Chapter One

Introduction

1.1 Background to the study

Hepatitis is a general term meaning inflammation of the liver and can be caused by a variety of causative agents such as hepatitis A, B, C, D, and E [1]. Of the 5 viral causes, Hepatitis B Virus (HBV) is the major cause of acute and chronic hepatitis worldwide. The HBV belongs to a family of DNA viruses called *Hepadnaviridae* and consists simply of a core particle (central portion) and a surrounding envelope (outer coat). The core is made up of the HBc antigen, whereas the envelope is made up of the HBs antigen. These viruses primarily infect liver cells. The severe pathological consequences of persistent HBV infections include the development of chronic hepatic insufficiency, cirrhosis and hepatocellular carcinoma (HCC). HBV infection occurs very often in early childhood where it is asymptomatic and often leads to the chronic carrier . Persons with chronic infection also serve as the main reservoir for continued HBV transmission. Humans are actually the only reservoir of HBV. Viral hepatitis is one of the most common diseases worldwide. The global burden of hepatitis B is severe with an estimated 350 million people or more being chronic carriers [2].

The virus is highly contagious, 50-100 times more infectious than HIV, and is transmitted between people through blood, semen, vaginal fluids and mucous membranes. The most common ways of transmission are by unprotected sex, unsafe blood transfusions, unsafe use of needles, from mother to child at birth, close household contact and between children in early childhood. HBV is unique compared to other sexually transmitted diseases, because it can be prevented with vaccine serological testing, searching for hepatitis B surface antigen (HBsAg) [3].

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All HBV infections do not give symptoms, meaning that there is a risk that people are contagious without knowing it [2]. However some people may experience acute symptoms like jaundice, fatigue, loss of appetite, nausea and/or abdominal pain. For almost all adults, 90%, the infection heals and they become healthy, but for infants and young children, there is a 90% and 30-50% risk respectively, that the infection leads to chronic hepatitis B [2]. This provides an increased risk, approximately 25% that they later in life will suffer from liver cirrhosis and/or liver cancer, if the infection is not medically managed [4].

Effective hepatitis B infection prevention is a product of high knowledge, good attitude and good practice of hepatitis B infection prevention[5]. Knowledge of hepatitis B infection prevention in this context is the awareness and understanding of the aetiology of hepatitis B infection, its transmission, clinical manifestation, diagnosis, treatment, complications, vaccination and existence of post exposure prophylaxis for the management of accidentally exposed persons[6]. Attitude towards hepatitis B infection prevention in this context is predicated on perceived susceptibility/risk, perceived severity and perceived threat of hepatitis B infection [7]. Good practice of hepatitis B infection prevention is the uptake of hepatitis B infection prevention activities such as hepatitis B screening, hepatitis B vaccination, post-hepatitis B vaccination antibody testing, changing of gloves per client, non-recapping of needles after use, prevention of NSI, and prevention of blood splashes on body.

High knowledge and good attitude towards disease prevention moderated by relevant socio-demographics, following health education have been demonstrated to be positively related to good practice of disease prevention, which is hypothesised to culminate in desirable disease prevention outcome[8].

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Acute infection manifests as acute viral hepatitis – an illness that begins with general malaise, loss of appetite, nausea/vomiting, body aches, low-grade fever, darkened urine and then progresses to development of jaundice. The incubation period is 30–180 days. Chronic infection with HBV may be either asymptomatic or may be associated with a chronic inflammation of the liver (chronic hepatitis), leading to cirrhosis over a period of several years [9].

HBV infection poses a grave public health problem worldwide, with over 2 billion people infected. An estimated 387 million are suffering from chronic HBV infection, with a rate of around 10 million new carriers each year [10].

About 90% of these cases live in developing countries and 50 million of which are in Africa. It is the tenth leading cause of death worldwide accounting for an estimated one million deaths per year worldwide. HBV may be the cause of up to 80% of all cases of hepatocellular carcinoma worldwide, second only to tobacco among known human carcinogens [11].

In Africa, Nigeria is ranked as one of the countries that is hyper-endemic for HBV infection (> 8%) [12]. Approximately nine in ten Nigerians who live with chronic HBV are unaware of their infection status, and are missing from the global public health statistics due to a lack of resources, awareness, and political will for addressing

Nigeria's HBV plight [13–15]. Consequently, Nigeria has one of the highest rates of HBV-attributable cancer in West Africa, with an age-standardised incidence estimate

of 2.6 to < 5.1 cases per 100,000 person-years [16, 17]. Hepatocellular carcinoma is a highly aggressive cancer with limited treatment options, often lacking in resource-constrained settings [18]. The lack of affordable diagnostics—for example specialised immunoassays and nucleic acid tests, as well as the out-of-pocket cost for vulnerable populations, constitute potential barriers to eliminating viral hepatitis B in Nigeria, thus making HBV a significant threat to public health.

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Nigeria, a tropical country, has been documented as highly endemic for HBV infection and about 75% of its population is likely to have been exposed to the virus at one time or the other in their lives[19]. Currently about 18 million Nigerians are infected [20]. A prevalence rate of 4.3 % was reported from Port Harcourt, 5.7% from Ilorin , 11.6% from Maiduguri and 8.3% from Zaria [21-24] Undergraduate students are majorly youths who may be sexually active. They are usually required when there is need for blood donation. Although many studies in various countries have been conducted, there have been very few attempts to evaluate the knowledge, attitudes and practice of Nigerian undergraduates regarding HBV.

1.2 Statement of the Problem

Hepatitis B infection is a highly resilient, blood-borne and sexually transmitted virus, which in chronically infected individuals can be found in high concentrations in blood, vaginal secretions and semen.

It is also a well-established fact that an unvaccinated individual stands the risk of 6% to 30% to acquire the infection on exposure to HBV contaminated blood or body fluids [25].

Undergraduate students are majorly youths who may be sexually active, this makes them more prone the viral infection.

Although, studies have been conducted in various countries, but there have been very few attempts to evaluate the awareness and attitudes of Hepatitis B virus among students in tertiary institutions in Nigeria.

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1.3 Justification of the Study

The study will highlight the extent of non-immunization of students and relate it to their awareness and attitudes towards HBV infection and Hepatitis B vaccination. This will assist the university and the university hospital to be aware of the extent of vaccination uptake, and develop strategies for promoting and improving Hepatitis B virus immunization uptake among students if coverage is found to be low.

Nigeria is in Sub-Saharan Africa where the prevalence of HBV is highest[26]. Unfortunately, Nigeria has lower vaccination rates against HBV than many Sub-Saharan African countries[27]. Therefore, HBV infection in Nigeria requires ongoing efforts towards improving identification, testing and treatment as part of routine care, along with vaccination to prevent new infections. Despite the existence of a national response to viral hepatitis, there are still a lot of people who are not aware or informed about the HBV and the need for vaccination in prevention.

Young adults are more likely to engage in behaviors and lifestyles that increase the risk of Hepatitis B infection and transmission, most of the tertiary institution students are young adults. This research will help in knowing the awareness, attitudes and vaccination status of students in tertiary institution which is populated by young adults who are at a high risk of the infection

1.4 Aims and objectives of the study

The aim is to assess the awareness and attitudes towards Hepatitis B virus and the status of Hepatitis B vaccination among students in a tertiary institution of Oyo state.

Specific objectives

i. To assess the awareness of Hepatitis B virus among students in a tertiary institution.

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ii. To determine the attitude of students towards Hepatitis B vaccination among students of tertiary institution.

iii. To determine the prevalence of hepatitis vaccination among students of tertiary institution.

1.5 Research Questions

i. What is the level of awareness about Hepatitis B among students in tertiary institution?

ii. What are the attitudes of students towards Hepatitis B infection and vaccination in tertiary institution?

iii. What is the prevalence of hepatitis B vaccination among students in tertiary institution?

1.6 Significance of the Study

Findings from this study would be very useful in diverse ways: Continual transmission of this disease could be attributed to a number of reasons including: missing of opportunities for prevention, lack of awareness about the prevalence and prevention (vaccination), misdiagnosis, absence of medical care and poor health outcomes in infected people.

Young adults are more likely to engage in behaviors and lifestyles that increase the risk of Hepatitis B infection and transmission, most of the tertiary institution students are young adults. This research will help in knowing the awareness, attitudes and vaccination status of students in tertiary institution which is populated by young adults who are at a high risk of the infection

1.7 Scope of the study

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The study will focus on the awareness and attitude of HBV among students of tertiary institution in Oyo state. The study will be conducted within Lead City University, Ibadan, Oyo State.

1.8 Limitation of the Study

Students who have been vaccinated as a child may not know their HBV status and this may reduce the prevalence reported in this study. There was hesitancy to respond to questions by most 3rd and 4th year students that were recruited into the study. However, the researcher was able to persuade them to participate in the study.

1.9 Operational Definition of Terms

Hepatitis: Hepatitis is an inflammation of the liver that is caused by a variety of infectious viruses and noninfectious agents leading to a range of health problems, some of which can be fatal. There are five main strains of the hepatitis virus, referred to as types A, B, C, D and E. While they all cause liver disease, they differ in important ways including modes of transmission, severity of the illness, geographical distribution and prevention methods.

Hepatitis B: It is a serious liver infection caused by the hepatitis B virus that's easily preventable by a vaccine. This disease is most commonly spread by exposure to infected bodily fluids.

Awareness: Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns. In this level of consciousness, sense data can be confirmed by an observer without necessarily implying understanding.

Attitude: A feeling or way of thinking that affects a person's behavior.

