Prevalence and Risk Factors of Human Immunodeficiency Virus and Hepatitis C Virus Infection among Pregnant Women Attending Antenatal Care at a Tertiary Hospital in Abuja, Nigeria

Chris Ovoroyeguono Agboghoroma, Binyerem Chigbonwu Ukaire

Department of Obstetrics and Gynaecology, National Hospital, Abuja, Nigeria

Abstract

Context: Human Immunodeficiency Virus (HIV) and Hepatitis C Virus (HCV) co-infection in pregnant women has increased potential for Mother-to-Child Transmission risks of both viruses. The reports on the prevalence and risk factors for HIV and HCV co-infection in pregnancy are limited in Nigeria. **Aim:** The aim of the study is to determine the prevalence and potential risk factors for HIV and HCV infection among pregnant women in Abuja. **Study Design:** A cross-sectional seroprevalence study carried out on pregnant women attending antenatal clinic of a tertiary hospital in Abuja from July 1st to October 31st 2016. Patients were recruited consecutively and counselled for HIV and HCV. Structured questionnaire was used to collect socio-demographic data, and information on potential risk factors for HIV and HCV infections. Blood samples were collected for HIV and HCV screening using rapid test kits following the national testing algorithm. Data generated were analyzed with statistical package for social sciences (SPSS) version 20.0. *P*-value less than 0.05 was considered statistically significant. **Result:** 252 pregnant women participated in this study. The mean age of the study population was 31.7 ± 4.9 years. The prevalence of HIV and HCV was 12.3% and 1.2% respectively. The prevalence of HIV/HCV co-infection was 0.8%. The prevalence of HCV among HIV positive cohorts was 6.5%. HIV infection was significantly associated with history of blood transfusion ($P = 0.047$), presence of tattoo/scarification marks ($P = 0.009$) and multiple sexual partners ($P < 0.0001$). HCV infections was not significantly associated with any of the risk factors studied. **Conclusion:** HIV prevalence is high among the pregnant women. HCV co-infection is common in women who are HIV infected. HIV infection unlike HCV was significantly associated with history of blood transfusion, presence of tattoo/scarification marks and multiple sexual partners.

Keywords: Hepatitis C virus, human immunodeficiency virus, human immunodeficiency virus/hepatitis C virus co-infection, mother-to-child transmission, pregnant women

INTRODUCTION

Hepatitis C virus (HCV) is an RNA virus from the *Flaviviridae* family. Like the human, immunodeficiency virus (HIV), it is a major global public health problem. Following HCV infection, the virus may be spontaneously cleared; however, the persistence state in the body may lead to chronic hepatitis, liver cirrhosis, hepatocellular cancer, and liver failure. The World Health Organization estimated that in 2015, about 71 million persons lived with HCV infection in the world which account for 1% of the world population and there were 1.75 million new infections in that year.[1] It was also estimated that among the 36.7 million persons living with HIV in 2015, about 2.3 million (6.3%) also had HCV. Sub-Saharan Africa has the highest burden of HCV in the world, with an estimated prevalence of 5.3% and a total of 32 million infected persons.[1-3]

Epidemiological studies have demonstrated that HIV and HCV co-infection is becoming increasingly recognized worldwide because of the similarities in the mode of transmission. The main routes of transmission of HCV are like those of HIV infections which include intravenous drug use, unsafe blood and blood product use, sexual contact, and mother-to-child transmission (MTCT).[4] While MTCT of

Access this article online

Quick Response Code:

Website:
www.nigeriamedj.com

DOI:
10.4103/nmj.NMJ_241_19

How to cite this article: Agboghoroma CO, Ukaire BC. Prevalence and risk factors of human immunodeficiency virus and hepatitis C virus infection among pregnant women attending antenatal care at a tertiary hospital in Abuja, Nigeria. Niger Med J 2020;61:245-51.

HCV is well documented,[5] unlike HIV, the risks factors for MTCT of HCV are yet to be fully elucidated. It is, however, documented that HCV transmission is not influenced by the mode of delivery or infant feeding practice but appears to be increased with high maternal viremia and HIV co-infection.[6]

There is a global call for the eradication of HIV and HCV by the year 2030.[1,7] Efforts to reduce risk of MTCT of HIV have led to the adoption of universal HIV screening for all pregnant women to identify those that are infected who should receive interventions to reduce MTCT. At present, screening for HCV is not part of routine antenatal care in most settings.

