Original Research Article

SEROPREVALENCE OF HEPATITIS B AND C ANTIBODY AMONG THE RESIDENCE OF ISLAND COMUNITIES OF LAKE CHAD BASIN, BORNO STATE, NIGERIA

Abstract

Aim: The study sought to determine the prevalence of hepatitis B (HBV) and hepatitis C (HCV) among the people of Lake Chad Basin of Borno State Nigeria.

Study design: A cross sectional quantitative survey that derived information on the behavioural characteristics, vulnerability of the population and prevalence of HBV and HCV.

Place and duration of study: Testing for HBV and HCV antibodies was carried out among the people of urban and rural communities of Lake Chad Basin of Borno State Nigeria in 2017.

Methodology: 1790 samples were collected on dried sample blot card, dried and transported to National Institute for Pharmaceutical Research and Development Abuja where the samples were tested using HBsAg ELISA rapid test kit (ACON, USA) and confirmed with HBsAg ELISA test kit (ABON, ABON Biopharm Hangzhou Co. Ltd). HCV tests was carried out using ACON hepatitis C test strip (ACON Laboratory, INC USA) and confirmed with ELISA HCV kit (ORTHO HCV version 3.0; Ortho-Clinical Diagnostics, Raritan, New Jersey, USA). The results were expressed in percentages

Results: The result of the study revealed that 28 representing 1.56% tested positive for HBV and 3(0.17%) was HCV positive. On disaggregation, Commercial sex workers (CSW) and prison inmates had the highest prevalence of HBV and HCV 8.5% and 1.41% respectively. The highest number of positive cases of HBV was recorded among the males in the age range of 40-44 (3.25%), while the highest cases among the females was within the age range of 35-39 (6.8%). HCV positive cases were one male and two females within the age range of 20-24. HBV was higher in urban communities (3.70%), while HCV was higher in rural communities (0.17%).

Conclusion: Interventions such as vaccination against HBV, sexual education prevention of blood exposure was suggested to mitigate further transmission of these infections

1.0 INTRODUCTION

Hepatitis is an inflammation of the liver caused by one of the five hepatitis viruses, it can also be due to toxins (notably alcohol, certain medications and plants), other infections and autoimmune diseases [1][2]. Although distinct from one another, infection with HBV and HCV can both cause either non-symptomatic or symptomatic acute infection. Infection with either virus may progress to chronic infection, and can result in severe illness and premature death. Hepatitis B and C infections can lead to an acute or silent course of liver disease progressing from liver impairment to liver failure, cirrhosis of liver, and hepatocellular carcinoma [3].

Hepatitis B virus (HBV) and Hepatitis C virus (HCV) have gained a lot of attention in recent times because their impact goes beyond the infected person to affect even national economies, therefore, have become worldwide public health challenge [4]. Despite their biological differences they share common routes of transmission and risk factors. They only differ in their efficiency by which certain types of exposures transmit them [5]. They share similar transmission routes including sexual, blood contact, and injecting drug usage. Co-infection with HCV and HBV is very common in certain populations, such as intravenous drug users (IDUs) who often share the contaminated needles/syringes for intravenous drug injection [6]. HBV and HCV may appear as coinfection due to the same mode of transmission. Therefore, the prevalence co-infection is common, especially in developing countries in South-East Asia and Africa [7][8]. Several studies documented that HBV and HCV coinfection accelerates liver disease progression and increases the risk of hepatocellular carcinoma, and the patients need high dose of interferon treatment [3].

Approximately 7% of the world's population (350 million people) are infected with HBV and 3% (170 million people) with HCV. However, these prevalence rates vary greatly from one region to another and over time. In Africa, HBV, HCV and HIV infections are considered to be endemic, but their rates are highly variable among the African countries. HBV and HCV prevalence rates range from 3–20% and 1–26%, respectively [9][10]. Worldwide, HBV and HCV affect about 170 million and 33 million individuals, respectively [8]. It was asserted that the rate of hepatitis C infection may rise up to 90% among people who inject drugs [4].

The prevalence of hepatitis B and C in Nigeria are 12% and between 0.5-4% respectively [11], and with current estimated population of 200 million according to the 2006 census, this transform to about twenty four (24,000,000) million of its general population infected with hepatitis B, 1 - 8 million infected with hepatitis C [12][11]. The aftereffects of infection with these viruses, such as hepatocellular carcinoma and liver cirrhosis, are accountable for over 20% of mortality in Nigeria [13].

Treatment alternatives for persons having chronic hepatitis B and C infections have improved greatly in some years back. For hepatitis B, the use of nucleoside or nucleotide analogues has given way to viral suppression in most individuals infected and prevents transmission and further complications [14]. The discovery and development of novel antiviral agents has changed hepatitis C infection from an unmanageable to a potentially manageable condition with sustained virological response of more than 90% even in persons infected with advanced liver disease [15][16].

The treatment guideline by Nigerian Society for Gastroenterology and Hepatology for the treatment of viral hepatitis recommends population based serological screening of all adults of both sexes for HBV and risk-based screening for hepatitis C. This therefore, gave opportunity to

screen persons visiting to a healthcare facility, preschool and pre-employment, ante natal care and any other health related challenges. The target population for risk based screening includes persons who abuse injection drugs (IDUs), healthcare workers, persons with sexually transmitted infections (STIs), especially HIV, and children born to viral hepatitis C-infected mothers [11].