Vaccination: Vaccination is a simple, safe, and effective way of protecting people against harmful diseases, before they come into contact with them.

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End notes

1. World Health Organization, 2018. Hepatitis B mhGAP operations manual, pg 95, WHO/CDS/CSR/LYO 2: 6-14

2. World Health Organization. 2022. *Hepatitis B*. World Health Organization., http://www.who.int/news-room/factsheets/detail/hepatitis-b

3. CDC. Travellers' Health; Yellow Book, 2021, *Recommendations for Routine Testing and Follow-up for Chronic Hepatitis B Virus (HBV) Infection*, *CR-009837 10/2021* doi:10.1002/hep.22882

4. T. Thi Hang Pham et al, 2019, *Knowledge, attitudes and medical practice regarding hepatitis B prevention and management among healthcare workers in Northern Vietnam*: *a cross-sectional study*, **Plus one***,* doi.org/10.1371 /journal.pone.0223733.

5. A.Chauhan, Webb G, Ferguson J. Clinical presentations of Hepatitis B: *A clinical review with representative case histories. Clinics and research in hepatology and gastroenterology*. 2019.

6. S. Setia, Gambhir R, Kapoor V. Hepatitis B and C infection: *clinical implications in dental practice. European Journal of General Dentistry*. 2013;2(1):13-19. Google Scholar

7. G.U. Mustapha, Ibrahim, A., M.S. Balogun, et al, 2020 *Seroprevalence of hepatitis B virus among antenatal clinic attendees in Gamawa Local Government Area, Bauchi State, Nigeria.* **BMC Infect Dis** 20, 194. https://doi.org/10.1186/s12879-020-4863-9

8. B.I. Ajuwon, Yujuico, I., Roper, K. et al, 2021 Hepatitis B virus infection in Nigeria: a systematic review and meta-analysis of data published between 2010 and 2019. BMC Infect Dis 21, 1120. https://doi.org/10.1186/s12879-021-06800-6

9. *The Journey to hepatitis elimination in Nigeria. In: Hepatitis Foundation*: media centre, 2020. https:// www. hepb. org/ blog/ journ ey- hepat itis- elimi nation niger ia/. Accessed 29 Sept 2021.

10. *Federal Ministry of Health. National AIDS/STIS control program. 2016*. https:// www. hepb.org/ assets/ Uploads/ Nigeria- Hepatitis- Guide lines- TX- guide lines. Accessed 29 Sept 2021.

11. World Hepatitis Alliance, 2018 *Find the missing millions: barriers to diagnosis global report*. Djs research ebook.

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12. International Agency for Research on Cancer, 2018, *Cancers attributable to infections: age standardized rates (in Africa) per 100 000 individuals in 2018 attributable to infections (Hepatitis B virus), by country*. https:// gco.iarc.fr/ causes/infections/tools- map?mode= 1& sex= 0& continent= 1& agent= 2& cancer= 0& key= asr& scale= thres hold. Accessed 29 Sept 2021.

13. D. C. Martel , Georges D, Bray F, Ferlay J, Clifford GM, 2020 *Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis*. **Lancet Glob Health**. 2020;8(2):e180–90.

14. World Health Organization ebook pub, 2020, *Prevention of mother-to-child transmission of hepatitis B virus, 2020, guidelines on antiviral prophylaxis in pregnancy*,. Licence: CC BY-NC-SA 3.0 IGO.

15. I.W. Elon, Iliya J, Yaya A, Ayomikun A, Difa AJ, et al, 2020, *Dual Carriage of Hepatitis B Surface and Hepatitis B Envelope Antigen in Children in a Tertiary Health Facility in the Poorest Region of Nigeria,* 2000-2015. **Int J Virol AIDS** 7:060. doi.org/10.23937/2469-567X/1510060

16. Thomas Djifack Tadongfack et al, 2020, *Hepatitis B infection in the rural area of Dschang, Cameroon: seroprevalence and associated factors*. **Pan African Medical Journal**, 36:362. doi: 10.11604/pamj.2020.36.362.17787.

17. M. Bittaye., Idoko, P., Ekele, B.A. et al, 2019, *Hepatitis B virus sero-prevalence amongst pregnant women in the Gambia*, **BMC Infect Dis** 19, 259 , https://doi.org/10.1186/s12879-019-3883-9

18. J.A. Ndako, 2017, *Risk Factors and Prevalence of Hepatitis B Surface Antigen (HBsAg) among Apparently Healthy Volunteers in an Urban Setting, North-Central Nigeria*, **International Journal of Sciences** 03 :9-15 DOI: 10.18483/ijSci.958

19. G. Gemechu, Abagez WE, Alemayehu DH, Tesfaye A, Tadesse D, Kinfu A, Mihret A and Mulu A (2022) *Occult Hepatitis B Virus Infection Among Blood Donors in the Capital City of Addis Ababa, Ethiopia: Implications for Blood Transfusion Safety*. Front. Gastroenterol. 1:887260. doi: 10.3389/fgstr.2022.887260

20. A.A. Atalay, Abebe RK, Dadhi AE, Bededa WK 2021 *Seroprevalence of hepatitis B virus among pregnant women attending Antenatal care in Dilla University Referral Hospital Gedio Zone, Ethiopia; health facility based cross-sectional study*. **PLoS ONE** 16(3): e0249216. https://doi.org/10.1371/journal.pone.0249216

21. J. Wang, ., Liu, F., Tan, J.B.X. *et al, 2019 Implementation of infection prevention and control in acute care hospitals in Mainland China – a systematic review*. **Antimicrob Resist Infect Control** 8, 32. https://doi.org/10.1186/s13756-019-0481-y

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22. World Health Organization (WHO). Hepatitis B. Fact sheet [monograph on the internet]. 2015. [cited 2016 Mar 30]. Available from: http://www.who.int/mediacentre/factsheets/fs204/en/.

23. B.I Ajuwon, Yujuico, I., Roper, K. *et al, 2021 Hepatitis B virus infection in Nigeria: a systematic review and meta-analysis of data published between 2010 and 2019*. **BMC Infect Dis 21**, 1120. https://doi.org/10.1186/s12879-021-06800-6

24. T.M. Block , Alter HJ, London WT, Bray M. 2016, *A historical perspective on the discovery and elucidation of the hepatitis B virus. Antiviral Res*. 2016 Jul;131:109-23. doi: 10.1016/j.antiviral.2016.04.012. Epub 2016 Apr 20. PMID: 27107897.

25. Yasuteru Kondo, Masashi Ninomiya, Eiji Kakazu, Osamu Kimura, Tooru Shimosegawa, 2013 *"Hepatitis B Surface Antigen Could Contribute to the Immunopathogenesis of Hepatitis B Virus Infection",* **International Scholarly Research Notices**, vol. 2013, Article ID 935295, 8 pages, 2013. https://doi.org/10.1155/2013/935295

26. Angioletta Lasagna, Valentina Zuccaro, Paolo Sacchi, Silvia Chiellino, Raffaele Bruno, Paolo Pedrazzoli, *Risk of reactivation of occult hepatitis B during immunotherapy in cancer treatment: myth, reality or new horizons*?, Future Oncology, 10.2217/fon-2020-1196, 17, 13, (1577-1580), (2021).

27. M. Al-Mahtab, Roy, P. P., Khan, M., & Akbar, S. M. 2020. *Nobel Prize for the Discovery of Hepatitis B and C: A Brief History in Time*. **Euroasian journal of hepatogastroenterology**, 10, 98-100

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Chapter Two

Literature Review

2.1 Conceptual Review

2.1.1 The discovery of the HBV

The history of research on viral hepatitis began in 1963, when Nobel Prize winner Baruch S. Blumberg and colleagues reported for the first time publicly on the discovery of a new antigen named the Australia antigen (AuAg) [1,2,3]. In the ensuing years, AuAg become the first specific marker of viral hepatitis, identified as the hepatitis B virus surface antigen (HBsAg). After that, viral hepatitis type B became a driving force for developing modern virus diagnostics and vaccines. Blumberg's discovery was significant for two reasons: firstly, it gave a conclusive answer to the decadeold quest of countless researchers to identify a viral cause of hepatitis. More importantly, it demonstrated that millions who were asymptomatically but chronically infected across the globe are potential candidates for developing liver cirrhosis and even liver cancer [4].

A century earlier, interest in the basis of this disease had increased when, in 1865, a German physician named Rudolf Virchow described a patient with symptoms of epidemic jaundice, in whom the lower end of the common bile duct was clogged with a plug of mucus. This led to the term "catarrhal jaundice," because the disease was believed to be caused by catarrh due to mucus obstructing the bile duct. This confused the understanding of the aetiology of epidemic jaundice [5]. Initially, the diagnosis of hepatitis required the existence of the clinical features of hepatic injury and a corresponding gross diagnosis if a liver biopsy was performed. In addition, evidence

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consistent with what was then known about the natural history of hepatitis was needed through the patient's history.

In the 19th century, a genuine insight into the transmisibility of viral hepatitis emerged, with epidemics of jaundice among military and civilian populations [6].

In 1885, A. Lurman documented an epidemic of "serum hepatitis", showing that more than a thousand German ship workers, initially vaccinated with human lymph to prevent smallpox, subsequently became the victims of jaundice [7].