The effective interventions of the use of antiretroviral drugs and safe antenatal, delivery, and infant feeding practices have resulted in the reduction of the risk to MTCT of HIV to <1% in many countries, compared to the natural MTCT risk of about 25%–40%.[8] The documented MTCT risk of HCV is 6%–8% and can be as high as 15%–25% in women with co-infection with HIV.[9] However, there are the challenges with the management of HCV in pregnancy. The treatment of HCV during pregnancy is essentially supportive as the known effective drugs including pegylated interferon, ribavirin, and direct-acting antivirals are contraindicated during pregnancy. HIV infection has a significant impact on the natural history of patients with HCV infection.[10] HIV coinfection accelerates the progression of HCV and vice versa. It is also documented that the vertical transmission of the two viruses is increased in the situation of coinfection.[11] Some authors from sub-Saharan Africa have reported an increased prevalence of HCV and HIV/HCV co-infection among pregnant women,[12] which may be partly related to the endemic nature of HIV infection in sub-Saharan Africa, where availability of blood screening facilities is questionable and many pregnant women receive blood transfusion especially from commercial blood donors, among whom a high prevalence of HCV infection has been reported.[13]

Until recently, HIV sentinel surveys among pregnant women in Nigeria were used to monitor the trend of the HIV epidemic in the country.[14] In 2018, a nationwide community survey of HIV in Nigeria was undertaken which showed a mixed epidemic. While the national median prevalence was 1.5%, the median prevalence in the states varied from 0.3% to 5.6%.[15] Although there are yet no organized nationwide study of HCV in Nigeria, an assessment of studies on HCV from across the country indicate the prevalence varies widely depending on the sub-population studied. Only a few of these studies on HCV focussed on pregnant women. This study set out to determine the prevalence of HIV, HCV, and co-infection rate of HIV/HCV among pregnant women in Abuja, Nigeria. We also determined the risk factors for acquisition of these infections among the pregnant women.

MATERIALS AND METHODS

Sample size estimation

The minimum sample size "n" was determined using the following formula: z^2pq/d^2, where:

- z = The standard normal deviate, usually set at 1.96 which corresponds to the 95% confidence interval (CI)
- p = Estimated prevalence of HCV (13.3% based on previous study in Keffi, Nigeria[16])
- $q = 1.0 - p$
- d = degree of accuracy desired, usually set at 0.05% or 5%
- Therefore $n = z^2pq/d^2$ = $(1.96^2 \times 0.13 \times 0.87)/0.05^2 = 173.8$.

Ten percent of the calculated minimum sample size was added to account for possible attrition, i.e., 173.8 + 17.4 = 191.2. However, 252 pregnant women participated in the study.

Study design and subjects

It was a cross-sectional study conducted in the antenatal clinic of National Hospital Abuja, Nigeria between July 1, 2016 and October 31, 2016. The hospital is a referral center for HIV care. It is one of the main centers for PMTCT services in the Federal Capital Territory.

The study population was made up of pregnant women who presented for antenatal care for the first time in the index pregnancy. The patients who gave consent were recruited consecutively into the study. Closed-ended structured questionnaires were used to obtain sociodemographic information, including age, ethnic group, religion, marital status, parity, educational attainment, and occupation. Other information collected were related to known risk factors for the transmission and acquisition of HIV and HCV infections including history of blood transfusion, renal dialysis, needle stick injury, tattoo/scarification marks on the body, multiple sexual partner, injection drug use like heroin or cocaine, ever been a health-care worker, and use of unsterilized blades.

Laboratory procedures

HIV-I and II were tested using commercially available rapid test kits following the manufacturers' protocol and national (serial) testing algorithms which involves two or three positive tests to confirm seropositivity. The presence of antibodies to HIV was determined using two or three different immune-chromatography rapid test kits in the serial order. Determine TM HIV-1/2 (Alere medical Co., Ltd, Japan) test kits were the first test kit used. When the test was positive the sample was re-tested with a second rapid test kit HIV-1/2 STAT PAK (Chembio Diagnostic Systems, Inc.). Positive result with the second test is confirmatory. However, negative result with the second test kit are re-tested using a third rapid test kit – Unigold TM rapid HIV-1/2 test kit (Trinity Biotech Plc, Ireland), which serve as a tiebreaker. A positive result with the third rapid test kit is also confirmatory. The HCV screening test was a serological test conducted in accordance with

the manufacturer's instructions using OnSite HCV Ab3.0 Plus (CTK Biotech, Inc., San Diego, California, USA). The test is based on the detection of antibodies against HCV.

