Ashaka *et. al.* Babcock Univ. Med. J.2024 7(2):155-163
https://doi.org/10.38029/babcockuniv.med.j..v7i2.552
eISSN: 2756-4657

RESEARCH ARTICLE OPEN ACCESS

Prevalence and risk implications of Hepatitis B and C Viruses in a University community in Lagos, Nigeria

Ashaka OS[1ID], Ezeanya-Bakpa CC[1ID], Olukoya FC[1], Awodesu CI[1], Abdulkadir OA[1], Mbata PI[1], Yangs FM[1], Orukotan AA[1, 2ID]

[1]Department of Biological Sciences and Biotechnology, Caleb University, Lagos 106102, Nigeria
[2]Department of Microbiology, Kaduna State University, Kaduna, Nigeria

Submitted: 7th July 2024
Accepted: 27th October 2024
Published: 31st December 2024
ID: Orcid ID

Abstract
Objectives: This study determined the prevalence and risk implication of HBV and HCV in an asymptomatic university student group in Lagos, Nigeria.
Methods: A total of 90 students (38 males and 52 females) aged 16-25 years were enrolled in this study. Hepatitis B surface Antigen (HBsAg) and Hepatitis C Virus Antibodies (Anti-HCV) were detected using an ELISA microplate spectrophotometer at 450nm absorbance. Data on medical and socio-demographic information was obtained using pretested structured self-administered questionnaires.
Results: The overall seroprevalence for HBsAg and Anti-HCV was 2.2% respectively. Hepatitis B surface antigen was tested in 2 (5.3%) males only. Anti-HCV antibody was detected in both males and females with a prevalence of 1 (2.63%) and 1 (1.92%) respectively; with a male-to-female ratio of 1: 1. The age 19-21 years had HBsAg with a prevalence of 4.26%. The age group 16- 18 years and 19-21 years had an Anti-HCV prevalence of 3.57% and 2.12% respectively. Sexual intercourse, intravenous drug use, tattoos and body piercings were found to be associated ($p < 0.05$) with HBsAg and anti-HCV.
Conclusions: The prevalence of HBV and HCV among undergraduate university students in Lagos was 2.2% respectively. HBsAg and anti-HCV were detected among an asymptomatic group of students aged 16 -21 years with associated risk factors. This group must be considered as a high-risk group for viral hepatitis infection intervention.

Keywords: Asymptomatic Infection, Adolescents, Hepatitis B virus, Hepatitis C virus, Prevalence

Plain English summary:
This study looked at how common hepatitis B and C are among university students in Lagos, Nigeria. Hepatitis B and C are viruses that can cause serious liver disease, including cirrhosis. Researchers tested 90 students, aged 16-25, for these viruses using a special blood test. They also collected information about the students' health and lifestyle. The results showed that 2.2% of the students had hepatitis B, and 2.2% had hepatitis C. Among the male students, 5.3% tested positive for hepatitis B. Both male and female students had similar rates of hepatitis C, with about 2.6% of males and 1.9% of females infected. The highest rate of hepatitis B was found in students aged 19-21, while hepatitis C was most common in students aged 16-18 and 19-21. The study found that certain behaviours were linked to a higher risk of having these infections. These behaviours included having sexual intercourse, using intravenous drugs, and getting tattoos or body piercings. It was concluded that young students, even if they don't show

Correspondence:
Ashaka, Oluwaseyi S
Department of Biological Sciences and Biotechnology, Caleb University,
Lagos 106102, Nigeria.
+234-8062673682, ashakseyi@gmail.com

symptoms, are at risk for hepatitis B and C. Young people should be considered a high-risk group and more efforts should be made to educate and protect them from these infections.

Background: Hepatitis B (HBV) and hepatitis C (HCV) are viral hepatitis infections with significant public health concerns globally. Infections range from chronic infection to cirrhosis and/or hepatocellular carcinoma with subsequent death. An estimated 292 million individuals have been reported to be infected with Hepatitis B infection globally by the World Health Organization. With an additional estimation of 74 million individuals reported for hepatitis C infection (1). Currently, there has been an increasing prevalence of both hepatitis B and C viral infections worldwide. (2).