During the early 20th century, the research on viral hepatitis was largely descriptive in nature, with only the causes of epidemics of jaundice being identified. The first documented cases of hepatitis in patients were in 1930 with several serum transmitted outbreaks observed. The next reported case was associated with a massive epidemic of jaundice in American soldiers in 1942. This was one of the largest outbreaks reported among the U.S. Army, and had followed the administration of a yellow fever vaccine containing human serum [8,9]. As they suspected it was associated with the vaccine, it inspired several studies using human volunteers, and by the end of World War II, it was well recognised that infections of the liver were believed to be caused by several distinct viruses, which led to use of the term "viral hepatitis" [10].

In 1947, the terms "hepatitis A" and "hepatitis B" were classified by a British hepatologist named F.O. MacCallum. Hepatitis A was designated as "infectious or epidemic" hepatitis, and hepatitis B was designated as "serum" hepatitis to correspond with their observed transmission routes within this nomenclature. The development of several liver function tests during the 1950s led to the recognition of anicteric infections and the existence of chronic carriers. However, the causative agents still could not be isolated [11]. Once Blumberg and colleagues had found a specific viral marker, the vast amount of accumulated epidemiologic and clinical data, together

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with huge numbers of stored serum samples, enabled rapid progress in understanding hepatitis B, and revealed the existence of a vast population of chronically infected people in Asia and Africa [12].

In 1971, using transmission electron microscopy, David Dane and colleagues discovered HBV virions composed of the core antigen, which was surrounded by a surface antigen envelope. At this stage, it was clear that AuAg was the hepatitis B surface antigen (HBsAg). In 1974, William Robinson discovered HBV Deoxyribonucleic acid (DNA), having detected endogenous DNA polymerase activity within the virus (Reviewed by Gerlich, 2013).

2.1.2 Global Epidemiology of Hepatitis B.

The threat posed by the global HBV epidemic continues to assume alarming proportions in areas of public health and national development. Globally, two billion people have been infected with HBV at some point in time in their life time and 360 to 400 million people which represents more than 5% of the world's population are chronic carriers with an estimated 600,000 deaths each year due to consequences of HBV [14]. It is estimated to be the tenth cause of deaths worldwide [15]. Hepatitis B virus mostly affects the liver and can cause liver cancer. The disease is 50 to 100 times more infectious than the deadly human immunodeficiency virus (HIV) and can remain on part of the body for close to seven days [16].

The incidence of acute hepatitis B varies greatly from country to country as a result of insufficient reliable data and also, comparisons between countries is often difficult due to different reporting systems with limited quality [17]. The World Health Organization has therefore demarcated the world according to chronic hepatitis B prevalence into three major blocks which include high, intermediate and low prevalence. High prevalence areas have a prevalence of

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chronic hepatitis B infection that is equal to or greater than eight (8%) made up of countries from North America, South America, Sub-Saharan Africa and most Asian countries. Intermediate prevalence areas have a prevalence rate which ranges between 2% and 7% and include countries from South America, North Africa,Western Europe, Eastern Europe and the Indian subcontinent. Low prevalence areas are estimated to have a prevalence of chronic infection less than (2%) which includes most of the North American countries, Australia and most of Western Europe including the United Kingdom (UK).

Hepatitis B transmission route varies according to the prevalence rate of the virus. Countries with very high prevalence rate usually have vertical transmission as the main route of transmission which is mostly found during childhood. Countries with intermediate prevalence rates normally have horizontal transmission as its major route where the disease is transmitted through sexual contact or through injecting of drugs. In countries with low prevalence rates such as the United Kingdom, the epidemic is mostly acquired during adulthood through sexual intercourse or injecting of drugs.According to the National Institute for Health and clinical Excellence [18], chronic hepatitis infection can be treated in high income countries with the combination of drugs and that people with severe liver cases are given liver transplants in the form of surgery and chemotherapy for liver cancer patients to prolong their lives. These options are unfortunately unavailable to those in low income countries due to the expensive nature of these treatments. Hence the only option for them is to stick to the saying that, “prevention is better than cure” through the use of vaccine. It was reported that hepatitis B vaccine has an excellent record of safety and effectiveness with over one billion doses used worldwide since 1982 and that, it has a 95% capacity to prevent children and adults from contracting chronic infection if they are not already infected with the disease. Completion of the hepatitis B

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vaccination series is the safest and the most effective way of protecting against hepatitis B virus infection[19].

The World Health Organization has targeted hepatitis B as one of eight infectious diseases that should be controlled through vaccination efforts. For the purpose of propagating this agenda the WHO in 1991 instructed all countries to incorporate hepatitis B vaccination into their national vaccination programs. But as at 2006, only 164 countries have acted according to the directive with most countries coming from East and South East Asia, the Pacific, Islands, Australia,Western Europe and the Middle East [20]. Despite the fact that since 1982 there is a vaccine against HBV that gives 90-100% protection against the infection, there are in the world today more than 350 million people living with chronic hepatitis B. The consequence of this is approximately 600 000 HBV related deaths every year around the world, where the cause is primary liver cirrhosis or liver cancer [21,22]. The virus is transmitted differently between geographic regions and countries depending on how endemic the HBV is there. In regions where the endemicity is low, it is more common that the virus is transmitted through horizontal routes such as injecting drug use, highrisk sexual behaviour and receiving blood products. Whiles in regions with high endemicity, for example in Vietnam, HBV is primarily spread by vertical transmission early in childhood or perinatally from mother to child at birth [23]. In the U.S., approximately 1.4million residents are chronically infected with HBV due to the fact that during the years 1974-2008[24,25], 17.6 million people born in countries of intermediate or high prevalence of chronic hepatitis B have immigrated to the U.S. [26].

Knowledge of region- and age-specific prevalence of hepatitis B infection is important for evaluating vaccination programs and national disease prevention and control efforts. Furthermore, any modeling and assessment of the disease burden associated with the hepatitis B

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virus (HBV) requires prevalence estimates. So far, global studies on HBV seroprevalence are limited and comprehensive data are not available for many countries. In addition, demographic changes and expanded vaccination can create new epidemiological patterns of the virus which impact on region-specific endemicity levels. HBV is spread predominantly by percutaneous or mucosal exposure to infected blood and other body fluids with numerous forms of human transmission.

The consequences of HBV infection include acute and chronic infection, cirrhosis of the liver and primary liver cancer. The likelihood of progression to chronic infection is inversely related to age at the time of infection. Around 90%of infants infected perinatally become chronic carriers, unless vaccinated at birth. The risk for chronic HBV infection decreases to 30% of children infected between ages 1 and 4 years and to less than 5% of persons infected as adults [27,28].

Chronic HBV infection progresses nonlinearly through 3–4 phases, from the immune-tolerant phase to immune clearance or immunoactive phase, to non-replicative inactive phase and possible reactivation [29,30]. After infection with HBV, most patients either develop immunity (87–90%) and clear the infection or become chronic carriers. A lower percentage will develop liver disease or chronic active hepatitis with an increased risk of developing cirrhosis, liver cancer or both [31]. The fatality of these diseases as well as their attribution to hepatitis infection is well known: 600,000 HBV-related deaths were estimated to occur annually [32] and 73% of all liver cancer deaths worldwide are due to hepatitis viruses, with much higher proportions in low and middle income countries [33]. The complex serology and natural history associated with HBV infection creates challenges for the assessment of HBV prevalence and the provision of comparable global estimates. This is due to the availability of multiple laboratory markers for

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hepatitis B infection. Antibodies and antigens associated with this infection include hepatitis B surface antigen (HBsAg), antibody to hepatitis surface antigen (anti-HBs), antibody to hepatitis B core antigen (anti-HBc), and IgM antibody subclass of anti-HBc (IgM anti-HBc). Some studies also report markers of high HBV replication such as hepatitis B "e" antigen (HBeAg), antibody to HBeAg (anti-HBe), and quantitative HBV-DNA. HBsAg is the main clinical marker indicating acute or chronic infection and prevalence as well as endemicity of HBV infection which is defined by the presence of HBsAg [34]. HBsAg testing is the primary way to identify persons with chronic HBV infection and several characteristics of this serological marker increase the precision of HBsAg estimates, including high specificity, long serum persistence, low possibility of chronic cases losing HBsAg [35,36] . However, routine population surveillance of chronic viral hepatitis is currently rare. Standardized monitoring would help not only in quantifying the disease burden on a population level but also in determining the characteristics of infected individuals, avoiding further transmission and allocating appropriate treatment. This is particularly important for populous countries that have been previously categorized as highly endemic for chronic hepatitis B infection such as China, Indonesia, Nigeria as part of Africa and Asia, where an immense absolute number of people live with the virus [37,38]. However, up to date region-specific and globally comparable chronic HBV prevalence data are lacking and no relevant meta-analysis has been published on this topic. In addition, the absolute number of individuals being chronically infected with HBV is not known.

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2.1.3 Hepatitis B - Situation in the World

Despite the fact that since 1982 there is a vaccine against HBV that gives 90-100% protection against infection, there are in the world today more than 350 million people living with chronic

hepatitis B. The consequence of this is approximately 600 000 HBV related deaths every year around the world, where the cause is primary liver cirrhosis or liver cancer [40,41].

The virus is transmitted differently between geographic regions and countries depending on how endemic the HBV is there. In regions where the endemicity is low, it is more common that the virus is transmitted through horizontal routes such as injecting drug use, high-risk sexual behaviour and receiving blood products. When in regions with high endemicity, for example in Vietnam, HBV is primarily spread by vertical transmission early in childhood or perinatally, from mother to child at birth [42].