Ethical considerations

Ethical clearance for the study was obtained from the Research and Ethical Committee of National Hospital Abuja. Written signed consent was received from every subject before recruitment into the study. All participants received pre- and post-test counseling for HIV and HCV. Those who were seropositive for one or the two viruses were appropriately managed both by the obstetric and medical teams.

Data analysis

Data generated in the study were entered and analyzed using the Statistical Package for the Social

Sciences (SPSS Inc., Chicago, IL, USA, version 20). Continuous variables were presented as mean and standard deviation. Categorical variables were presented as frequencies and percentages. For the univariate analysis, the Chi-square test or Fisher's exact test was used to evaluate the association between self-reported risk factors and HIV and HCV infections. In the multivariate analysis, logistic regression model was applied to predict the effect of the independent variables on the depended variables-HIV and HCV infection. An odds ratio (OR) with a 95% CI was calculated for each parameter. $P \leq 0.05$ was considered statistically significant.

RESULTS

The sociodemographic characteristics of the women are shown in Table 1. The age of the study population ranged from 19 to 46 years, with a mean age of 31.7 ± 4.9 years. Two hundred and twenty-eight (90.5%) of the women had tertiary level education, 163 (64.7%) are gainfully employed, 251 (99.6%) are married, and 196 (77.8%) are Christians. In general, the sero-prevalence of HIV infection was 12.3% (31/252), while the sero-prevalence of HCV was 1.2% (3/252). HIV/HCV co-infection rate was 0.8% (2/252). The sero-prevalence of HCV among HIV positive cohorts was 6.5% (2/31). The prevalence of HIV and HCV infections according to the various demographic characteristics is shown in Table 1.

In the univariate analysis, previous blood transfusion, presence of tattoo/scarification marks and history of multiple sexual partners were positively associated with HIV infection [Tables 2 and 3]. HIV infection was also positively associated with history of previous blood transfusion, presence of tattoo/scarification marks and history of multiple sexual partners in the multivariate model [Table 4]. In both univariate and multivariate analyses, HCV infection was not associated with any of the studied risk factors [Tables 3 and 5].

DISCUSSION

From the study, the seroprevalence of HIV and HCV was 12.3% and 1.2%, respectively. The seroprevalence of HCV among HIV-positive cohorts (HIV/HCV co-infection) was 6.5%. The HIV/HCV co-infection among all pregnant women in the study was 0.8%.

The HIV seroprevalence of 12.3% recorded in this study was high. An earlier report from the same facility gave the seroprevalence of HIV as 11.5%.[17] The persistent high prevalence of HIV in Abuja has been partly attributed to the influx of youths from within and outside the country into Abuja because of its social, political, and economic importance as the Federal Capital of Nigeria.[18] Furthermore, the hospital serves as a major referral center for HIV care and PMTCT. However, a 2018 nationwide community survey of HIV in Nigeria showed a mixed epidemic with

Table 1: Demographic characteristics and prevalence of human immunodeficiency virus and hepatitis C virus