It was reported by researchers that most available prevalence data on viral hepatitis B and C in Nigeria are among cohorts of either persons with liver disease, hospital based or blood donors [13][17]. Documented data on large scale research on Hepatitis B and C among the people of Lake Basin of Borno State is in dearth, therefore it is important to establish population-based data on the prevalence of these viral hepatitis. The study sought to determine the prevalence of hepatitis B and C among the people of Lake Chad Basin of Borno State Nigeria.

2.0 MATERIALS AND METHODS

2.1 Type of Survey

The study design was a cross sectional quantitative survey. It consists of sections that obtained information on the behavioural characteristics of the general population and the vulnerability.

2.2 Survey sites and target groups

The sero-prevalence of hepatitis B and C was carried out on samples collected for HIV behavioural characteristics of the general population and the vulnerable groups with respect to STI and HIV/AIDS in Lake Chad Basin of Borno State Nigeria. The samples were collected from the following communities Madaji, Maiduguri, Shuwaran, Mari, KauKiri, Kangarwa, Kirenoa, Koloram and Boboshe all in Borno State.

The target group aged from 15 to 49 years old included the residential population, traders (hawkers, display sellers, fish sellers, lady sellers), Commercial sex workers, commercial

transporters, men and women in uniform, the peninsular population of the Lake Chad and the prisoners.

2.3 Sample size

For ease of application, the sample size determination was calculated separately for each target group. The methodology used for calculation of samples size does not take into account the size of the target population. To this effect, the whole sample depends on the precision searched and the reliability of the statistical analysis and not the size of the population that the sample was extracted from. To determine the sample size that can help to detect any change; the formula beneath was used [18].

$$n=\frac{D\,(Z\alpha+Z\beta)^{2} \times (P1\,(1-P1)\,P2\,(1-P2)}{\Delta 2}$$

Where:

D = design effect;

P1 = the estimated proportion at the time of the first survey;

P2 = the proportion at some future date such that the absolute quantity (P2 - P1) is the size of the magnitude of change that is desired to be detected (5%);

P = (P1 + P2) / 2;

Z_1-α = z-score corresponding to the probability to detect the change P2 - P1.

$Z_{1-\beta}$ = z-score corresponding to the degree of confidence (power of the study) with which it is desired to detect the actual and absolute change P2 - P1.

$\Delta = P1 - P2$

$\alpha = 0.05$ ($Z_{1-\alpha} = 1.96$)

$\beta = 0.20$ ($Z_{1-\beta} = 0.84$)

2.4 Ethical issues

In line with the National Guideline for surveys involving human subjects, an ethical approval for the study was obtained from the University of Maiduguri Teaching Hospital. Respondents' informed consent was sought and obtained before the administration of questionnaires and sample collection.

2.5 Methodology

2.5.1 Blood Sample Collection

For each study subject, identification information was written on a filter paper by the team technician followed by selection of one of the 2 middle fingers which was thoroughly cleansed with alcohol wipe and allowed to air dry for a few seconds. A sterile, disposable lancet was used to puncture the skin to the side of the finger tip. The first small blood drop was wiped away with a gauze pad. All the blood samples were blotted on Dried Blood Sample Card (Protein SaverTM 903TM Card by WhatmanTM LOT 6834509/83). This was done by placing it close to the pierced surface without touching and then followed by application of gentle pressure to the base of the finger and the second large blood drop was allowed to fall from the tip of the finger onto the surface of the filter paper inside of the circles. The circles were completely filled with blood before moving to the next empty circle. Blood was applied to one side of the filter paper (the side with printing) until all circles are filled. The DBS samples were dried under atmospheric temperature.

2.51 Packaging Blood Spots and Storage

Once DBS cards were completely dry, they were stacked between sheets of glassine paper to prevent blood spot cards from different patients touching each other. Ten to fifteen blood spot cards were packed in low gas permeable ziplock bags and 5 to 10 desiccant packs for removal of any residual moisture from the cards and humidity indicator cards (HI CARD MS20003-2, Batch

0123590C, USA) for measurement of relative humidity inside the bag were added. The DBS cards were kept in zip-lock bags with desiccant and stored at 4^{O}C until ready for shipment. The DBS cards were shipped to Virology Unit of the Department of Microbiology and Biotechnology, National Institute for Pharmaceutical Research and Development (NIPRD), Abuja where they were kept at 4^{O}C.

2.5.3 Elution of the dried blood spots

The DBS were punched using 6mm file puncher into well labelled 5ml disposable tubes and 200µl of the elution buffer was added to each of the tubes. The diluents were carefully mixed three times using the pipette to ensure that the discs were completely submerged. Two elution were done for each sample. One set of the tubes were incubated between 2^{O}Cto 8^{O}C while the other set were incubated under normal laboratory conditions for two hours.