In a study made in Singapore the authors looked into the health-seeking behaviours of those infected with HBV by interviewing 39 HBV infected individuals[43]. Those who had a family member that had had HBV-related liver disease or had liver abnormality themselves, were more likely to seek help. They wanted to know if their own livers were functioning normally, but were at the same time reluctant to find out the results of a test, in fear of it. The authors concluded that the low compliance to follow-up among the patients was partly due to a widespread perception that there was no efficient treatment to the disease. Many patients preferred traditional medication such as herbs instead of western medication, which was perceived not to be as effective[44].

In a study by Mohamed and co-workers , knowledge, attitudes and practices among 483 chronically HBV infected people in Malaysia was investigated. The study showed that more than half of the participants felt worried about the diagnosis and felt anxious about spreading the HBV infection to family and friends. A third of the participants felt embarrassed to make their diagnosis public. About 11.6% reported that they would not tell their doctor or dentist about being HBV positive, while most of them would tell their family and friends. Many of the

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participants had changed their life-style habits after receiving the HBV diagnosis. A majority of those who had smoked and drunk alcohol reduced their intake-level and about half of the participants also made healthier food choices and increased their daily exercise level. A large increscent about encouraging family members to get screened for HBV was also noticed after receiving the HBV diagnosis [45].

In the U.S. approximately 1.4 million residents are chronically infected with HBV [46]. According to the fact that during the years 1974-2008 17.6 million people born in countries of intermediate or high prevalence of chronic hepatitis B have immigrated to the U.S., there is an increased burden of chronic hepatitis B in the country [47]. More than half of the estimated chronic hepatitis B cases were from the Western Pacific region, from countries such as the Philippines, China and Vietnam. These were the main countries of birth for imported cases of chronic hepatitis B. Africa was the second largest region for imported cases of chronic hepatitis B.

According to a systematic review migrants from East Asia, the Pacific and Sub-Saharan Africa represented a high seroprevalence of chronic hepatitis B, 10.3-11.3%, and migrants from Eastern Europe, Central Africa and South Asia were an intermediate seroprevalence. The seroprevalence of chronic hepatitis B was low among migrants from the Caribbean, Latin America, the Middle East and North Africa. Refugees and asylum seekers had higher seroprevalence of chronic hepatitis B compared to migrants[48].

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2.1.4 HBV Situation in Africa

Africa is on the whole considered to have a high HBV endemicity. HBV infection is hyperendemic [> 8% of hepatitis B surface antigen (HBsAg) chronic carriers in the general

population] only in some sub-Saharan countries such as Nigeria, Namibia, Gabon, Cameroon, Burkina Faso. Other countries like Kenya, Zambia, The Ivory Coast, Liberia, Sierra Leone and Senegal are considered areas of intermediate endemicity (2%-8%), while Egypt, Tunisia, Algeria and Morocco, located in the north of the continent, show a low endemicity level (< 2%)[49]. The prevalences of HBV carriers and genotype distribution in some African countries are listed in.

The endemicity level varies also in different districts and in different target groups in the same country, *e.g.*, in Burkina Faso, one of the African countries with a high endemicity, the HBV overall prevalence is estimated at around 14.5%, some authors having reported a level of 12.1% in the health district of Nanoro, 18% in blood donors of Nouna, 11% in blood donors and 9.3% in pregnant women in the district of Ouagadougou[50-54]. In Nigeria, HBsAg seropositivity is estimated at around 13.6%, but higher rates have been found in surgeons (25.7%), voluntary blood donors (23.4%) and infants (16.3%) [55-57]. In Cameroon, recent studies reported an HBV prevalence of 10.1% and 12.1% in blood donors referring to two hospital blood banks and of nearly 8% in pregnant women[58-62]. HBsAg-positive age-specific rates were estimated on a global level for 1990 and 2005 using an empirical Bayesian hierarchical model. A 12% prevalence was observed in 1990 in children and adolescents aged up to 19 years in western sub-Saharan African countries, the highest rate documented in the world in this age class, and only slightly decreasing in 2005. In southern sub-Saharan Africa, chronic HBV infection among younger age groups (0-14 years) had increased in 2005, with a prevalence of 8%-9% in females. Also in eastern sub-Saharan African countries, the HBsAg positivity rate had increased in the younger ages over time, whereas no significant changes were detected in the older age groups. An evident decrease in the HBV endemicity was observed in central sub-Saharan Africa, from a high endemicity in the aged 0-34 in 1990 to intermediate values in all ages in 2005. Also in northern Africa and the

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Middle East regions, the HBV prevalence decreased from 1990 to 2005, particularly among males aged up to 34 years[63].

Of note, the epidemiology in Africa is characterized by a much higher HBsAg prevalence in rural than in urban areas and by a greater risk for males of becoming HBV chronic carriers, with a male to female ratio ranging from 1.1:1 to 3:1 and increasing with the increase in age [64-78]. The higher percentage of HBsAgpositive males harboring HBV chronic infection may be the result of differences in tribal and sexual behaviors between males and females[79]. Compared with the adult HBsAg chronic carriers from Southeast Asia, another hyperendemic area, those from Africa show a lower rate of HBeAg positivity. In African countries, 20%-30% of subjects infected by HBV in their early childhood become chronic carriers and only 10% of them remain HBeAgpositive during adolescence. The majority of HBeAgpositive subjects lose HBeAg quickly, at an annual rate of 14%-16%[80]. As is the case in Euro-Mediterranean countries, also in Africa a large majority (> 85%) of patients with a biochemically and histologically active disease are HBeAg-negative[81,82]. In addition, the rate of HBeAg-positive cases found in HBsAg-positive pregnant women was < 1% in Ethiopia, 1.16% in Ghana, 1.39% in Nigeria, 3.3% in Zimbabwe, 4.6% in South Africa, 9.5% in Senegal, 16.1% in Zambia, and 24% in southern Tanzania [83-89]. The low rate of HBeAg positivity in HBsAg-positive pregnant women in most African countries correlates with the low rate of perinatal transmission observed in Africa[90]. The data from 18 African countries showed a median HBsAg-positive prevalence of 12.1% in human immunodeficiency virus (HIV)-infected individuals (range 3.9%-70.3%)[91]. In sub-Saharan Africa, the prevalence of patients with HIV/HBV co-infection varies from 0% to 28.4% in different studies, with a median rate of 3.8% (0%-13%) in pregnant women and 7.4% (1.2%-7.8%) in children and young adults aged from 18 mo to 17 years. Western African countries

seem to have the highest co-infection rates (median: 11.5%) in the continent, southern African countries the second highest (median 5.4%), and eastern African countries the lowest (median 4.1%) [92-96],

With a wide variation in single countries[97]. Also the prevalence of cases with occult HBV infection in HIVinfected patients varies largely across the continent, the available information, mostly from southern and western Africa, stating rates from 10% to 33% [98-103].

In African countries, children are at a high risk of acquiring HBV infection. The annual seroconversion rates to HBV markers varied from 10.2%-60.5% in children aged 1-10 years in Somalia, with the highest rate in those with a lower socio-economic condition[104]. The highest rate of children with HBV infection was 15.7% in children aged 5 and 6 years in a study from South Africa[105]. Children acquire HBV infection most frequently by parenteral horizontal transmission[106] from parents or siblings, as clearly demonstrated by phylogenetic analysis in Gambian families where HBV transmission occurred in at least two-thirds of the families investigated[107]. Unsafe sharing in the daily practices of toiletries and sharpening, cutting, scraping or scratching objects accounts for such a high horizontal transmission. In addition, cultural practices like scarification and tattooing and promiscuous sexual activity greatly increase the risk of HBV infection[108-111].

HBV transmission through the transfusion of blood or blood products still occurs and is believed to have an epidemiological impact in some areas in sub-Saharan Africa [112, 113]. Over the last decade, the United States President's Emergency Plan for AIDS Relief and the Global Fund have supported blood safety programs in 38 sub-Saharan African countries. The median percentage of HBV markers in blood donations was 7.1% in 2000/2004 and 4.4% in 2010/2011.

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From 2000/2004 to 2010/2011, 28 (82%) of the 34 reporting countries described a statistically significant decrease in HBsAg marker-reactive donations. Overall, the combined data from the 34 countries showed a 37% decrease in the HBsAg-reactive donations[114]

2.1.5 Prevalence of Hepatitis B Virus in Nigeria

2.1.5.1 Prevalence of Hepatitis B Virus Among Blood Donors

Mosley et al., suggested that anti-HBc screening of blood donations might prevent HBV transmission from HBsAg-negative blood donors that are positive for anti- HBc [115] The prevalence of OHB varies significantly between geographical regions as well as among various patient populations tested. Recent Evaluation of hepatitis B virus sero-positivity among 300 voluntary blood donors at a centralized blood service center in Nigeria by revealed that Thirty-three (13.8%) of first-time donors were positive for hepatitis B markers while all retained donors were sero-negative[116]. There were 32 (13.3%) sero- positive reactions to HBsAg and 3 (1.3%) reacted to HBeAg. In another study in Jos, Uneke and others reported a 14.3% HBsAg Seropositivity among their blood donors against a higher 25.9% among patients infected with HIV. They also noted higher infection rate of 44% in donors 51-60 years and 28% frequency within the age bracket of 31-40 years [117,118]. while studying Seroprevalence of hepatitis B e antigen (HBe antigen) and B core antibodies among hepatitis B surface antigen positive blood donors at a Tertiary Centre in Nigeria found a seroprevalence of 8.2% (22 of 267) HBeAg, 4 of 267 (1.5%) were indeterminate while 241 (90.3%) of their subjects tested negative. Only 27 out of 267 donors (10.1%) tested positive to IgM anti-HBcore, 234(87.6%) tested negative, while 6(2.2%) were indeterminate. A higher percentage of 60.7% (162 of 267) tested positive to IgG anti- HBcore, while 39.3% (105 of 267) tested negative. They concluded that there is a low

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seroprevalence rate of HBeAg-positive chronic hepatitis and relatively high IgG anti-HBcore and IgM anti-HBcore rates in South West Nigeria [119].