Characteristic	Total, n (%)	Positive test results	
		HIV, n (%)	HCV, n (%)
Age group (years)			
10-19	1 (0.4)	0	0
20-29	89 (35.3)	6 (6.7)	2 (2.2)
30-39	146 (57.9)	21 (14.1)	1 (0.7)
40-49	16 (6.4)	4 (25.0)	0
Educational status			
Primary/koranic	2 (0.8)	2 (100.0)	0
Secondary	22 (8.7)	3 (13.6)	0
Tertiary	228 (90.5)	26 11.4)	3 (1.3)
Occupation			
Unemployed	89 (35.3)	7 (7.9)	1 (1.1)
Unskilled	4 (1.6)	0	0
Semi-skilled	32 (12.7)	6 (18.8)	0
Skilled	20 (7.9)	8 (40.0)	1 (5.0)
Intermediary category	52 (20.9)	8 (15.4)	1 (1.9)
Senior category	55 (21.8)	2 (3.6)	0
Parity			
0	87 (34.5)	11 (13.6)	3 (3.4)
1	59 (23.4)	7 (11.9)	0
2-4	99 (39.3)	10 (10.1)	0
≥5	7 (2.8)	3 (42.9)	0
Marital status			
Married	251 (99.6)	30 (12.0)	3 (1.2)
Not married	1 (0.4)	1 (100.0)	0
Ethnic group			
Hausa	12 (4.8)	1 (8.3)	0
Fulani	11 (4.4)	4 (36.4)	0
Yoruba	34 (13.5)	5 (14.7)	1 (2.9)
Igbo	69 (27.4)	2 (2.9)	1 (1.4)
Others	126 (50.0)	19 (15.1)	1 (0.5)
Religion			
Christianity	196 (77.8)	22 (11.2)	2 (1.0)
Islam	54 (21.4)	9 (16.7)	1 (1.9)
Others	2 (0.8)	0	0

HIV – Human immunodeficiency virus, HCV – Hepatitis C virus

Table 2: Self-reported risk factors and prevalence of human immunodeficiency virus				
Risk factors	Total	HIV positive, n (%)	Fisher's exact test	P
Blood transfusion				
Yes	29	7 (24.1)	4.256	0.047
No	223	24 (10.1)		
Renal dialysis				
Yes	6	1 (16.7)	0.109	0.549
No	246	30 (12.2)		
Needle stick injury				
Yes	25	3 (12.0)	0.002	0.630
No	227	28 (12.3)		
Unsterilized blade				
Yes	22	4 (18.2)	0.773	0.278
No	230	28 (11.7)		
Tattoo/scarification mark				
Yes	28	9 (32.1)	11.495	0.003
No	224	22 (9.8)		
Health care worker				
Yes	49	4 (8.2)	0.960	0.235
No	203	27 (13.3)		
Multiple sexual partner				
Yes	101	24 (23.8)	20.529	<0.0001
No	151	7 (4.6)		
Injection drug use				
Yes	2	0	0.283	0.769
No	250	31 (12.4)		

HIV – Human immunodeficiency virus

Table 3: Self-reported risk factors and prevalence of hepatitis C virus				
Risk factors	Total	HCV positive, n (%)	Fisher's exact test	P
Blood transfusion				
Yes	29	1 (3.4)	1.420	0.308
No	223	2 (0.9)		
Renal dialysis				
Yes	6	0	0.074	0.930
No	246	3 (1.2)		
Needle stick injury				
Yes	25	1 (4.0)	1.862	0.270
No	227	2 (0.9)		
Unsterilized blade				
Yes	22	1 (4.5)	2.307	0.241
No	230	2 (0.9)		
Tattoo/scarification mark				
Yes	28	1 (3.6)	1.518	0.299
No	224	2 (0.9)		
Health care worker				
Yes	49	1 (2.0)	0.374	0.478
No	203	2 (1.0)		
Multiple sexual partner				
Yes	101	0	2.031	0.213
No	151	3 (2.0)		
Injection drug use				
Yes	2	0	0.024	0.976
No	250	3 (1.2)		

HCV – Hepatitis C virus

the national median prevalence of 1.5%, but with a wide variation of 0.3%–5.6% prevalence across the states of the country.[15,16] UNAIDS currently adopts this report as the best estimate for HIV in Nigeria.[19]

Since HIV and HCV infections share similar transmission routes, including sexual intercourse, a correlation for prevalence was expected. However, this was not the case in this study, and in other studies, where the prevalence of HIV was much higher than that of HCV. The HCV sero-prevalence of 1.2% obtained in this study is comparable to the 1.03% and 1.3% reported from Europe and the Americas, respectively.[20,21] In the past higher HCV, seroprevalence was reported by many authors from within and outside the country. In Nigeria, higher prevalence of 4.3% from Jos,[22] 13.3% from Keffi,[16] and 14.9% from Enugu[13] had been documented. The difference in the HCV sero-prevalence recorded in the older studies compared with the index study can be partly attributed to current public health awareness and application of preventive measures to reduce the risks of transmission including screening of blood and blood products, sterilization of equipment, non-sharing of sharps/injections and use of condoms.