2.5.4 Testing for Hepatitis B antigen

All the elutes were screened for Hepatitis B virus (HBV) using the hepatitis B surface antigen (HBsAg) ELISA rapid test kit (ACON, USA) and all positive samples were further subjected to another rapid ELISA test kit (ABON, Abon Biopharm Hangzhou Co., Ltd) for confirmation according to the manufacturer's instructions. The two samples incubated at different temperatures were tested to determine the effect of temperature on the elution

2.5.5 Testing for Hepatitis C antigen

All the eluted blood samples were screened for anti-HCV using HCV one step hepatitis C test strip ACON (ACON, laboratory INC. USA). The HCV one step hepatitis virus C test strip (serum) is a qualitative, membrane-based immunoassay for the detection of antibody to HCV in serum. Hepatitis C positive samples were confirmed with a second serum based third generation rapid enzyme-linked immunosorbent assay (ELISA) HCV kit (ORTHO HCV version 3.0 ELISA

(Ortho- Clinical Diagnostics, Raritan, New Jersey, USA) according to the Manufacturer's instructions. The two sets of eluted samples incubated at different temperatures were given the same treatment as described above.

2.6 Data and Statistical analysis

The data obtained was analyzed using statistical product and service solutions (SPSS) (version 17.0), descriptive statistics were presented in Tables and Figures. The Chi-square (X^2) test was used to determine the level of association of the prevalence of HBV, HCV and HBV/HCV co-infection among the people of Lake Chad Basin. Values obtained were considered statistically significant at p=.05.

3.0 RESULT

A total of one thousand, seven hundred and ninety samples collected in the Lake Chad Basin of Borno State Nigeria were tested for hepatitis Band C antibodies. The result of the study revealed that twenty eight (28) representing 1.56% with a 95% confidence interval of 22.1 – 26.1 tested positive for hepatitis B and three 3(0.17%) was hepatitis C positive. The highest Hepatitis B prevalence was observed in Abadan where (2.83%) out of 106 people tested were found to be infected with hepatitis B, while the hepatitis C cases were recorded in Jere and Dikwa Local Government Areas. A total of two hundred and fifty five people (255) were tested in Dikwa 5(1.96%) were positive, while Kukawa has a prevalence of 0.99% out of 907 people tested. Jere had prevalence of 2.38% while Maiduguri Metropolitan City had seroprevalence of 1.89%. There were no hepatitis B positive samples among the respondents from Marte and Ngala Local Government Areas of Borno State (Table 1).

Table 1: Hepatitis B and C Seroprevalence disaggregated by local government area

Local Government Area	**Number of Samples**	**Number of HBV Positive**	**Number of HCV Positive**
Abadan	106	3(2.83)	0(0%)
Dikwa	255	5(1.96%)	1(0.39%)
Jere	252	6(2.38%)	2(0.79%)
Kukawa	907	9(0.99%)	0(0%)
Maiduguri Metropolitan City	265	5(1.89%)	0(0%)
Marte	2	0(0%)	0(0%)
Ngala	3	0(0%)	0(0%)
Over all prevalence	1,790	28(1.56%0	3(0.17%)

The result indicates that hepatitis B and C are more prevalent among the CSWs (hepatitis B 8.5% hepatitis C 1.4%) and the prison inmates. There was no record of hepatitis B among the traders and uniform service mem while hepatitis C was only detected among the CSWs and prison inmates.

Table 2 shows prevalence of HBV and HCV disaggregated by target groups.

Target groups	No of respondents		HBV		HCV	
	N	%	N	%	N	%
Household population	393	46.8	7	1.7	0	0
Island population	307	73.1	3	0.98	0	0
Traders	358	41.33	0	0	0	0
Road transporters	346	41.68	2	0.58	0	0
CSWs	142	147.1	12	8.5	2	1.41
Uniform service men	172	20.84	0	0	0	0
Prisoners	69	12.54	4	5.79	1	1.45
Total	**1,790**	**100**	**28**	**1.56**	**3**	**0.17**