Another study among blood donors, in North Central Nigeria, at the Bishop Murray Medical Centre in Makurdi, age group prevalence of HBV was reported at 11.90%, 13.05% and 6.53% within the age ranges of 18-22, 23-27 and 28-32 years respectively [120]. Jeremiah and others reported a prevalence of 8.6% HBsAg in Maiduguri, Northeast Nigeria with anti HBc IgM in 18.4% suggesting that donors negative for HBsAg are not necessarily uninfected with HBV and recommended the mandatory screening of HBc in donor blood [121].

In Southwest Nigeria Salawu and others reported the occurrence of other HBV markers in HBsAg negative blood donors and recommended the inclusion of routine testing of markers such as antibody to hepatitis B core (HBC) antigen in donor blood before transfusion [122]. Japhet and his co-workers found an overall prevalence of transfusion transmissible infections of 32.6% in their study with 19.6% HBsAg positivity, 13.0% HBC antibody reaction and 8.9% hepatitis B envelop antigen (HBeAg) detection which marks infectivity of the virus and appears in blood after HBsAg [123].

In Benin City of Nigeria, Mutimer and others reported an overall 14% prevalence of TTIS. They concluded that screening of blood routinely may not reduce the incidence of HBV infections. Far in the North Eastern Nigeria, Harry and colleagues reported a high 22.0% HBsAg and 6.64% HBeAg among blood donors. They found only 11.6% and 1.39% of pregnant women subgroup of their study reactive for HBsAg and HBeAg respectively [124].

2.1.5.2 Prevalence of Hepatitis B Virus Among Pregnant Women

Adabara et al., 2012 evaluated the Prevalence of Hepatitis B Virus among Women Attending Antenatal Clinic in the General Hospital, Minna, Niger State, there results revealed that Thirteen

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(6.5%) out of the 200 subjects investigated were found to be positive for hepatitis B infection. On the basis of age, the distribution of HBV infection among the subjects revealed that the age group 20-29 has the highest rate of infection of 10.3% followed in descending order by 40-49 (4.5%), 30-39 (4.2%) and 10-19 (0.0%). The authors linked the prevalence of the virus to low level of awareness and the poor standard of living observed among the subjects carry out a cross-sectional study over a 3-month period (August-October 2009)[125]. On Prevalence and pattern of hepatitis B among 480 women attending antenatal clinics in Nnewi, Nigeria was done by simple random sampling using computer generated random numbers. Of these, 40 tested positive to HBsAg, accounting for 8.3% of the sample population. The age of the subjects studied varied from 14 to 45 years (mean age - 24.3 years) while the mean parity was 2.18. The HIV/HBV co-infection rate was 4.2%.

Agarry and Lekwot also evaluated the prevalence of hepatitis B virus surface antigen (HBsAG) and hepatitis C (HCV) antibody amongst 200 pregnant women attending ante-natal clinic in Gwagwalada, Abuja.Of the 200 blood samples tested, 19 (9.5%) and 1 (0.5%) were positive for the presence of hepatitis B and C respectively. No mixed infection of both viruses was observed in the pregnant women tested [126,127]. While studying the seroprevalence of hepatitis B virus (HBsAg) antibodies in pregnant women In Akure, Ondo State found that out of Eight hundred and sixty pregnant women. Only forty (4.7%) were positive while eight hundred and twenty (95.3%) were negative, indicating an overall prevalence of 4.7% [128].

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The prevalence of Hepatitis B Virus (HBV) carrier and infectivity status among three hundred (300) pregnant women in Makurdi were evaluated Maternal HBV infectivity status was determined by testing all HBsAg positive samples for the presence of hepatitis B e antigen (HBeAg) [129]. Overall, 33 (11%) pregnant women were identified as carriers of HBV and 10 of

the 33 (30.3%) pregnant women identified as HBV carriers tested positive for HBeAg. Hence, 3.3% of the entire study population was found to have high viral replication as well as high risk of transmitting HBV to their neonates.

2.1.5.3 Prevalence of Hepatitis B Virus Co-infections with other Disease

Rescently Ejeliogu, evaluated the Prevalence of Hepatitis B Virus Co-infected Nigerian Children (2 months to 15 years) with Human Immunodeficiency Virus[130]. Out of 452 Children that were screened, three hundred and ninety-four (87.2%) were mono-infected with HIV while 58 (12.8%) were co-infected with HIV and HBV (HIV/HBV). Egah et al while studying seropositivity to hepatitis B, C and the human immunodeficiency viruses among clergy men in training, in a seminary in Jos, found a 15.5% hepatitis B surface antigen positive reaction among their subjects who were a low risk blood donor group[131]. They also documented a crude transfusion transmissible infection prevalence of 22.1% and HIV/ HBV co-infection rate of 0.4% in their study .

In the year 2011 Omalu., evaluated the Seroprevalence of Malaria and Hepatitis B (HBsAg) with Associated Risk Factors among Pregnant Women Attending Antenatal Clinic in General Hospital Minna, North-Central Nigeria. Out of the 269 pregnant women screened 216(80.30%) were positive for malaria, 22(8.18%) for hepatitis B and 21(7.81%) were co-infection of malaria and hepatitis B and 10 were negative, while non-pregnant women had 51(51.00%), 8(8.00%) and 6(6.00%) for malaria, hepatitis B and co-infection of both out of 100 screened found out that out of 1535 sampled individuals analyzed for Hepatitis B Virus (HBV), 1319 (85.9%) showed a serological evidence of exposure to HBV infection, some through natural infection (22.7%) and others (13.0%) through vaccination; 12% of the exposed were inferred to be currently infected and 91.2% chronically infected. Hepatitis delta virus (HDV) antigen was also detected in 2.7%

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of the HBsAg positive individuals; and was encountered more (6.7%) in those with acute hepatitis than those with chronic disease[132,133].

Jibrin & Mustapha, screened, two hundred consecutively recruited HIV-infected individuals comprising 97 males and 103 females for HBsAg using ELISA[134]. A total of Fifty-three of the patients tested positive for HBsAg giving an overall prevalence rate of 26.5% which was significantly higher ($p < 0.001$) than the 10.4% recorded among non-HIV-infected individuals. Co-infection rate in males (24.7%) did not differ significantly from that of females (28.2%). Co-infection was highest in the 40-49 years age group (41.6%), while no case of co-infection was recorded in the ≤ 19 years. Among the different occupational groups businessmen had the highest co-infection rate (44%) followed by long distance drivers (39.5%). In relation to marital status, divorcees/widows had the highest.

Proportion of those with coinfection (53%) followed by those who were unmarried (32.5%) and those married (21.6%). The authors confirm the high prevalence rate of HBV co-infection in HIV-infected patients compared to the non-HIV- infected population. Therefore, there is a need to screen all HIV-infected patients for HBV infection.

Among patients in Lagos State University Teaching Hospital (LASUTH), Dual presence of HBsAg and anti-HCV was observed in 4(3.9%) of HIV infected patients, while 29(28.4%) and 15(14.7%) were repeatedly reactive for HBsAg and anti-HCV respectively[135]. HIV negative blood donor controls have HBsAg and anti-HCV prevalence of (22) 6.0% and (3) 0.8% respectively. The prevalence of hepatitis co infection is higher among the male study patients 16(50%) than the female32 (45.7%). Salawu et al. studied the Prevalence and trends of HBsAg, anti-HCV, anti-HIV and VDRL in blood donors in the last three and a half years in a tertiary health care facility in Ile-Ife, Nigeria[136]. The screening records of all blood donors from January

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2006 to June 2009 were evaluated with respect to screening outcome for HBsAg, anti-HIV, anti-HCV and VDRL. Of the total 14,500 donors bled, 7.50% were positive for HBsAg, 0.96% for anti- HIV, 0.86% for anti-HCV and 2.61% for VDRL. There was a gradual decline in the prevalence rate of HBsAg from 9.20% in 2006, to 8.37 in 2007 and 6.25% in 2008; with a rise in the first half of 2009 to 6.32%. Similarly, HIV prevalence declined from 1.44% in 2006 to 0.94% in 2007 and 0.66% in 2008 but rose to 0.96% in the first half of 2009. HCV prevalence fluctuated throughout the period under study. Prevalence of syphilis declined from 2.93% in 2008 to 1.92% in 2009.

It was evaluated the sero-prevalence of HCV in HIV sero-positive children in Lagos, Nigeria. A total of 132 blood HIV sero-positive children aged 1-15 years were serological assay for HCV. Out of the 132 HIV sero-positive samples, 6 were positive for HCV with a prevalence of 4.54% Zero prevalence was recorded between age groups 1-3 years while a sero-prevalence of 20% was found among age groups 12-15 years. Ejeliogu et al., evaluated the Prevalence of Hepatitis B Virus Co-infected Nigerian Children (2 months to 15 years) with Human Immunodeficiency Virus[137]. Out of 452 Children that were screened, three hundred and ninety-four (87.2%) were mono-infected with HIV while 58 (12.8%) were co-infected with HIV and HBV (HIV/HBV).