Higher sero-prevalence of HCV ranging from 3.9% to 17% have been reported from across African countries.[4,23]

Various factors have been implicated as contributory to the high prevalence in Africa. Egypt with a reported HCV seroprevalence of 17.1%, attributed the high prevalence to a "now-discontinued mass-treatment campaign and treatment with injections for schistosomiasis," which was endemic in that country.[23] Some of the other possible factors for the high prevalence of HCV in Africa include the screening procedures adopted. Many HCV prevalence estimates from sub-Saharan Africa which are based on screening systems without supplemental testing are associated with overestimation. The supplemental testing includes confirmatory tests such as nucleic acid test for HCV RNA or recombinant immunoblot assay. The use of more accurate screening and diagnostic methods such as polymerase chain reaction,[24] though have potential to reduce overdiagnosis, may increase the cost of testing and make it inaccessible to many in developing countries.

The impact of level of education and occupational status on HCV infection appears to vary based on geographical region. Contrary to some report that HCV positivity in pregnant women was associated with lower educational achievement and unemployment,[25] our findings showed

Table 4: Multivariate analysis (logistic regression) of risk factors association with human immunodeficiency virus infection

Indicators "risk factors"	Regression coefficient "B"	P	Estimated odd ratio Exp(B)	95% CI for Exp(B)	
				Lower	Upper
Blood transfusion	1.153	0.047	3.167	1.014	9.897
Renal dialysis	−0.782	0.529	0.457	0.040	5.217
Needle stick injury	−0.193	0.828	0.824	0.145	4.682
Unsterilized blade	0.271	0.740	1.311	0.266	6.468
Tattoo/scarification mark	1.349	0.009	3.853	1.407	10.549
Health care worker	0.027	0.965	1.027	0.315	3.345
Multiple sexual partners	1.769	<0.0001	5.865	2.336	14.721

CI – Confidence interval

Table 5: Multivariate analysis (logistic regression) of risk factors association with hepatitis C virus infection

Indicators "risk factors"	Regression coefficient "B"	P	Estimated odd ratio "Exp(B)"	95% CI for Exp(B)	
				Lower	Upper
Blood transfusion	2.115	0.127	8.291	0.546	125.800
Kidney dialysis	−16.580	0.999	0.000	0.000	
Needle stick injury	0.773	0.693	2.167	0.047	100.970
Unsterilized blade	1.629	0.405	5.101	0.111	235.211
Tattoo/scarification marks	2.042	0.133	7.706	0.538	110.424
Health care worker	0.903	0.505	2.467	0.174	34.987
Multiple sexual partners	−17.524	0.996	0.000	0.000	

CI – Confidence interval

that women with the tertiary level of education and gainful employment are equally susceptible to infection.

The comparatively low HCV prevalence could be due to the population studied, which comprise mainly young pregnant women. This is in line with the global epidemiology of HCV infection which indicated that HCV prevalence increases with age with different HCV prevalence peak in different age groups in different regions.[26] In this study, women 25–39 years were found to be more likely to be HCV infected compared to those <25 years. This finding is similar to that of the Rwandan study which reported that pregnant women aged 25–49 years were more likely to be infected with HCV than younger pregnant women (15–24 years).[25] The increase of HCV prevalence with age was also observed in another study conducted in Brazil among pregnant women.[27] These findings support the report that HCV prevalence is lower among pregnant women compared to the general population, because women of child-bearing age are usually <40 years old as compared to the older women above 40 years who have a higher risk of HCV infection due to a longer period of viral exposure during the lifetime.

The HCV/HIV coinfection rate of 6.5 recorded among the HIV-positive pregnant cohort is comparable to 5.3% reported in Malawi;[28] 6.0% in Central African region,[29] and 7.0% in Brazil.[27] It is however, higher than coinfection rate of 1.5% in Lagos,[30] 0.4% in Abuja.[31] 2.4% in Ouagadougou,[32] 1.8% in Ethiopia,[33] and 1.65% in Ibadan.[34] On the other hand, the co-infection rate of 6.5% is lower

compared to some published rates, including the report of 11.3% in Jos,[35] 23.3% in South-west Nigeria,[36] and 33% in Benin City.[12] In addition to other potential factors, the comparatively lower rate documented in this study could be partly attributed to the smaller sample size.