Hepatitis B and hepatitis C virus infection is endemic in many parts of Africa, with a higher prevalence in Nigeria when compared to other African countries (3). Of the general population of 60 million individuals living with HBV in Africa, 8.1% have chronic HBV in Nigeria (4). Also, HCV is said to infect 3 million (5.3% prevalence rate) individuals in Africa with approximately 1.1 % reported in Nigeria. Nigeria is a West African country and one of the hyper-endemic regions for HBV and HCV (5). Due to challenges in the implementation of universal vaccination against HBV and the application of high throughput detection methods for screening HBV and HCV among blood donors and the general population (6, 7). High throughput detection methods such as nucleic acid amplification tests provide specific information on the viral replication including the variants and identify reservoirs. These diagnostic tests, as well as, serology tests; identify and quantify common biomarkers of hepatitis B surface antigens (HBsAgs) and hepatitis C surface antibodies (anti-HCV) for HBV and HCV infection respectively. This promotes identification of patients or carriers with HBV and HCV infection and monitors disease progression consequently, leading to the reduction in new hepatitis infections and subsequent death.

In Nigeria, studies have shown that approximately nine in ten young adults with chronic viral hepatitis infection (HBV and HCV) are asymptomatic due to the absence of resources (nucleic acid and specific immunoassay tests) and awareness (8, 9). Consequently, this is considered a public health threat to the virus-attributable cancer in the general population. Studies have reported varying prevalence rates of viral hepatitis infection among young adults in Nigeria. In 2019, Mohammed *et al*. (10) reported an overall HBV prevalence of 9.7% among Nigerian students in Nasarawa aged 15-40 years. An earlier study in 2018 reported an HCV prevalence of 0.7% among young adults at a Nigerian University in Ogun State (11). However, similar to Hepatitis B, prevalence rates can vary across different regions within the country. Further, epidemiological investigations on HBV and HCV infection in Nigeria are evolving, but there are limited up-to-date epidemiological data of young adults aged 16-25 years in a general population in Lagos, Nigeria.

In Africa, the presence of HBV and HCV infections in the general population increases the likelihood of transmission among young adults, especially through peculiar modes of transmission such as unsafe sexual practices, injection drug use, and exposure to contaminated blood (12). The changing social orientation especially among young people that embraces risky behaviors, such as unprotected sexual activity and injection drug use seems to be significant factors in the transmission of HBV and HCV among young adults in Nigeria. These behaviours persist particularly among young people who are not equipped with knowledge which could contribute to limiting the ongoing spread of these viruses (13). Limited awareness about the risks and modes of transmission, as well as the stigma and discrimination associated with these infections, discourage individuals from seeking timely medical care. Also, the unavailability of antiviral medications further impedes the effective management of hepatitis B and C among the young population (14).

The impact of HBV and HCV infections on young people in Lagos, Nigeria is multifaceted. It is known that the majority of HBV and HCV infections occur during adolescence or early adulthood thus resulting in long-term sequela (15, 16). Chronic hepatitis B and C infections can progress silently for years, causing minimal symptoms, which often results in delayed diagnosis and treatment initiation. As a result, the infected individuals may unknowingly transmit the viruses to others. This suggests a knowledge gap that requires an investigation. It is with this intent that this study aims to determine the prevalence of HBV and HCV infection and identify the factors that contribute to the risk of infection among a subset of young adults in a closed university community in Lagos, Nigeria.

Materials and Methods:

Study Area and Design

This cross-sectional study was carried out among ninety (90) undergraduate students which comprised 38 males and 52 females in a closed

University community in Lagos State, Nigeria. The sample size was determined at 0.05 degree of accuracy based on a prevalence of 4.2% from previous studies among University students in Kogi State, Nigeria (17). The University community houses about 8,500 students with more female students when compared to males. Participation in the study was voluntary as purposive sampling; a non-probability sampling technique was used to select participants within the student community. This study was conducted between February and May 2022.

Eligibility criteria
Inclusion criteria: Male and female undergraduate students (aged 16 -25 years) at all academic levels. Exclusion criteria: Postgraduate students of the University; Undergraduate students on anti-viral medication three months before the time of the study; Undergraduate students with symptoms associated with viral hepatitis infection.