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Similarly, it was evaluated the prevalence of HIV-HBV- patients in Kano State and find out that 54/440 were HB-HIV coinfected [139], also evaluated the prevalence of HIV-HBV- patients in Kano State and find out that 211/300 were HB-HIV coinfected Udeze et al. (2015), evaluated the prevalence rate of HB and C infections among HIV-infected patients accessing healthcare at HIV and AIDS section of University of Ilorin Teaching Hospital, Ilorin, Nigeria. Of the 356 HIV-infected participants, 114 (32.0%) and 14 (3.9%) were respectively positive for HBsAg and anti-HCV antibody.

2.1.5.4 Prevalence of Hepatitis B Virus Among Healthy Individuals

James et al., carried out a study to assess the sero-prevalence of hepatitis B surface antigen (HBsAg) and associated risk factors among students of a secondary school in Jagindi Tasha, Kaduna State, Nigeria. Out of One hundred and ninety (190) apparently healthy students that were screened for HBsAg, 35 (18.4%) were sero-positive. Subjects aged 13-15 years recorded 6.8% positivity and male subjects had 25.5% positivity compared to 10.9% positivity for females. Risk factors such as blood transfusion was 32.0% among male subjects compared to 30.0% in females[140].

Evaluation shows the prevalence of Hepatitis B virus infections in apparently healthy urban Nigerians. Of the 1,891 participants, 957 (50.6 %) were males and 934 (49.4%) were females. Overall 114 (6.0%) were positive, of whom 71 (7.4%) were males and 43 (4.6%) females. Those aged 21–30 years had the highest infection rate, and males were more likely to be infected with the virus than females. According to Gambo et al. out of 182 Fulani nomads in Toro, North-Eastern Nigeria the gender-specific seroprevalence of HBsAg was found to be in the ratio of about 2:1 male-female. Infection rate was found to be higher in those between 25 and 29 years (8.2%) followed by those the age group 30-37 years (6.0%)[141].

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Five hundred and ninety-five consecutively recruited voluntary blood donors in Yola, Nigeria that were screened for hepatitis B and hepatitis C virus infections. Only 14 donors (male) each (2.4%) were positive for HBsAg and anti- HCV. The authors concluded that the seroprevalence of hepatitis B and C virus infection is low among voluntary blood donors in Yola, Nigeria, evaluated the Prevalence of Hepatitis B surface Antigen among the Newly Admitted Students of University of Jos, Nigeria. Out of the 300 newly admitted students that were screened, 50 (16.7%) were seropositive to HBsAg. The prevalence of HBsAg was higher in males 34(11.33%) compared to 16(5.33%) in females[142]. Age specific prevalence was significantly higher in the age bracket 25-29, with 16(28.57%) and the lowest was found in the age bracket 15 -19 years with 12(17.39%).

In a study conducted , a total of 188 Health personnel, which constitutes Nurses, Doctors, Medical Laboratory Scientists, Technicians/Assistants, Pharmacists and Ward Assistance in Uyo Metropolis, were screened for HBV surface antigen (HBsAg). Out of the one hundred and Eighty-eight (188) respondents screened. Thirty-two (32) representing 17.0% were found to be seropositive, female subjects recorded (17.3%) prevalence compared to (16.7%) recorded by the Male subjects. Frank et al., 2004 carried out epidemiology study of HBV infection among 124 unvaccinated Dutch missionaries and family members who lived in a rural area of Nigeria. Antibodies to hepatitis B core antigen were found in 5 (9.8%) of 51 adults (incidence rate, 1.7 per 1000 person-months at risk [PMAR]) and 9 (12.3%) of 73 children (incidence rate, 2.8 per 1000 PMAR)[143].

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2.1.6 Clinical Features

Hepatitis B shows variable clinical manifestations ranging from asymptomatic HBV carriers to fulminant liver failure, and it becomes chronic, often progresses to chronic hepatitis, cirrhosis, and hepatocellular carcinoma[144]. These clinical manifestations may vary depending on their age at infection, showing symptoms in less than 10% of children under 5 years old, while causing symptoms of the infection in 30 to 50% in adults[145]. The risk of chronic HBV infection varies inversely with age; 80 to 90% of neonatal infections, 30 to 60% of infants, 5% or less of adults[146]. The majority of cases of vertical transmission from mother progresses to chronic carriers.

The incubation period for the onset of acute hepatitis B is 3 to 4 months, showing prodromal symptoms such as fatigue, fever and anorexia, which are similar to other viral

hepatitis. Serum-sickness syndromes such as joint pain and rash were observed in about 10% of patients[147]. Jaundice occurs at 1 or 2 weeks after the onset of symptoms, and clinical symptoms are improved in the majority of cases within 3 months. Fulminant hepatitis, accompanied by hepatic encephalopathy is complicated in 0.5% of cases in adult patients[148]. In most cases of acute hepatitis B, HbsAg disappears within 6 months and liver function is recovered. When the virus persists longer than 6 months, it becomes a chronic state. The natural history of chronic hepatitis B is determined by the immune response and viral replication.

The initial phase of perinatally acquired infections is characterized by high levels of virus replication with no evidence of active liver disease with normal transaminase levels due to immune tolerance[149]. The second phase of perinatally acquired chronic infection, immune clearance phase, is characterized by high levels of virus replication with active liver disease. Fibrosis of the liver can develop during this phase, which can lead to cirrhosis. During the immune clearance phase, seroconvesion of HBeAg and decrease in HBV DNA level may occur, hereafter staying as 'inactive HBV carriers' with low viral load and normal liver function[150].

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Some patients show repeated increase in virus levels and necroinflammation, progressing to cirrhosis or liver cancer over a long period of time[151]. The clinical course of hepatitis B is determined by the interaction of viral replication status and host immune response. Otherwise, it can be worsened by the factors such as alcohol and coinfection with other viruses. The risk of progression to decompensated liver disease or the incidence of liver cancer increases with high viral replication status and the risk is higher in patients with cirrhosis than hepatitis[152]. It has been known that the risk of liver cancer is increased further in patients with older age, family history of liver cancer or cirrhosis, alcohol and the coinfection of hepatitis C virus[153]

2.1.7 Stages of Hepatitis B Virus Infection

There are three stages of hepatitis B virus infection which include; Acute, fulminant and chronic stages of hepatitis B virus infection.

2.1.7.1 Acute HBV Infection

Acute HBV infection can be either symptomatic or asymptomatic; the latter is more common, especially in infants and young children. Acute infection runs a self-limited course and recovery is marked by hepatitis B surface antibody (anti-HBs) seroconversion. In symptomatic patients, the prodromal symptoms, including general malaise, anorexia, nausea, vomiting, and fever, may persist for several days to weeks. Some cases may have jaundice with or without light yellow stool. Hepatomegaly with tenderness on right upper quadrant of abdomen is typical; however, splenomegaly is uncommon. Alanine aminotransferase (ALT) levels do not increase until after

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viral infection is well established because time is required for virus-specific cytotoxic T lymphocytes to develop against HBV-infected hepatocytes.

In acute hepatitis B, HBsAg is the first marker detectable in the blood after an incubation period of 4 – 10 weeks, followed shortly by anti-hepatitis B core antibodies (HBc), which are predominantly of the immunoglobulin (IgM) type in the early phase. Viremia is established by the time HBsAg is detected, and the level of HBV DNA in acute infection is very high, frequently in the range of 109–1012 copies/mL (108–1011 IU/mL). Circulating HBeAg can be detected early but is cleared rapidly in patients with acute hepatitis B, and anti-hepatitis B surface antibodies (HBs) appear within 6 months of disease onset in most patients. Patients with acute hepatitis B usually recover completely from the liver damage with the development of lasting immunity to reinfection.

However, with the development of sensitive assays for HBV DNA, it has been determined that low levels of HBV DNA may persist in the blood for up to 10 years in some patients, despite the presence of anti-HBs and specific cytotoxic T lymphocytes (Yotsuyanagi et al.,1998). These observations suggest that HBV may not be completely eradicated after recovery from acute hepatitis, which supports reports of reactivation of HBV replication in patients with anti-HBs who receive chemotherapy or immunosuppression after organ transplantation[154].

2.1.7.2. Fulminant Hepatitis B

Fulminant hepatitis B is considered in people who develop signs of liver failure, including coagulopathy, increasing bilirubin levels with declining aminotransferase levels, and a decreasing liver size, with or without hepatic encephalopathy, within 8 weeks after the initial symptoms of HBV[155]. Bernuau and colleagues defined fulminant hepatitis as hepatic encephalopathy developing 2 weeks after the onset of jaundice and subfulminant hepatitis as

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hepatic encephalopathy developing between 2 and 12 weeks after the onset of jaundice [156]. The incidence of fulminant hepatitis B is higher in infancy than in other age periods [157]. As the diagnosis of hepatic encephalopathy is difficult to establish in infants aged less than 1 year, the presence of hepatic encephalopathy is not an absolute requisite for fulminant hepatic failure in this age group [158]. Fulminant hepatitis B can occur as early as 2 months of age in infants of HBsAg-positive mothers [159]. Maternal transmission is the most important route in infants with fulminant hepatitis B, especially in those of HBeAg seronegative mothers [160]. The mortality rate for infants with fulminant hepatitis B is high; 67% of affected infants die without liver transplantation [161]. Regarding older children or other age groups with fulminant hepatitis B, HBV infection occurs via a horizontal route (i.e., blood transfusion), which could potentially be prevented by vaccination or blood products screening [162].

2.1.7.3 Chronic HBV Infection

The natural course of chronic HBV infection, which is defined as persistence of HBsAg for more than 6 months, consists of three to four phases, according to the serum hepatitis B envelope antigen (HBeAg) and HBV DNA status.