Many risk factors for HIV and HCV transmission and acquisition have been identified in previous Studies.[37] In this study, we investigated the potential association of eight of the known risk factors, including history of blood transfusion, renal dialysis, needle stick injury, unsterilized blades, tattoo/scarification marks on the body, being a health-care worker, multiple sexual partner, and injection drug use. Only blood transfusion, tattoo/scarification marks and multiple sexual partners were statistically significant predictors of HIV infection. On the other hand, HCV infection was not significantly associated with any of the studied risk factors. The absence of known risk factors in the significant proportion of HCV-infected patients has been reported by many authors.[34,38-40] This portend a major challenge in the development of strategies for the prevention. However, there appears to be interplay in the risk factors with respect to HIV/HCV co-infection, which is probably due to the shared risk factors of multiple sexual partners in addition to intravenous drug use, which is a predominant mode of transmitting HCV infection.[41,42] It is worthy of note that none of the infected women in our study reported history of drug use, which may be due to fear of stigmatization and the fact that it is illegal in the country.

In a study conducted among pregnant women in Bangkok, intravenous drug use by the women and by their sexual partners was found to be associated with the risk of HCV infection.[43] Partner use of injection drug was not assessed in the index study.

There are some limitations in the study. HIV diagnosis was based on serological test, using rapid test kits. False-negative results could have occurred in the circumstances of low levels of antibody below the detection limit of the test kits as seen with specimen from persons during early or "window" period; infection with a variant of the virus that is less detectable by the kit configuration; and specimen handling conditions which result in loss of the viral antibody multivalence. However, compliance with the National serial algorithm of at least two different test kits and diligent observance of manufacturer's instruction for the use of test kits ensured that the results obtained in the study can be relied upon. Immunosuppressed or immunocompromised individuals may not produce antibodies to the virus leading to false-negative results. With respect to HCV diagnosis, confirmatory test such as nucleic acid test for HCV RNA were not used in this study. It was, therefore, difficult to differentiate active HCV infection from spontaneously cleared HCV.

CONCLUSION

HIV infection is prevalent among the pregnant women. HCV co-infection is common in HIV infected women. More studies with larger sample size are needed to confirm these findings and to determine the risk factors for HCV infections. In addition to primary prevention, comprehensive antenatal care should include screening all pregnant women for HIV, and the HIV-positive women and those with risk factors for HCV should also be screened for HCV. The detection and effective management of those who are HIV and HCV infected will help in the achievement of the goal of eliminating MTCT of HIV and HCV and reduction in morbidity and mortality associated with these conditions.