Study Instrument
A questionnaire was designed in the English language for this study. The tool consisted of three sections: five items on socio-demographic characteristics of participants, twelve (12) items for testing knowledge of hepatitis B and C infection, six (6) items to assess participants' attitudes towards HBV vaccination, and thirteen (13) items to assess participants risk to hepatitis B and C infection as well as HBsAg and Anti-HCV status. For knowledge and attitude components, the answers to the questions were ranked as 'YES', 'NO' and 'DO NOT KNOW'.
A panel of six experts assessed the face and content validity of the instrument. The scale-level content validity index was 0.97 for the knowledge component, 0.93 for the attitude component and 0.98 for the risk component. The item-level content validity index ranged from 0.7 to 1.0 and the content validity ratio ranged from 0.8 to 1.0. The instrument was pretested among 10 participants through convenience sampling. The internal consistency reliability (Cronbach's α) for the instrument was 0.93.

Data Collection
Relevant medical information of students was collected using pretested structured self-administered questionnaires. Information about the socio-demographic characteristics of participants, knowledge of Hepatitis B and C infection, attitude towards HBV vaccination, and risk to hepatitis B and C infection as well as HBsAg and Anti-HCV status (positive or negative) of students were recorded. Personal identification information of students such as names and matric numbers was excluded to ensure anonymity. The questionnaires were coded with numbers corresponding to the collected blood sample of the individual.

Serologic testing
Five (5) ml of blood samples were aseptically collected from each consenting participant through vein puncture into a well-labeled non-anticoagulant tube. The blood samples were centrifuged at 3,500 rpm for 5 minutes after clotting to extract the serum. Sera samples were stored at -20 ℃ until the ELISA technique was performed to detect Hepatitis B Surface Antigen and Hepatitis C Virus Antibodies. Both assay techniques were performed according to the manufacturer's instructions. Absorbance was measured at 450 nm using an ELISA microplate spectrophotometer.

Data Analysis
Data from the questionnaire in the three (3) sections were analyzed as 'CORRECT ANSWER', 'INCORRECT ANSWER', and 'DID NOT KNOW'. The 'correct answer' to the questions could vary between being "YES" and "NO". Therefore, the answers in the questionnaires were compared to a template with the 'correct answers' during analysis. The participant's level of knowledge was categorized based on correct responses to twelve (12) items on the questionnaire as Poor knowledge (≤ 6), Fair knowledge (7-8), and good knowledge (≥ 9). Participants' attitude was assessed and ranked based on correct responses to six (6) items on the questionnaire: Poor attitude (< 3), Fair attitude (3-4), and good attitude (≥ 5).
Descriptive statistics were used. The chi-square was used to determine differences between groups and a one-sided probability of < 0.05 was considered statistically significant.

Results
Demographic characteristics of the study participants
The age of the participants was 16-25 years which comprised 38 males (42.2%) and 52 females (57.8%). The highest age distribution pattern was 47 (52.2%) among age-group 19-21 years while the least participation was recorded among age-group 22-25 years 12 (13.3%). The highest participation was recorded among those in their final and penultimate school year with 35.6% (32/90) and 33.3% (30/90) respectively while those in their first school year had the least participation of 14.4% (13/90) as shown in Table 1.

Table 1. Demographic characteristics of the participants involved in the study

Demographic characteristics	Total (N=90)	Male (N = 38)	Female (N = 52)
Age	N (%)	N (%)	N (%)
16-18	28 (31.1)	11 (29.0)	17 (32.7)
19-21	47 (52.2)	19 (50.0)	28 (53.9)
22-25	12 (13.3)	7 (18.4)	5 (9.6)
Undeclared Age	3 (3.3)	1 (2.6)	2 (3.8)
School Year			
1	13 (14.4)	4 (10.5)	9 (17.3)
2	15 (16.7)	5 (13.2)	10 (19.2)
3	30 (33.3)	14 (36.8)	16 (30.8)
4	32 (35.6)	15 (39.5)	17 (32.7)
Religion			
Christian	79 (87.8)	32 (84.2)	47 (90.4)
Muslim	10 (11.1)	5 (13.2)	5 (9.6)
Traditionalist	1 (1.1)	1 (2.6)	0 (0)
Extra Job			
Yes	17 (18.9)	8 (21.1)	9 (17.3)
No	73 (81.1)	30 (78.9)	43 (82.7)