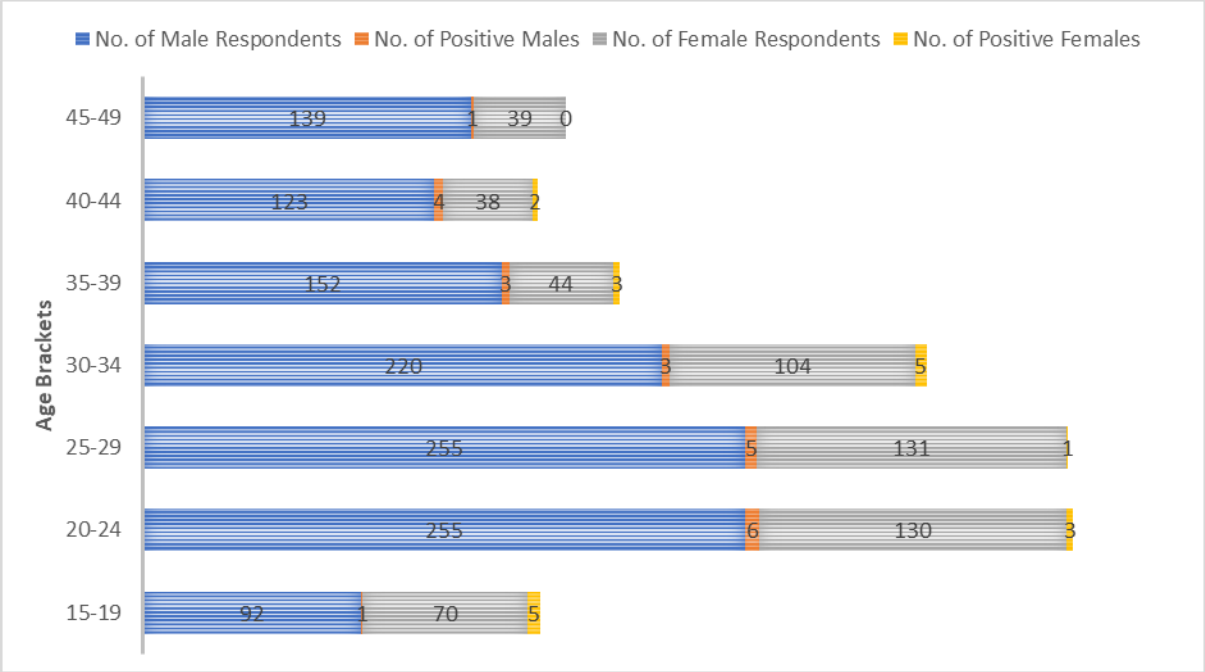

Figure 1. Hepatitis B seroprevalence according to age bracket and disaggregated by sex

Upon disaggregation by age and sex, the highest number of positive cases of hepatitis B was recorded among the males in the age range of 40-44 (3.25%), while the highest cases among the females was within the age range of 35-39 (6.8%) (figure 1). Hepatitis C positive cases recorded in this study were one male and two females within the age range of 20-24 (figure 2).

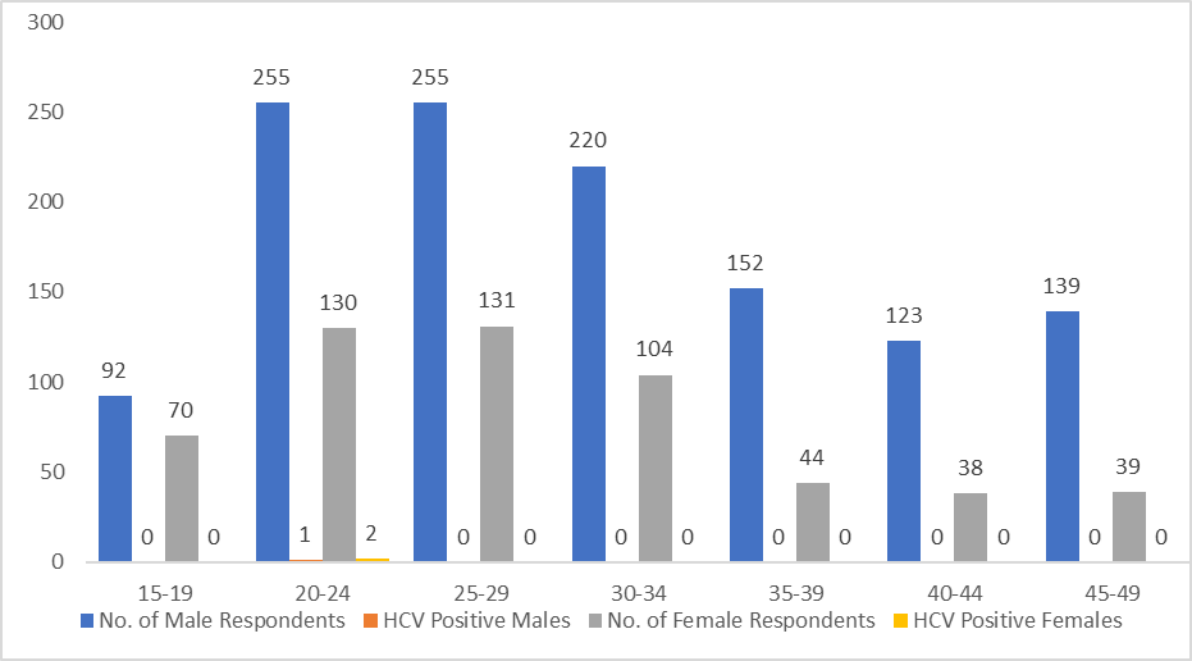

Fig 2. Hepatitis C seroprevalence according to age bracket and disaggregated by sex.

Figure 3 showed the prevalence of Hepatitis B and C according to the type of community. The prevalence of Hepatitis B was higher among the people living in the urban communities than the rural communities while hepatitis C was only detected among the people of the rural communities.