Financial support and sponsorship

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. World Health Organization. Global Hepatitis Report, 2017. Geneva: World Health Organization; 2017.
2. Lauer GM, Walker BD. Hepatitis C virus infection. N Engl J Med 2001;345:41-52.
3. Prasad MR, Honegger JR. Hepatitis C virus in pregnancy. Am J Perinatol 2013;30:149-59.
4. Madhava V, Burgess C, Drucker E. Epidemiology of chronic hepatitis C virus infection in sub-Saharan Africa. Lancet Infect Dis 2002;2:293-302.
5. Gibb DM, Goodall RL, Dunn DT, Healy M, Neave P, Cafferkey M, et al. Mother-to-child transmission of hepatitis C virus: Evidence for preventable peripartum transmission. Lancet 2000;356:904-7.
6. Steininger C, Kundi M, Jatzko G, Kiss H, Lischka A, Holzmann H. Increased risk of mother-to-infant transmission of hepatitis C virus by intrapartum infantile exposure to maternal blood. J Infect Dis 2003;187:345-51.
7. Joint United Nations Programme on AIDS (UNAIDS). 90-90-90: An Ambituous Treatment Target to Help end the AIDS Epidemic. Geneva: UNAIDS; 2014. Available from: http://www.unaids.org/sites/default/files/media_asset/90-90-90_en_0.pdf. [Last accessed on 2019 Mar 06].
8. Agboghoroma OC, Iregbu KC, Audu LI. The effectiveness of mother-to-child transmission of HIV program in Abuja, Nigeria. J HIV Human Reprod 2015;3:7-13.
9. López M, Coll O. Chronic viral infections and invasive procedures: Risk of vertical transmission and current recommendations. Fetal Diagn Ther 2010;28:1-8.
10. Hernandez MD, Sherman KE. HIV/HCV Coinfection natural history and disease progression, a review of the most recent literature. Curr Opin HIV AIDS 2011;6:478-48.
11. Newell ML, Pembrey L. Mother-to-child transmission of hepatitis C virus infection. Drugs Today (Barc) 2002;38:321-37.
12. Onakewhor JU, Okonofua FE. The prevalence of dual human immunodeficiency virus/hepatitis C virus (HIV/HCV) infection in asymptomatic pregnant women in Benin City, Nigeria. Afr J Reprod Health 2009;13:97-108.
13. Halim NK, Ajayi OI. Risk factors and seroprevalence of hepatitis C antibody in blood donors in Nigeria. East Afr Med J 2000;77:410-2.
14. Federal Ministry of Health (FMoH). 2014 National HIV Sero-Prevalence Sentinel Survey among Pregnant Women Attending Antenatal Clinics in Nigeria. Technical Report. FMoH, Abuja; 2015.
15. National Agency for the Control of AIDS (NACA). Nigeria HIV/AIDS Indicator and Impact Survey (NAIIS). National Summary Sheet. NACA, Abuja; 2019.
16. Pennap G, Aliyu Y, Odula O, Joseph F. Prevalence of hepatitis B and C virus infection among people of a local community in Keffi, Nigeria. Afr J Microbiol Res 2010;4:274-8.
17. Agboghoroma OC, Iliyasu Z. HIV prevalence and trends among pregnant women in Abuja, Nigeria: A 5-year analysis. Trop J Obstet Gynaecol 2015;32:82-9.
18. FCT Agency for the Control of AIDS (FACA). FCT HIV/AIDS Strategic Plan 2010-2015. Abuja. FCT Agency for the Control of AIDS; 2010.
19. Joint United Nations Programme on AIDS (UNAIDS). 2019 Report on Nigeria HIV and AIDS Epidemic. Available from: https://www.unaids.org/en/regionscountries/nigeria. [Last accessed on 2019 Nov 11].
20. Hadzic N. Hepatitis C in pregnancy. Arch Dis Child Fetal Neonatal Ed 2001;84:F201 – F204. Available from: http://fn.bmj.com/content/84/3/f201.full.html. [Last accessed on 2019 Oct 04].
21. Petruzziello A, Marigliano S, Loquercio G, Cozzolino A, Cacciapuoti C. Global epidemiology of hepatitis C virus infection: An up-date of the distribution and circulation of hepatitis C virus genotypes. World J Gastroenterol 2016;22:7824-40.
22. Egah DZ, Banwat EB, Audu ES, Iya D, Mandong BM, Anele AA, et al. Hepatitis B surface antigen, hepatitis C and HIV antibodies in a low-risk blood donor group, Nigeria. East Mediterr Health J 2007;13:961-6.
23. Frank C, Mohamed MK, Strickland GT, Lavanchy D, Arthur RR, Magder LS, et al. The role of parenteral antischistosomal therapy in the spread of hepatitis C virus in Egypt. Lancet 2000;355:887-91.
24. Firdaus R, Saha K, Biswas A and Sadhukhan PS. Current molecular methods for the detection of hepatitis C virus in high risk group population: A systematic review. World J Virol 2015;4:25-32.
25. Mutagoma M, Balisanga H, Sebuhoro D, Mbituyumuremyi A, Remera E, Malamba SS, et al. Hepatitis C virus and HIV co-infection among pregnant women in Rwanda. BMC Infect Dis 2017;17:167.
26. Mohd Hanafiah K, Groeger J, Flaxman AD, Wiersma ST. Global epidemiology of hepatitis C virus infection: New estimates of age-specific antibody to HCV seroprevalence. Hepatology

2013;57:1333-42.