Prevalence of HBV and HCV infection by gender and age

Only two (2) participants tested positive for HBsAg and Anti-HCV, implying a seroprevalence of 2.2% for HBV and HCV respectively. The participants who tested positive for HBsAg were unrelated to those who had HCV antibodies. Of all the males tested for HBsAg, two participants (5.3%) were positive for HBsAg while a zero (0%) prevalence was recorded among female participants. Hepatitis C antibodies were detected in one male and female participant with a prevalence of 2.63% and 1.92% respectively (Table 2). Only those within the age groups of 19-21 years had HBsAg detected with a prevalence of 4.26% (2/47). The age-related HCV prevalence of 3.57% (1/28) and 2.12% (1/47) was reported among age groups 16-18 years and 19-21 years respectively. Participants in their later school year (final and penultimate years) were found to be positive for both HBsAg and Anti-HCV with a prevalence of 3.2% (2/62).

Table 2: Prevalence of HBsAg and Anti-HCV among young university students and differences based on gender

	Positive			Negative		
	Total N (%)	Male N (%)	Female N (%)	Total N (%)	Male N (%)	Female N (%)
HBsAg	2 (5.3)	2 (5.3)	0 (0.0)	88 (97.8)	36 (94.7)	52 (100)
Anti-HCV	2 (3.9)	1 (2.6)	1 (1.9)	88 (97.8)	37 (97.4)	51 (98.1)

HBsAg: X^2=2.799, 1; P value =0.094*; Anti-HCV: X^2=0.050*, 1; P value=0.8218

Associated risk factors

In this study, the risk factors associated with possible HBV and HCV transmission included: sexual intercourse, intravenous drug use, tattoos and body piercings ($p < 0.05$). Among the male participants, sexual intercourse (57.9%), piercing (26.3), intravenous drug use (10.5%) and surgery (10.5%) were predominant while the females engaged more in piercing (50.0%), sexual intercourse (21.2%) and injection drug use (15.4%) as shown in Figure 1.

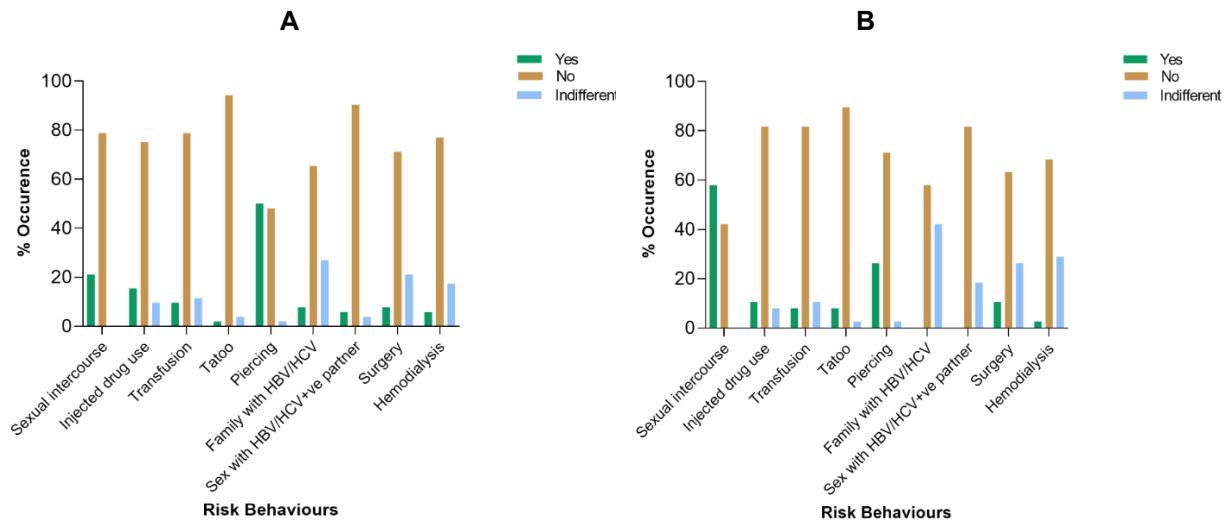

Figure 1: Prevalence of risk behaviours for hepatitis B & C viruses among males (A) and females (B)

The knowledge of hepatitis B and C infection which could influence the risk of contraction and transmission was poor among 73.3% (66/90) of the participants when compared to 26.7% (24/90) who had fair to good knowledge about the subject following the evaluation of the correct responses as shown in Table 3. A total of 11.5% (6/52) of females had good knowledge of HBV and HCV infection compared to the males with 5.3% (2/38). There was no significant difference in knowledge of hepatitis B and C infection by gender (X^2=1.068, 2; P value=0.5863).