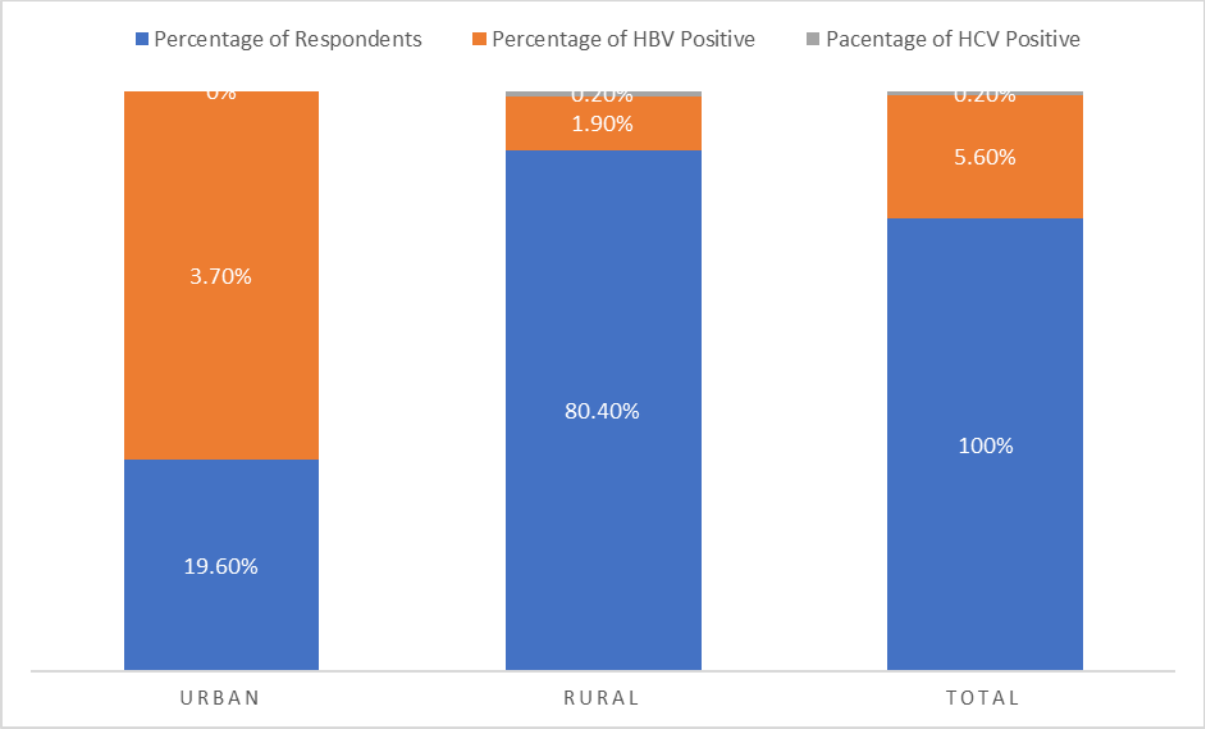

Fig 3. Hepatitis B and C prevalence by type of community

4.0 DISCUSSION

Seroprevalence studies of infectious diseases in general population is important as it enable policy makers to plan effectively towards control strategies. Also, the use of rapid testing techniques for antibody test at the point of care for viral hepatitis is important among the general population for early detection of diseases before the debilitating effect of the viral infection. The infected individuals have the advantage of early medical advise regarding measure to be taken about medical care and treatment options [19].

This study therefore aimed at determining the seroprevalence of Hepatitis B surface antigen (HBsAg) and Anti-HCV antibodies among the people living lake Chad Basin of Borno State Nigeria. The serological analysis revealed varied frequency but low prevalence of hepatitis B and C viruses among the various risk groups. The prevalence of HBsAg and anti-HCV-antibody was 1.56% and 0.17%, (p0.05) respectively. Dual infection was however, not detected among the people of this population. The prevalence of I.56% of HBsAg is considered low when compared

to 13.3% reported by [20] in Northern Nigeria, and 4.9% from Port Harcourt Nigeria [21]. A similar study conducted among the health seekers in outpatient department of General Hospital Lapi in Niger State Nigeria reported prevalence of 8.25% [22]. Then result is also not comparable to Nigeria National prevalence of 13.6% as reported by [17]. Though, this can be readily explained by the fact that the national estimates are modelled on higher rates [23]. The previous studies of 28.7% in Jos [24], 30.4% in Ilorin [25], 70.5% in Kano [26] are far above the result of this study. However, the result of this study is comparable with the finding of 1.2% by [27].

On segregation by sex. The analysis show that the prevalence of hepatitis Bis higher among the males than females. This is in agreement with the result of study conducted by [9] among the patients with chronic liver diseases in public hospitals in Adis Ababa, Ethiopia where 38.2% and 22.5% of the males and females were hepatitis B positive but not in consonance with the findings of [27] where prevalence was higher among the females.

Considering the age brackets of the respondents tested for Hepatitis B antigen, the people within the age range of 40-44 has the highest prevalence of Hepatitis B (3.25%) among the males while females within the age backet of 35-39 has the highest prevalence of 6.8%. The result of this study therefore suggests that the infection with hepatitis B virus among this population may not be an active infection. The result of the finding is therefore not in agreement with the results of [20][9][28].

The respondents were drawn from different high-risk groups. The result indicates a significant relationship between risk factors and prevalence of HBV ($P \leq 0.05$). The commercial sex workers have the highest prevalence of hepatitis B (8.5%) and then followed by prison inmate (5.79%). The finding is also in agreement with the work of [29] where 17.1% of the CSW tested were

HBV positive. However, the result of this study is lower than the findings of 17.1% [29], and 11.4% in Thailand by [30], 10.7% in China [31] but higher than 4.2% in Republic of Congo by [32].

Out of 1790 screened for hepatitis C antibody, three (0.17%%) were tested positive, while two were female (0.17%) and one male (0.16%). The outcome of the study showed no significant difference in prevalence between the male and female respondents. This is similar to the report of 0.4% by [33], 0.26% [34], 0.7% [35], (0.31%) had HCV in Kenya [10].

