2 parity. It further revealed a significant association (p=0.04) between the history of abortion and HSV-2 prevalence. However, no significant association (p=0.10) between the history of STDs, HIV-serostatus (p=0.08) and HSV-2 prevalence.

The study found that 44 (48.9%) pregnant women were seronegative for HSV IgG antibodies. Most neonatal HSV infections occur among infants born to women experiencing primary HSV infections. Seronegative women should avoid unprotected oral-genital contact with an HSV seropositive partner and conventional sex with a partner having a genital infection during the last trimester of pregnancy to prevent neonatal infections [15]. These considerations underscore the importance of educating women and their partners about preventing the acquisition of HSV during pregnancy.

Conclusions

This study has confirmed that the prevalence of HSV-2 IgG antibodies among pregnant women in Port Harcourt, Nigeria is very high (51.1%). The study indicates a considerable risk of acquiring primary or recurrent HSV infection during pregnancy. Identifying

those at the highest risk is an appropriate initial step before the design of intervention strategies. Consequently, intervention strategies will be harnessed and implemented to reduce the risk of transmission to the fetus or newborn.

References

1. Agyemang-Yeboah F, Debrah O, Donkoh ET, et al. Coinfection Prevalence of Herpes Simplex Virus Types 1 and 2 with Human Papillomavirus and Associated Risk Factors among Asymptomatic Women in Ghana, International Journal of Infectious Diseases and Therapy 2018;3:45-51.
2. Xu F, Sternberg MR, Kottiri BJ, et al. Trends in herpes simplex virus type 1 and type 2, seroprevalence in the United States. Journal of American Medical Association (JAMA) 2006; 296:964-73.
3. Mbps-Keou FX, Robinson NJ, Mayaud P, et al. Herpes simplex virus type 2 and heterosexual spread of human immunodeficiency virus infection in developing countries: hypothesis and research priorities. Clinical Microbiology and Infectious Disease 2003;9:161-71.
4. Celum CL. The Interaction between Herpes Simplex Virus and Human Immunodeficiency Virus. Herpes, 2004;11:36A-45A.
5. Looker KJ, Garnett GP, Schmid GP. An estimate of the global prevalence and incidence of herpes simplex virus type 2 infection. Bulletin of World Health Organization 2008;86:805-12.
6. Krebs JM. Understanding herpes simplex virus: transmission, diagnosis, and considerations in pregnancy management. Journal of Midwifery and Women's Health 2008;53:202-8.
7. Baker DA. Consequences of herpes simplex virus in pregnancy and their prevention. Current Opinions in Infectious Diseases 2007;20:73-6.
8. Sauerbrei A, Wutzler P. Herpes simplex and varicella-zoster virus infections during pregnancy: current concepts of prevention, diagnosis and therapy. Part 1: herpes simplex virus infections. Medical Microbiology and Immunology 2007;196:89-94.
9. Rathore S, Jamwal A, Gupta V. Herpes simplex virus type 2: Seroprevalence in antenatal women. Indian Journal of Sexually Transmitted Diseases 2010;31:11-15.
10. Mindel A, Taylor J, Tideman RL et al. Neonatal herpes prevention: a minor public health problem in some communities. Sexual Transmitted Infections 2000;76:287-9.
11. Dhoha EEE, Abbas BMR, Elgaili AE, Wafa IE. Seroprevalence of Herpes Simplex Virus Type 1 among Pregnant Women Attending Abo Gota Antenatal Care Clinic, AlGezira State, Sudan. International Journal of Advances in Pharmacy, Biology and Chemistry (IJAPBC) 2016;5:93-9.
12. Whitley RJ, Roizman B. Herpes simplex viruses. Lancet 2001;357:1513-8.
13. Money D, Steben M. Guidelines for the management of herpes simplex virus in pregnancy. International Journal of Gynecology & Obstetrics 2009;104:167–71.
14. Anzivino E, Fioriti D, Mischitelli M, et al. Herpes simplex virus infection in pregnancy and in neonate: status of art of epidemiology, diagnosis, therapy and prevention. Virology Journal 2009;6:40-6.
15. Straface G, Selmin A, Zanardo V, et al. Herpes Simplex Virus Infection in Pregnancy. Infectious Disease Obstetrics and Gynecology 2012;2012:385697.
16. Centers for Disease Control and Prevention. Sexually transmitted disease guidelines. 2006. Available from: www.cdc.gov/std/treatment/2006/rr5511.pdf
17. Chen KT, Segú M, Lumey LH, et al. New York City Perinatal AIDS Collaborative Transmission Study (PACTS) Group. Genital herpes simplex virus infection and perinatal transmission of human immunodeficiency virus. Obstetrics and Gynecology 2005;106:1341-8.
18. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian Journal of Psychological Medicine 2013;35:121-6.
19. Weiss H. Epidemiology of herpes Simplex Virus Type-2 infections in the developing world. Herpes 2004;11:24A-35A.
20. Corey L, Handsfield HH. Genital herpes and public health: Addressing a global problem. Journal of American Medical Association (JAMA) 2000;283:791-4.
21. Agabi YA, Banwat EB, Mawak JD, et al. Seroprevalence of herpes simplex virus type-2 among patients attending the Sexually Transmitted Infections Clinic in Jos, Nigeria. Journal of Infections in Developing Countries 2010;4:572-5.
22. Okonko IO, Cookey TI. Seropositivity and determinants of immunoglobulin-G (IgG) antibodies against Herpes simplex virus (HSV) types -1 and -2 in pregnant women in Port Harcourt, Nigeria. African Health Sciences 2015;15:737-47.
23. Ghazi HO, Telmesani AM, Mahomed MF. TORCH agents in pregnant Saudi women. Medical Principles and Practices 2002;11:180-2.
24. Sauerbrei A, Schmitt S, Scheper T, et al. Seroprevalence of Herpes Simplex Virus Type 1 and type 2 in Thuringia, Germany, 1999 to 2006. European Surveillance 2011;16:20005.
25. Apurba SS, Sandhya BK, Senthamarai S, et al. Serological Evaluation of Herpes Simplex Virus Type- 1/ Type- 2 Infections in Pregnant Women with Bad Obstetric History in a Tertiary Care Hospital, Kanchipuram. International Journal of Advance Research 2013;1:123-8.
26. Sadiq MS, Fatima H, Jamil K, Patil C. Study of TORCH profile in patients with bad obstetric history. Biology and Medicine 2012;4:95-101.
27. Obeid OE. Prevalence of herpes simplex virus types 1 and 2 and associated sociodemographic variables in pregnant women attending king Fahd hospital of the university. J. Family Community Med 2007;14:3-7.
28. Rezaei-Chaparpordi S, Assmar M, Amirmozafari N, et al. Seroepidemiology of Herpes Simplex Virus Type 1 and 2 in Northern Iran. Iran. Journal of Public Health, 2012;41:75-9.
29. Sukik L, Alyafei M, Harfouche M, Abu-Raddad LJ. "Herpes simplex virus type 1 epidemiology in Latin America and the Caribbean: Systematic review and meta-analytics." PLoS ONE 2019;14:e0215487.
30. Smith JS, Robinson NJ. Age-specific prevalence of infection with herpes simplex virus types 2 and 1: a global review. Journal of Infectious Disease 2002;186:S3-S28.
31. Malkin JE, Morand P, Malvy D, et al. Seroprevalence of HSV-1 and HSV-2 infection in the general French population. Sexual Transmitted Infections 2002;78:201-3.