Phase 1: Immune Tolerance Phase

Patients with chronic HBV infection have an initial immune tolerance state, which is characterized by the presence of HBeAg and high levels of HBV DNA due to rapid viral replication. The host is highly infectious, and an important source of horizontal infection in the family. During this phase, the host is usually asymptomatic and aminotransferase levels are usually normal, or mildly elevated. This phase is mostly seen in patients infected at birth or during early childhood. Infected persons do not mount effective immune responses and exhibit immune tolerance, which leads to a high risk of chronicity in adulthood. Despite high levels of

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HBV DNA, liver damage in this phase is absent or minimal as a consequence of T cell immune tolerance to HBeAg and hepatitis B core antigen (HBcAg) [163]. Mechanisms underlying this immune tolerance are not well understood. During this phase, positivity of HBeAg and high HBV DNA levels in blood can persist for years after primary infection.

Phase 2: Inflammatory (Immune Active) Phase

When the host immune system becomes mature and begins to recognize HBV related epitopes on hepatocytes, immune-mediated viral clearance and hepatocyte damage begin [164]. This phase, which lasts from several months to many years, is characterized by HBeAg positivity, high levels of HBV DNA, but no elevated serum aminotransferase levels, and active inflammation of the liver. In patients with perinatal or early childhood infection, transition from immune tolerance to immune clearance occurs mainly during the second or third decade of life [165].

Patients in the HBe seroconversion stage mostly remain asymptomatic, or have mild nonspecific symptoms such as general malaise, poor appetite, etc., making it difficult to detect the beginning of immune clearance. Serum ALT levels become elevated and fluctuate depending on the severity of liver damage during the virus–host interaction process. The peak levels of ALT often vary and are mostly <600 international unit per mil (IU/mL.) Active inflammation and hepatocyte damage are common histologic findings, but liver cirrhosis occurs uncommonly during childhood. Only 3.4% of 292 Italian HBsAg carrier children with elevated ALT were found to have liver cirrhosis at presentation [166].The HBe seroconversion process, implying that the host loses the immune tolerance, varies in different individuals and is affected by age and maternal HBsAg status [167]. Some patients present with a flare of hepatitis followed by the disappearance of HBeAg and the presence of antibodies against HBeAg (anti-HBe); some have transient decreased HBV DNA levels without the clearance of HBeAg. In general, it takes

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around 2–7 years for the process of HBe seroconversion to occur. The annual HBe seroconversion rate is less than 2% before the age of 3 years in a Taiwanese cohort; after 3 years of age, the annual HBe seroconversion rate gradually increased to about 5% [168].

Phase 3: Low Replication Phase (Inactive Carrier State)

After HBeAg seroconversion, most patients remain positive for anti-HBe antibodies and have gradual normalization of serum ALT levels. Patients in this phase are commonly referred to as "inactive HBsAg carriers." HBV DNA can only be detected in 1% of anti-HBe-positive patient using the less sensitive hybridization method but can be persistently detected in sera, usually at less than 104 copies/mL, in the long term by assays that use the polymerase chain reaction (PCR). In an Italian study, 87% of 37 children after HBeAg seroconversion had detectable HBV DNA by PCR at 5-year follow-up and 58% had HBV DNA at 10-year follow-up [169]. Histologicallyminimal ormild hepatitis may be observed in children after HBeAg seroconversion. Reactivation of HBV replication and a rise in ALT levels are not common in this phase in children; however, permanent liver damage and integration of the HBV genome may develop insidiously and gradually despite clearance of HBeAg. The subsequent development of liver cirrhosis or hepatocelular carcinoma (HCC) is rarely observed but may happen during childhood [170]. In general, however, around 80% of childhood HCC occurs in children with anti-HBe antibodies [171]. In an Italian long-term follow-up study for 29 years, the overall prognosis in horizontally infected children after HBeAg seroconversion showed that 2% of them progressed to HCC and 6% had HBeAg-negative hepatitis [172].

Phase 4: Reactivation Phase (Hbeag Negative Chronic Hepatitis B)

HBeAg seroconversion is generally considered as a good event indicating the cessation of liver inflammation and the beginning of an immune inactive status with low viral replication and

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minimal liver inflammation. However, HBeAg negative hepatitis is an important cause of liver injury after HBeAg seroconversion in adults. Subsequent reactivation of chronic hepatitis B occurs in up to one-third of inactive adult HBV carriers without reversion of HBeAg [173].

This phase is characterized by the absence of HBeAg, the presence of anti-HBe antibodies, detectable HBV DNA levels (<104 copies/mL), serum ALT elevations, and histologically continuous necro inflammation of the liver. Most patients progress to this phase after a variable duration in the inactive carrier state, but some directly progress into this phase from immune clearance phase [174]. Selected HBV variants that cannot express HBeAg because of mutations in the precore or core regions of the HBV genome are thought to be the cause of HBeAgnegative chronic hepatitis [175]. The significance of HBeAg seroconversion occurring in childhood and young adulthood is clarified after a long-term follow-up study of 7–23.7 years [176]. In contrast to HBeAg seroconversion in adults, most children who underwent HBeAg seroconversion early had decreased viral loads, normal ALT levels, and uneventful courses after the HBeAg seroconversion.

A prospective follow-up study of children with chronic hepatitis B showed that only 4.3% of 140 HBeAg seroconverters had re-elevated ALT after seroconversion [177]..

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2.1.8 Prevention of Hepatitis B

Preventive measures of HBV infection include the avoidance of high-risk behaviors, the prevention of exposure to blood and body fluids, the screening of women in pregnancy for HBV, active immunization or passive immunization before or after exposure. There are active immunization method using vaccines and passive immunization with HBIG.

Active Immunization

Types of Vaccines

Plasma vaccines isolated from HBV carriers have been used since 1980s. The plasma vaccines were developed in the early days of vaccines in Korea, and plasma vaccines was used from 1983 [178]. Plasma vaccines produce good immunogenecity and they are effective and safe. However, they are rarely used in recent years due to the shortage of

plasma of HBsAg carriers, the concerns for the safety of blood product, and the development of recombinant DNA technology. Recombinant DNA vaccines are produced by introducing HBsAg into yeast or mammalian cells (CHO; Chinese Hamster Ovary cell)[179]. Antibody conversion rates and geometric means of the generated antibody titers by recombinant vaccines are similar to the plasma vaccines[180]. Combination vaccines containing a hepatitis B vaccine component are developed. These include DTP-HepB vaccine, DTP-Hib-HepB vaccine, DTP-Hib-inactivated poliovirus vaccine-HepB vaccine, Hib-HepB vaccine, and hepatitis A-HepB vaccine[181,182].

Vaccine Dose and Method

Hepatitis B vaccine includes 20 µg of surface antigen for adults, and 10 µg for children. The vaccine should be given by intramuscular injection in anterolateral aspect of thigh of infants and children less than 2 years of age, and in the deltoid muscle of older children, adolescents, and adults. Injection in the buttocks is not recommended because of the possibility of subcutaneous inoculation into deep fat tissue, which is associated with decreased protective antibody levels[183]. There is no interference effect of simultaneous vaccination with any other vaccines, and in this case, injection site should be in other parts or at least 1.5 cm apart from the hepatitis B vaccine inoculation site.

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Hepatitis B vaccine is generally administered in three doses, with the second dose given one month after the first dose and the third dose given six months after the first dose. Vaccines from the other manufactures can be used interchangeably. If the series is interrupted after the first dosem the second dose should be given as soon as possible and the second and third doses should be separated by an interval of at least 2 months. If the third dose is delayed, it should be given as soon as possible. It is not necessary to restart the vaccine series when there has been prolonged interval
between the doses [184,185].

Vaccination shall be given at 0, 1, and 6-month intervals. A second vaccination shall be given at one month after the first vaccination, and in case of missing the vaccination schedule, without having to start again, it shall be given right away, and a third vaccination shall be given at the interval of two months or more after second vaccination.

Storage and Safety of Vaccines

Most hepatitis B vaccines should be kept in 2-8℃ storage temperatures, and the efficacy is maintained at least 4 years. Vaccine efficacy is maintained at room temperature and can be stored for up to one year. Vaccine should not be frozen because the freezing causes the HbsAg protein to dissociate from the alum adjuvant and lose immungenicity[186].

Serologic Testing

Serologic testing is not indicated before routine vaccination of infants or children. Screening test in adults is considered in the endemic area of HBV infection or in the groups with a high risk of HBV infection. Serologic test following vaccination in healthy adults is not recommended. However, antibodytests should be considered in health care workers who are at the high risk of

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infection or in the cases of hemodialysis patients, HIV-infected patients, and spouses of hepatitis B patients. Post-vaccination testing should be performed 1-2 months after completion of the vaccine series.

Vaccine Non-responder

Anti-HBs response less than 10 mIU/mL after completion of the first vaccine series is called 'nonresponders'. Re-vaccination is recommended in the nonresponders. Administration of a single dose of vaccine, followed by measurement of anti-HBs antibody response 1-3 months later to differentiate anamnestic response. For persons who are seronegative after the booster dose, a second vaccine series of two additional doses, which result in seroconversion in 50 to 60% of recipients[187]. Generally, additional vaccination is not recommended to the complete nonresponders who do not achieve the appropriate antibody level even after a total of 6 times of vaccinations. HBIG should be administered when they are exposed to HBV.

Adverse Reactions

Hepatitis B vaccine is safe and mild side effects appear within 24 hours, showing fever in 1-6%, injection site pain in 3-29%, redness and mild swelling in 3%, and headache in 3%. Arthritis, multiple sclerosis, diabetes, Guillain-Barre syndromes have no direction association to the hepatitis B vaccination[188-190]. Hypersensitivity to vaccine components, such as yeast, can cause anaphylaxis[191].