Table 3: Knowledge categories about HBV & HCV among young university students based on gender

Knowledge Categories (score)	Knowledge about Hepatitis B & C Viruses		
	Total (N=90) N (%)	Male (N=38) N (%)	Female (N=52) N (%)
Poor knowledge (≤ 6)	66 (73.3)	29 (76.3)	37 (71.2)
Fair knowledge (7-8)	16 (17.8)	7 (18.4)	9 (2.3)
Good knowledge (≥ 9)	8 (8.9)	2 (5.3)	6 (11.5)

X^2=1.068, 2; p-value=0.5863

A good attitude towards vaccination could mitigate the risk of HBV infection and It was observed that 53.3% (48/90) of participants had a poor attitude to HBV vaccination as against 46.7% (42/90) who had fair to good attitude as shown in Table 4. Good attitude towards Hepatitis B vaccination was found in four (4) males and seven (7) females with 10.5% and 13.5% respectively. There were no significant differences in the attitude to HBV vaccination among both genders (X^2=0.2017, 2; p-value= 0.9041).

Table 4: Attitude towards HBV vaccination among young university students based on gender

Attitude Categories (score)	Attitude towards HBV vaccination		
	Total (N=90) N (%)	Male (N=38) N (%)	Female (N=52) N (%)
Poor attitude (<3)	48 (53.3)	21 (55.3)	27 (51.9)
Fair attitude (3-4)	31 (34.4)	13 (34.2)	18 (34.6)
Good attitude (≥ 5)	11 (12.2)	4 (10.5)	7 (13.5)

X^2=0.2017, 2;P value= 0.9041

Discussion

Findings from this study showed that the prevalence of HBV and HCV infection among a

subset of young adults was 2.2% (2/90) respectively. This justifies the widespread presence of these viruses that contribute to the burden of chronic liver disease in Nigeria and globally. It was necessary to determine the prevalence of HBV and HCV infection in a closed university community due to the peculiarity of these populations. The prevalence in this study was lower than the report of 4.5% and 4% as reported for HBV and HCV respectively in Maiduguri, Nigeria (18). A lower prevalence of 1.5% and 0% for HBV and HCV infection respectively was reported by Enitan *et al.* (19) among university students in south-west Nigeria. However, a higher prevalence data of 12.5% was reported for HBV infection by Dawurung *et al*. (20) among a similar population in Zaria, Nigeria. Similarly, Mabayoje *et al.* (21) reported a higher prevalence of 9.5% and 4.8% for HBV and HCV infection respectively. In Libreville Gabon, the prevalence of HBV and HCV was 3.92% and 2.94% respectively among high school learners and University students which was higher than the prevalence obtained in this study (22). Another study in Rio de Janeiro, Brazil reported a lower prevalence among urban University students reported an HBsAg prevalence of 0.14% with an anti-HCV prevalence of 0.44% which was lower than the prevalence obtained in this study (23). The differences in the prevalence data among university students could be attributed to the difference in sampling, population tested as well as sensitivity and/or specificity of the diagnostic method used.

Two persons in the age group 19-21 years were positive for HBsAg (4.3%) while negative results were reported among other age groups. This was similar to studies by Enitan *et al.* (19) who reported a 2.7% prevalence of HBV infection among undergraduate students aged 16-20 years. But differs from studies by Isa *et al.* (24) who reported a higher HBV prevalence of 13.9% among undergraduate students in Zaria, Nigeria within the age group 16-20 years. Both studies attest to priority transmission of hepatitis B infection among young adults in a university community which corroborates our study's findings. Hepatitis B and C infection has been reported to be prevalent in the younger age (16 -21 years). This could be due to association with increased vulnerability to risk factors such as increased sexual activity, use of intravenous drugs, tattooing and other social vices (25).