27. Costa ZB, Machado GC, Avelino MM, Gomes Filho C, Macedo Filho JV, Minuzzi AL, *et al*. Prevalence and risk factors for Hepatitis C and HIV-1 infections among pregnant women in Central Brazil. BMC Infect Dis 2009;9:116.

28. Chasela CS, Wall P, Drobeniuc J, King CC, Teshale E, Hosseinipour MC, *et al*. Prevalence of hepatitis C virus infection among human immunodeficiency virus-1-infected pregnant women in Malawi: The BAN study. J Clin Virol 2012;54:318-20.

29. Rao VB, Johari N, du Cros P, Messina J, Ford N, Cooke GS. Hepatitis C seroprevalence and HIV co-infection in sub-Saharan Africa: A systematic review and meta-analysis. Lancet Infect Dis 2015;15:819-24.

30. Ezechi OC, Kalejaiye OO, Gab-Okafor CV, Oladele DA, Oke BO, Musa ZA, *et al*. Sero-prevalence and factors associated with Hepatitis B and C co-infection in pregnant Nigerian women living with HIV infection. Pan Afr Med J 2014;17:197.

31. Ya'aba Y, Isu NR, Mohammed SB, Oladepo DK, Ibrahim K, Oladosu P, *et al*. Prevalence of Hepatitis C virus (HCV) and human immunodeficiency virus (hiv) co-infection among pregnant women attending antenatal clinics in Abuja, Nigeria. JOPAT 2009;14:45-8.

32. Zeba MT, Karou SD, Sagna T, Djigma F, Bisseye C, Ouermi D, *et al*. HCV prevalence and co-infection with HIV among pregnant women in Saint Camille Medical Centre, Ouagadougou. Trop Med Int Health 2011;16:1392-6.

33. Barth RE, Huijgen Q, Taljaard J, Hoepelman AI. Hepatitis B/C and HIV in sub-Saharan Africa: An association between highly prevalent infectious diseases. A systematic review and meta-analysis. Int J Infect Dis 2010;14:e1024-31.

34. Adesina OA, Akinyemi JO, Ogunbosi BO, Michael OS, Awolude OA, Adewole IF. Seroprevalence and factors associated with hepatitis C

coinfection among HIV-positive pregnant women at the University College Hospital, Ibadan, Nigeria. Trop J Obstet Gynaecol 2016; 33:153-8.

35. Ladep NG, Agaba PA, Agbaji O, Muazu A, Ugoagwu P, Imade G, *et al*. Rates and impact of hepatitis on human immunodeficiency virus infection in a large African cohort. World J Gastroenterol 2013;19:1602-10.

36. Rahman Z, Ullah M. Prevalence and risk factors of hepatitis C infection in pregnant women. EC Microbiol 2017;8.3:195-9.

37. Lima MP, Pedro RJ, Rocha MD. Prevalence and risk factors for hepatitis C virus (HCV) infection among pregnant Brazilian women. Int J Gynaecol Obstetrics 2000;70:319-26.

38. Mboto CI, Andy IE, Eni OI, Jewell AP. Prevalence, sociodemographic characteristics and risk factors for hepatitis C infection among pregnant women in Calabar municipality, Nigeria. Hepat Mon 2010;10:116-20.

39. Obienu O, Nwokediuko S, Malu A, Lesi OA. Risk factor for hepatitis C virus. Transmission obscure in Nigerian patients. Gatroenterol Res Pract 2011;4. doi: 10.1155/2011/939673.

40. Pondé RA. Hidden hazards of HCV transmission. Med Microbiol Immunol 2011;200:7-11.

41. Thaikruea L, Thongsawat S, Maneekarn N, Netski D, Thomas DL, Nelson KE. Risk factors for hepatitis C virus infection among blood donors in northern Thailand. Transfusion 2004;44:1433-40.

42. Eicher AD, Crofts N, Benjamin S, Deutschmann P, Rodger AJ. A certain fate: Spread of HIV among young injecting drug users in Manipur, North-East India. AIDS Care 2000;12:497-504.

43. Jamieson DJ, Skunodom N, Chaowanachan T, Roongpisuthipong A, Bower WA, Chotpitayasunondh T, *et al*. Infection with hepatitis C virus among HIV-infected pregnant women in Thailand. Infect Dis Obstet Gynecol 2008;7. doi: 10. 1155/2008/840948..