This is however, lower than 5.2 and 11.09% reported in Kaduna, respectively [36] 4.3% among a presumed low risk population in Jos [37], 4.7-5% in Ilorin, 5.3-6%in Enugu, 11% in Ibadan, 20%in Benin [38], 4.7% from a tertiary Hospital in Nigeria [39], 1.79% among pregnant women and blood donors in Ogbomoso [40], 14.9% by [41] and 1.39% among pregnant women in Nigeria [2]. The prevalence of HCV infection among the people of Laje Cad Basin of Borno State was also found to be high when compared to reports from some countries in Africa (5.3%), Eastern Mediterranean (4.6%), Western Pacific (3.9%), South East Asia (2.15%), America (1.17%) and Europe (1.03%) [42], Egypt (20%) [43]. 23.5 in Pakistani [3].

The three persons tested positive for HCV antibody were all within the age range of 20-24 years. This is in consonance with the reports of 1.1% by [44], where the highest prevalence was among the people within the age range of ≤30 years, 0.5% within the age range of 21-30 [33] who reported highest prevalence of 1.5% among the people within the age range of ≤24 years. Hepatitis C was only detected among the CSW and prison inmates with a prevalence of 0.17% (P0.05) was similar to report of 0.7% from Republic of Congo [32], 0.9% in Brazil [45]. The result is however lower than result of 6.6% in Democratic Republic of Congo by [46] 2001 and 1.5% in Burkina Fasso [45], 1% in China by [31].

Our finding may imply that the transmission of viral hepatitis is generally low and not found to be significantly associated with any of the risk factors examined ($p > 0.05$). However, participants that were ≤30 years old had a prevalence of 2.25% against 2.44% among the older participants. This does not correlate with age of greatest sexual activity as is the case in the studies by [47][48] though, the result of HVC however indicated a relationship between the risk behaviour and prevalence of infection because the only positive cases in this study were detected among the CSW and prison inmates. This is in agreement with widely suggestion that risk behaviours can lead to accumulated risk for viral transmission [49].

5. CONCLUSION

This study suggests that HBV and HCV are of public health concern. Therefore, to mitigate further transmission of these viruses, among the people of Lake Chad Basin of Borno State, there is need for quick intervention programs ranging from awareness to early treatment options for those infected. Those interventions should consider behaviours and needs that predisposes the people to those viral infections. It should also include vaccination against HBV, sexual education, prevention of blood exposures and treatment of HCV.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

REFERENCES

1. Public Health Agency of Canada (2013). Report on Hepatitis B and C In Canada 2013.
2. Esan AJ, Omisakin, VT, Ojo B, Owoseni MF, Fasakin K.A, Ogunleye A.A. Sero-Prevalence of Hepatitis B and Hepatitis C Virue Co-Infection among Women in Nigeria. Amer J Biomedic Res. 2014; 2(1): 11-15
3. Jafar K, Mehwish S, Sameera M, Sultan A, Riaz U, Naser MA, Fouad H, Mohammad A. Seropositivity and Coinfection of Hepatitis B and C among Patients Seeking Hospital Care in Islamabad, Pakistan. BioMed Res Intl. 2014:4 http://dx.doi.org/10.1155/2014/516859.
4. World Health Organization. Guidelines on Hepatitis B and C Testing; WHO: Geneva, Switzerland, 2016. Available online: https://www.who.int/ (accessed on 10 June 2021).
5. Pennap GR, Yahuza AJ, Abdulkarim ML Oti VB. Prevalence of Hepatitis Band C Viruses and Human Immunodeficiency Virus Infected Children attending an Antiretroviral Therapy Clinic in Lafia Nigeria. The Asia J Appl Microbiol. 2016; 3(4): 38-43.
6. Beatrice M., Michael MG, Dorcas W, Anthony KN, Samoel AK. Prevalence of hepatitis B and C viral co-infections among HIV-1 infected individuals in Nairobi, Kenya. BMC Res Notes. 2013; 6:363 http://www.biomedcentral.com/1756-0500/6/363.
7 Kourtis AP, Bulterys M, Hu DJ, Jamieson DJ. HIV-HBV coinfection-a global challenge. N Engl J Med. 2012;366(19):1749-52. doi: 10.1056/NEJMp1201796.
8. Platt L, Easterbrook P, Gower E. (2016). Prevalence and burden of HCV coinfection in people living with HIV: A global systematic review and metaanalysis. Lancet Infectious Disease. 2016; 16(7):797-808.

9. Abel GA, Solomon GS. Prevalence and Risk Factors of Hepatitis B and Hepatitis C Virus Infections among Patients with Chronic Liver Diseases in Public Hospitals in Addis Ababa, Ethiopia. ISRN Trop Med. 2013; 7 Article ID 563821. http://dx.doi.org/10.1155/2013/563821

10. Kerubo G, Khamadi S, Okoth V, Madise N, Ezeh A, Abdalla Z, Matilu M. Hepatitis B, Hepatitis C and HIV-1 Coinfection in Two Informal Urban Settlements in Nairobi, Kenya. PLoS ONE. 2015; 10(6): e0129247. doi:10.1371/journal.pone.0129247.