The gender-related prevalence of HBsAg in this study was 5.3 % among male participants while a zero prevalence was reported among female participants tested (0%). The HBsAg prevalence among male participants in this study is lower compared to the prevalence report by Imarenezor *et al*. (26) in Taraba, Nigeria who reported a prevalence of 12% among male participants. But similar to our reported prevalence of 0% among the female study participants. Likewise, the HBsAg prevalence among the males in our study is higher when compared to the work of Enitan *et al*. (19) who reported an HBsAg prevalence of 2.1% but differs in prevalence (1%) among the females. The prevalence of HCV antibodies in this study among males and female participants was 2.63% and 1.92% respectively which differs from the work of Imarenezor *et al*. (26) who reported a prevalence of 10% among males and 2% among females. This study reveals that there is no significant difference in the positivity of HBsAg and anti-HCV and gender of the participants (HBsAg: X^2=2.799, 1; p-value =0.0943, Anti-HCV: X^2=0.05072, 1; p-value=0.8218).

The prevalence of HBV and HCV among males could be attributed to some risk factors such as sexual intercourse, piercing, intravenous drug use and surgical procedures while females engaged more in piercing, sexual intercourse and injection drug use as shown in Figure 1. This implies that the exposure to HBV and HCV among this population is through similar routes. The need for advocacy and education on HBV and HCV prevention among young people which is necessary for intervention spurred the assessment of knowledge about hepatitis B and C viruses as well as attitude towards HBV vaccination which gives insight into the implied risk among this population.

In this study, knowledge of hepatitis B and C was poor among 73.3% (66/90) of the participants when compared to 26.7% (24/90) who had fair to good knowledge about both infections. There was no observed significant difference when knowledge of hepatitis B and C was considered among the different genders (X^2=1.068, 2; p-value=0.5863). The work of Deji-Agboola *et al*. (27) affirms that poor knowledge about HBV exists among undergraduate university students corroborating our findings. This implies that there is a wide knowledge gap that needs to be addressed to break the chain of transmission of HBV and HCV among young undergraduate university students. The work of Amorha *et al*. (28) agreed with the findings of this study that in a university environment, knowledge of possible transmission of HBV and HCV is crucial since the majority of the students are youths and may be subject to influence by peer pressure.

Attitude to vaccination as a means of intervention showed that approximately 47% had fair to good

attitude and knowledge of the hepatitis B vaccine. A total of 52.2% (47/90) know that they can be vaccinated at their age while 42.2% (38/90) affirm receptivity towards the HBV vaccine. There are still considerable gaps that need to be filled to educate young people who are within educational settings to aid seamless integration into the hepatitis elimination plan.

Conclusion

This study shows the prevalence of HBV and HCV among undergraduate university students in Lagos to be 2.2% respectively. The factors that contribute to the risk of infection include sexual intercourse, intravenous drug use, tattoos, and body piercings which were consistent among both genders tested. This study also reveals the contribution of knowledge about hepatitis B and C, as well as, attitudes to HBV vaccination among the population studied. Although there was no statistically significant impact of knowledge and attitude to HBV and HCV infection. This observation cannot be ignored. Hence, we strongly recommend targeted health education to students in tertiary institutions using formal approaches like teaching and informal approaches like the use of social media to engage and bring the required intervention of testing, vaccination, and advocacy which can spread to other communities of young people for a realistic elimination plan especially in Nigeria. Commitment to the use of implementation science to drive hepatitis intervention among young people is germane and will yield better outcomes than the traditional hospital-based approach.

List of Abbreviations

HBV: Hepatitis B virus
HCV: Hepatitis C virus
HBsAg: Hepatitis B surface antigen
Anti-HCV: Hepatitis C virus antibodies
ELISA: Enzyme-linked immunosorbent assay

Declarations

Ethical approval and consent to participate

Ethical approval for the study was obtained from the Caleb University Health Research and Ethics Committee following the principles of the Helsinki Declaration on human subject research with approval number CUL 23/002. Written Informed consent was obtained from the participants before the collection of samples and data. Data collected were treated with confidentiality.

Consent for publication

All the authors gave consent for the publication of the work under the Creative Commons Attribution-Non-Commercial 4.0 license.

Availability of data and materials

The data and materials associated with this research will be made available by the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

The authors did not receive any external funding for this research work.

Author contributions

AOS and ECC conceived the research idea, AOS and OAA analyzed the data and wrote the first draft of the manuscript. OFC, ACI, AOA, MPI, and YFM collected the data. The final draft has been read and approved by all the authors.