11. Malu AO, Borodo MM, Ndububa DA. Hepatitis B and C treatment guidelines for Nigeria. Nig J Gastroenterol Hepatol 2015; 157(2):63-75

World Health Organisation. Hepatitis C, estimated prevalence and number infected by world region. 2007. Available at http://www.who.int/csr/disease/hepatitis.

12. National Population Commission, Abuja, Nigeria. Nigeria demographic and health survey 2013. National Population Commission Federal Republic of Nigeria. 2014.

13. Kooffreh-Ada M, Okpara H, Oku A. Risk factors for chronic liver disease amongst patients receiving care in a gastroenterological practice in Calabar. IOSR J Med Dent Sci. 2015; 14(12):6-13.

14. Stockdale AJ, Phillips RO, Beloukas A, Appiah LT, Chadwick D, Bhagani S, Bonnett L, Sarfo FS, Dusheiko G, Geretti AM, Hepatitis B Infection in Kumasi (HEPIK) Study Group. Liver Fibrosis by Transient Elastography and Virologic Outcomes After Introduction of Tenofovir in Lamivudine-Experienced Adults With HIV and Hepatitis B Virus Coinfection in Ghana. Clinical Infectious Diseases Journal. 2015 61(6):883-91. doi: 10.1093/cid/civ421.

15. Knowdley KV, Gordon SC, Reddy KR. Ledispavir and sofosbuvir for 8 or 12 weeks for chronic HCV without cirrhosis. New England J Med. 2014; 370(20):1879-1888.

16. Poordad F, Hezode C, Trinh R. (2014). ABT-450/rombitasvir and dasabuvir with ribavirin for hepatitis C with cirrhosis. New England J Med. 2014; 370(21):1973-1982. https://doi.org /10.

17. Musa BM, Bussell S, Borodo MM. Prevalence of hepatitis B virus infection in Nigeria, 2000-2013: A systematic review and meta-analysis. Nig J Clin Pract. 2015; 18(2):163-172.

18. Estimation and Projection Package, (2009). http://www.unaids.org/en/dataanalysis/tools/estimationandprojectionpackageepp.

19. Centers for Disease Control and Prevention (CDC). Testing for HCV infection: An update of guidance for clinicians and laboratorians. MMWR Morb Mortal Wkly Rep. 2013;62(18):362-365.

20. Grace RP, 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 (4): 274-278. ISSN 1996-0808

21. Ejele QA, Ojulu AC. The prevalence of Hepatitis B surface antigen among prospective blood donors and patients in Port Harcourt, Nigeria. Niger Med J. 2004; 13: 336–338.

22. Ya'aba Y, Mohammed SB, Izebe KS, Chuku A, Abdulmumin AR Abarike MC. Risk Factors And Prevalence Of HIV, Viral Hepatitis B And C Among Patients In General Hospital Lapai, Niger State. Nig J Sci. 2020; 54 (1): 137-145

23. Ado A, Alhassan S, Chonoko UG (2010). Sero-prevalence of hepatitis B surface antigen (HBsAg) among blood donors attending Ahmadu Bello university teaching hospital

(ABUTH), Zaria, Nigeria. Bayero J Pure Appl Sci. 2010; 3(1):20-22. https://doi.org/10.4314/bajopas.v3i1.58557

24. Irisena, ND, Njoku, MD, Idoko JA. HBsAg in patients with HIV-1 infection in Jos, Nigeria. Nig J Med Pract. 2002; **41**(12): 18-20.

25. Adesina O, Oladokun A, Akinyemi O,Adedokun B, Awolude O, Odaibo G,Olaleye D, Adewole. Human immunodeficiency virus and hepatitis B virus coinfection in pregnancy at the University College Hospital, Ibadan. Afr J Med Med Sci. 2010;39(4):30510.

26. Nwokedi EE, Epopees MA Dutse AI. Human Immunodeficiency Virus and Hepatitis B virus co-infection among patients in Kano, Nigeria. Nig J Med. 2006; 15(3): 227-9.

27. Joanah I, Henry O, Elemi I. Ogarepe Y, Udoh E, Ekanem E. The prevalence of hepatitis B virus infection in Nigerian children prior to vaccine introduction into the National Programme on Immunization schedule. Pan Afri Med J. 2016; 23:128 doi:10.11604/pamj.2016.23.128.8756.

28. Forbi JC, Onyemauwa N, Gyar SD, Oyeleye AO, Entonu P, Agwale SM. High Prevalence of Hepatitis B Virus Among Female Sex Workers In Nigeria. Rev. Inst. Med. trop. S. Paulo.2008; 50(4):219-221

29. Hongjaiseea S, Khamduang W, Sripana P, Choyrumb S, Thepbundit V, Ngo-Giang-Huongb N, Tangmunkongvorakula A. Prevalence and factors associated with hepatitis B and D virus infections among migrant sex workers in Chiangmai, Thailand: A cross-sectional study in 2019. Intl J Inf Dis. 2019; 100 (2020): 247–254.

30. Su S, Eric PFC, Kathryn EM, Lei Y, Joseph DT, Xiaohu Z, Jiehui R, Christopher KF, Jun J, Lei Z. Sustained high prevalence of viral hepatitis and sexually transmissible infections

among female sex workers in China: a systematic review and meta-analysis. BMC Inf Dis.2016; 16(2). DOI 10.1186/s12879-015-1322-0.