Acknowledgment

The authors acknowledge the contributions of the Doctors, Nurses, and Laboratory Scientists at the Health Services Department for their assistance in participant recruitment.

References

1. Center for Disease Control and Prevention (CDC). Viral Hepatitis Surveillance Report-United States, 2019. Atlanta, GA: May. 2021.
2. Alberts CJ, Clifford GM, Georges D, Negro F, Lesi OA, Hutin YJ, et al. Worldwide prevalence of hepatitis B virus and hepatitis C virus among patients with cirrhosis at country, region, and global levels: a systematic review. The Lancet Gastroenterology & Hepatology. 2022. https://doi.org/10.1016/S2468-1253(22)00050-4
3. Hsu Y-C, Huang DQ, Nguyen MH. Global burden of hepatitis B virus: current status, missed opportunities and a call for action. Nature Reviews Gastroenterology & Hepatology. 2023:1-14. https://doi.org/10.1038/s41575-023-00760-9
4. Ajuwon BI, Yujuico I, Roper K, Richardson A, Sheel M, Lidbury BA. Hepatitis B virus infection in Nigeria: a systematic review and meta-analysis of data published between 2010 and 2019. BMC infectious diseases. 2021;21:1-15. https://doi.org/10.1186/s12879-021-06800-6

5. Lekskulchai V. Prevalence of Hepatitis B and C Virus Infections: Influence of National Health Care Policies and Local Clinical Practices. Medical Science Monitor Basic Research. 2021;27:e933692-1. https://doi.org/10.12659/MSMBR.933692
6. Osuji A, Agbakoba NR, Ifeanyichukwu MO, Abdullahi IN, Ezeanya-Bapka CC, Duru GC. Hepatitis B virus serological profile and associated risk factors in surface antigen negative blood donors in Nigeria. Microbes and Infectious Diseases. 2021;2(3):440-50. https://doi.org/10.21608/mid.2020.33141.1025
7. Hofstraat S, Falla A, Duffell E, Hahné S, Amato-Gauci A, Veldhuijzen I, et al. Current prevalence of chronic hepatitis B and C virus infection in the general population, blood donors and pregnant women in the EU/EEA: a systematic review. Epidemiology & Infection. 2017;145(14):2873-85. https://doi.org/10.1017/S0950268817001947
8. Onyekwere CA, Hameed L. Hepatitis B and C virus prevalence and association with demographics: report of population screening in Nigeria. Tropical doctor. 2015;45(4):231-5. https://doi.org/10.1177/0049475514560211
9. Jimah E, Felix O, Ashaka O, Omoare A, Oladipo K, Agbede O. Investigation of Hepatitis C virus among blood donors in Kwara state. International Journal of Infectious Diseases. 2020;101:507. https://doi.org/10.1016/j.ijid.2020.09.1317
10. Mohammed HI, Pennap GR, Oti VB, Adoga MP. Markers of hepatitis B virus infection in a subset of young people in central Nigeria. Scientific African. 2019;5:e00121. https://doi.org/10.1016/j.sciaf.2019.e00121
11. Omolade O, Adeyemi A. Prevalence of hepatitis C virus antibody among university students in Nigeria. Elsevier; 2018. p. 228-9. https://doi.org/10.1016/S2055-6640(20)30307-1
12. Guure C, Obiri-Yeboah Laryea SM, Dery S, Baptista da Silva C, Asamoah-Adu C, Ayisi-Addo S, et al. Behavioural Risk for HIV, Hepatitis B, and Hepatitis C Infections among a Population of Drug Users and Injectors across Four Regions in Ghana. Interdisciplinary Perspectives on Infectious Diseases. 2022. https://doi.org/10.1155/2022/2544481
13. Egbe KA, Ike AC, Egbe F, Unam NF. Hepatitis B and C virus knowledge and infections in Enugu State, Nigeria. Journal of Clinical Virology Plus. 2023;3(4):100172. https://doi.org/10.1016/j.jcvp.2023.100172
14. Lemoine M, Nayagam S, Thursz M. Viral hepatitis in resource-limited countries and access to antiviral therapies: current and future challenges. Future virology. 2013;8(4):371-80. https://doi.org/10.2217/fvl.13.11
15. Salu O, Oyefolu A, Gbadegesin A, James A, Oke B, Ashaka O, et al. Co-infection of hepatitis B and C viruses among human immunodeficiency virus-infected children in Lagos, Nigeria. African Journal of Clinical and Experimental Microbiology. 2018;19(2):125-32. https://dx.doi.org/10.4314/ajcem.v19i2.8
16. Oyefolu AOB, Ashaka OS, Anjorin AA, Salu O, Akinyemi KO, Omilabu S, et al. Seroprevalence of hepatitis C virus in HIV seropositive children in Lagos, Nigeria. African Journal of Microbiology Research. 2016;10(2):62-5. https://doi.org/10.5897/AJMR2015.7737
17. Emmanuel AB, PO AS, Joshua AO, Peter AB. Seroprevalence of hepatitis B virus of university students in Kogi State, Nigeria. Indian Journal of Forensic and Community Medicine. 2019;6(4):202-7. http://doi.org/10.18231/j.ijfcm.2019.044
18. Aminu M, Okachi EE, Abubakar SM, Yahaya A. Prevalence of hepatitis B virus surface antigen among healthy asymptomatic students in a Nigerian University. Annals of African Medicine. 2013;12(1):55. http://doi.org/10.4103/1596-3519.108257
19. Enitan SS, Adebola OK, Adejumo EN, Itodo GE, Ileoma E, Oluremi AS, et al. Prevalence of Hepatitis B and C virus infection among students of a private tertiary institution in South-Western Nigeria. International Journal of Tropical Disease & Health. 2019;36(3):1-15. https://doi.org/10.9734/ijtdh/2019/v36i330144
20. Dawurung J, Bukbuk D, Ajayi B, Baba M. Prevalence of hepatitis B and C virus co-infection among students of University of Maiduguri, Nigeria. Archives of Applied Science Research. 2012;4(4):1581-4.
21. Mabayoje V, Akinwusi P, Opaleye O, Egbewale B, Fagbami A, Aboderin A. Prevalence of hepatitis B surface antigen, hepatitis C and human immunodeficiency virus antibodies in a population of students of tertiary institution in Nigeria. African Journal of Clinical and Experimental Microbiology. 2010;11(2). https://doi.org/10.4314/ajcem.v11i2.53908
22. Djoba Siawaya JF, Kouegnigan Rerambiah L. HIV, HBS, HCV, HTLV and syphilis prevalence among high school learners and university student in Libreville, Gabon. Vulnerable Children and Youth Studies. 2015;10(3):220-4.