31. Niama FR, Loukabou Bongolo NC, Mayengue PI, Mboussou FF, Kombo Bayonne ES, Kouckodila Nzingoula FM, Dossou-Yovo LR, Louzolo I, Etoka-Beka MK, Lanzy A, Yameogo I, Louvouezo D, Kobawila SC, Puruhence MF, Parra HJ. A study on HIV, Syphilis, and Hepatitis B and C virus infections among female sex workers in the Republic of Congo. Arch Pub Health. 2017; 75(21). doi: 10.1186/s13690-017-0189-5. PMID: 28503303; PMCID: PMC5421326

33. Jemilohun1 AC, Oyelade BO, Oiwoh SO. Prevalence Of Hepatitis C Virus Antibody Among Undergraduates in Ogbomoso, Southwestern Nigeria. Afr J Infect Dis. 2014; 8(2): 40–43 doi.org/10.4314/ajid.v8i2.5

34. Molla S, Munshea A, Nibret E. Seroprevalence of hepatitis B surface antigen and anti HCV antibody and its associated risk factors among pregnant women attending maternity ward of Felege Hiwot Referral Hospital, northwest Ethiopia: a cross-sectional study. Virol J. 2015; 12**:**204 DOI 10.1186/s12985-015-0437-7.

35. Damola AB, Adeniji JA, Bakarey AS. Hepatitis C virus seropositivity and the risk factors for transmission among blood donors in some selected centers in Lagos State, Southwest Nigeria. J Immunoassay Imunochem. 2019; 40(5):528-539. doi: 10.1080/15321819.2019.1647853.

36. Strickland GT. HCV in developing Countries. Postgrad. Doc. (Africa). 2002; 24: 18-20

37. Egah DZ, Banwat EB, Audu ES, Iya D, Mandong BM, Awele AA, Gomwalk NE Hepatitis B surface antigen, Hepatitis C and HIV antibodies in a low risk blood donor group, Nigeria. E Med. Health J. 2007;13: 211-215.

38. Ejiofor O S, Emechebe G O, Igwe W C, Ifeadike C O, Ubajaka C F. Hepatitis C virus infection in Nigerians. Nig Med J. 2010; 51(4): 173-176.

39. Onyekwere CA, Ogbera AO, Dada AO, Adeleye OO, Dosunmu AO, Akinbami AA, Osikomaiya B, Hameed O. Hepatitis C Virus (HCV) Prevalence in Special Populations and Associated Risk Factors: A Report From a Tertiary Hospital. Hepat Mon. 2016; 16(5): e35532. doi: 10.5812/hepatmon.35532.

40. Hilda AE, Kola OJ, Kolawole EO. Prevalence of anti-hepatitis C virus antibody among pregnant women and blood donors at Bowen University Teaching Hospital, Ogbomoso, Oyo State, Nigeria. 2017; 38(2):221-234.
doi: 10.1080/15321819.2016.1241264.

41. Ebie JC, Pela OA. Some sociocultural aspects of the problem of drug abuse in Nigeria. Drug and Alc. Dep. 2006; 8: 301-306.

42. World Health Organization. Global Hepatitis report, 2017 WHO: Geneva, Switzerland, 2017. Available online https://www.who.int/

43. Frank C, Mohammed M, Strickland G. The role of parenteral anti-schistosomal therapy in the spread of Hepatitis C virus in Egypt. Lancet. 2002; 355: 887-891.

44. Oshun PO, Odeghe, E. Prevalence of Hepatitis C virus and HIV among adults presenting for health screening in Lagos. Afr J Clin Exp Microbiol. 2019; 20 (2): 143 – 149 https://www.afrjcem.org ISSN 1595-689X.

45. Ouedraogo HG, Kouanda S, Goodman S, Lanou HB, Ky-Zerbo O, Samadoulougou, BC, Dabire C, Camara C, Traore Y, Baral S, Barro N. Hepatitis B, C and Delta Viruses' Infections and Correlate Factors Among Female Sex Workers in Burkina Faso, West-Africa. The Open Virol. 2019; 13(3); 9-17. DOI: 10.2174/1874357901913010009.

46. Ferreira-Junior O, Guimarães MDC, Damacena GN, de Almeida WS, de Souza-Junior PRB, Szwarcwald CL, The Brazilian FSW Group. Prevalence estimates of HIV, syphilis, hepatitis B and C among female sex workers (FSW) in Brazil. Med. 2016; 97: S1-S8.

47. Laurent C, Henzel D, Mulanga-Kabeya C, Maertens G, Larouzé E, Delaporte B. Seroepidemiological survey of hepatitis C virus among commercial sex workers and pregnant women in Kinshasa, Democratic Republic of Congo. Int J Epidemiol. 2001; 30(4):872-7. doi: 10.1093/ije/30.4.872. DOI: 10.1093/ije/30.4.872 .

48. Koate BB, Buseri FI, Jeremiah Z. Seroprevalence of Hepatitis C virus among blood donors in Rivers State, Nigeria. Transf Med. 2005; 15 449-451.

49. Sy T, Jamal MM. Epidemiology of Hepatitis C virus (HCV) infection. Int J Med Sci. 2006; 3: 41 -46.