https://doi.org/10.1080/17450128.2015.1034800
23. Pinto FP, Ferreira Jr OC, Olmedo DB, Precioso PM, Barquette FR, Castilho MC, et al. Prevalence of hepatitis B and C markers in a population of an urban university in Rio de Janeiro, Brazil: a cross-sectional study. Annals of hepatology. 2016;14(6):815-25. https://www.medigraphic.com/cgi-bin/new/resumenI.cgi?IDARTICULO=63671
24. Isa I, Aminu M, Abdullahi S, Sani M, Usman M, Esona M, et al. Seroprevalence of hepatitis B virus and human immunodeficiency virus infection among students in Ahmadu Bello University, Zaria, Nigeria. Archives of Medical and Biomedical Research. 2017;3(2):77-90. https://doi.org/10.4314/ambr.v3i2.4
25. WHO. Guidelines on hepatitis B and C testing. World Health Organization Geneva; 2017.
26. Imarenezor E, Brown S, Yakubu O, Soken D. Survey of hepatitis B and C among students of Federal University Wukari, Taraba State, Nigeria. International Research Journal of Medicine and Medical Sciences. 2016;4(3):31-7.
27. Deji-Agboola AM, Ogunbanjo OA, Osinupebi OA, Makanjuola SO. Knowledge, Attitude, Practice, and Detection of Hepatitis B Virus Infection among Fresh Undergraduate Students of Olabisi Onabanjo University, Ago-Iwoye, Nigeria. African Journal of Science and Nature. 2019;9:24-34.
28. Amorha KC, Chiebue MI, Ayogu EE, Ukoha-Kalu OB, Okonta MJ. Knowledge, Attitudes, and Practice of Undergraduate Students in the University of Nigeria Enugu campus (UNEC) towards Hepatitis B. Journal of Pharmacy and Biological Sciences. 2017;12(3):66-71.