Indications

Comprehensive HBV immunization strategies prevent chronic HBV infection acquired in all age groups. In the past, vaccination to all newborns was performed mainly in the hepatitis B prevalent areas, but since 1997, hepatitis B

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vaccinations to newborns are being performed worldwide regardless of the prevalence of hepatitis B. Currently, vaccinations to all newborns are being performed and even in adults, catch-up vaccination is recommended in case of unvaccinated person without anti-HBs.43,54 It should be particularly recommended to high-risk groups of hepatitis B [194].

Contraindications

The vaccination is contraindicated in those who have a history of hypersensitivity to vaccine components or who have experienced severe side effects after the hepatitis B vaccination previously. There is limited data on the safety of hepatitis B vaccine for pregnant woman, however, there is no apparent adverse effect to fetus. Therefore, pregnancy or breast feeding are not a contraindication to vaccination[195]. The vaccine can be given to immunocompromised patients, but the antibody response to the vaccination is lower than in healthy people[196].

Passive Immunization

Hepatitis B vaccination not only prevents hepatitis B but also can attenuate the severity of illness or inhibit the progress toward chronic phase even if they have already been infected and in the incubation period during vaccination. HBIG is recommended for postexposure prophylaxis in the setting of perinatal exposure, percutaneous or mucous membrane exposure to HBV, and sexual exposure to an HBV carrier. It is also used to reduce the risk of recurrent HBV infection after liver transplantation[197]. HBIG is prepared from human plasma of those who contain a high titer of anti-HBs. HBIG is effective in preventing clinical hepatitis B or chronic infection, if used shortly after exposure to HBV [198]. One of the major uses of HBIG is as an immuonprophylaxis in preventing perinatal HBV transmission. It has been reported that immunoprophylaxis with both

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HBIG and hepatitis B vaccine could increase the efficacy of preventing perinatal HBV transmission to 85% to 95% and provide long-term protection [199,200]. HBIG in indicated for postexposure prophylaxis after needle stick injury or percutaneous exposure. In cases of the percutaneous and mucosal exposure to blood or body fluids, such as HBsAg-positive needle stick, the prophylactic procedures vary depending on the vaccination status of the exposed person and the status of antibody. The persons who have anti-HBs after vaccination do not need the vaccine or HBIG. In unvaccinated cases, HBIG 0.06 mL/kg, up to 5 mL is given by intramuscular injection. and the first dose of vaccine should be given within 24 hours after exposure. In nonresponders, restart the vaccination after the injection of HBIG immediately.

In nonresponders who did not complete re-vaccination after the primary vaccination, it is better to start again after 1 time of HBIG injection. In nonresponders even after 3 times of re-vaccination, it is preferred to perform 2 times of HBIG injection.

2.1.9 HBV Transmission

HBV is spread through contact with infected body fluids and the only natural host is human. Blood is the most important vehicle for transmission, but other body fluids have also been implicated, including semen and saliva [201,202]. Currently, three modes of HBV transmission have been recognized: perinatal, sexual and parenteral/percutaneous transmission. There is no reliable evidence that airborne infections occur and feces are not a source of infection. HBV is not transmitted by contaminated food or water, insects or other vectors.

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Perinatal Transmission

Transmission of HBV from carrier mothers to their babies can occur during the perinatal period, and appears to be the most important factor in determining the prevalence of the infection in high endemicity areas, particularly in China and Southeast Asia. Before HBV vaccine was integrated into the routine immunization program, the proportion of babies that become HBV carriers is about 10-30% for mothers who are HBsAg-positive but HBeAg-negative. However, the incidence of perinatal infection is even greater, around 70-90%, when the mother is both HBsAg-positive and HBeAg-positive [203,204]. There are three possible routes of transmission of HBV from infected mothers to infants: transplacental transmission of HBV in utero; natal transmission during delivery; or postnatal transmission during care or through breast milk. Since transplacental transmission occurs antenatally, hepatitis B vaccine and HBIG cannot block this route. Epidemiological studies on HBV intrauterine infection in China showed that intrauterine infection occurs in 3.7-9.9% pregnancy women with positive HBsAg and in 9.8-17.39% with positive HBsAg/HBeAg and it was suggested that a mother with positive HBeAg (OR = 17. 07) and a history of threatened premature labor (OR = 5. 44) are the main risk factors for intrauterine infection[205-212]. The studies on transplacental transmission of HBV suggested two possible mechanisms (1) hemagenous route: a certain of factors, such as threaten abortion, can make the placental microvascular broken, thus the high-titer HBV maternal blood leak into fetus' circulation [213-215]; (2) cellular transfer: the placental tissue is infected by hightiter of HBV in maternal blood from mother's side to fetus' step by step, and finally, HBV reach fetus' circulation through thevillous capillary endothelial cells[216-220].

For neonates and children younger than 1 year who acquire HBV infection perinatally, the risk of the infection becoming chronic is 90% [221], presumably because neonates have an immature

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immune system. One of the possible reasons for the high rate of chronicity is that transplacental passage of HBeAg may induce immunological tolerance to HBV in fetus.

Sexual Transmission

Sexual transmission of hepatitis B is a major source of infection in all areas of the world, especially in the low endemic areas, such as North America. Hepatitis B is considered to be a sexually transmitted disease (STD). For a long time, homosexual men have been considered to be at the highest risk of infection due to sexual contact (70% of homosexual men were infected after 5 years of sexual activity)[222]. However, heterosexual transmission accounts for an increasing proportion of HBV infections. In heterosexuals, factors associated with increased risk of HBV infection include duration of sexual activity, number of sexual partners, history of sexual transmitted disease, and positive serology for syphilis. Sexual partners of injection drug users, prostitutes, and clients of prostitutes are at particularly high risk for infection [223].

Parenteral/Percutaneous Transmission

The parenteral transmission includes injection drug use, transfusions and dialysis, acupuncture, working in a health-care setting, tattooing and household contact. In the United States and Western Europe, injection drug use remains a very important mode of HBV transmission (23% of all patients) [224]. Risk of acquiring infection increases with duration of injection drug use. Although the risk for transfusion-associate HBV infection has been greatly reduced since the screening of blood for HBV markers and the exclusion of donors who engage in high-risk activities, the transmission is still possible when the blood donors are asymptomatic carrier with HBsAg negative [225]. Obvious sources of infection include HBV-contaminated blood and blood products, with contaminated surgical instruments and utensils being other possible hazards. Parenteral/percutaneous transmission can occur during surgery, after needle-stick injuries,

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intravenous drug use, and following procedures such as ear piercing, tattooing, acupuncture, circumcision and scarification. The nosocomial spread of HBV infection in the hospital, particularly in dialysis units, as well as in dental units, has been well described, even when infection control practices are followed[226]. As with other modes of transmission, high vial titers have been related to an increased risk of transmission. People at high-risk of infection include those requiring frequent transfusions or hemodialysis, physicians, dentists, nurses and other healthcare workers, laboratory technicians, intravenous drug users, police, firemen, laundry workers and others who are likely to come into contact with potentially infected blood and blood products.

The risk of chronicity is low (less than 5%) for transmission through sexual contact, intravenous drug use, acupuncture, and transfusion[227]. Individuals at risk for these transmission modes usually acquire HBV infection during adolescence or adulthood without immune tolerance. Instead, the disease progresses directly to the immune clearance phase and is of short duration, which probably accounts for high spontaneous recovery.

2.1.10 Diagnostic Investigation for Hepatitis B Virus Infection

The following are investigation carried out to diagnose or confirm hepatitis B virus infection.

- Radioimmuno assay to detect hepatitis B surface antigen (HBsAg).
- Radioimmuno assay to detect antibody to hepatitis B core antigen (anti-HBc).
- Radioimmuno assay to detect antibody to hepatitis B surface antigen (anti-HBs).
- Liver function test. (Test for serum transferase levels (Aspartate aminotransferase (AST),
- Alanine aminotransferase (ALT)}
- Blood Clotting test.

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- Viral load
- Ultrasonography

2.1.11 Treatment/management of Hepatitis B Virus Infection

Acute hepatitis B has no specific treatment. Care is aimed at maintaining comfort and adequate nutritional balance, including replacements of fluid that has been lost through vomiting and diarrhoea. Chronic hepatitis B can be managed rather than treated. Some of the general management strategies for HBV recommended by medical experts include;

Avoidance of:

- heavy alcohol consumption.
- unprotected sexual intercourse with partners who are not vaccinated.
- sharing of needles or other items that potentially contain blood such as shavers or toothbrushes
- donation of blood or organs

Screening of family members and sexual partners for HBV infection and vaccination of those who are sero-negative, Patient education and long-term follow-up with regular testing of liver biochemistry and surveillance of hepatocellular carcinoma in high risk groups.

However, drugs including interferon and other anti-viral agents are recommended for the treatment of hepatitis B viral infection. These include;

Adefovir

Adefovir (ADF) is a nucleotide analogue that on average reduces HBV DNA levels to 3.5 log10 copies/ml after 48 weeks of therapy in HBV monoinfected patients [226], but is less potent than Tenofovir (TDF). Only one of these studies has reported use beyond 48 weeks [227]; in that study 25% achieved undetectable HBV DNA (400 copies/ml) by week 144 and no breakthrough or

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ADF resistant mutations were observed. ADF dosage ranges from10mg every 48hrs to 10mg every 7days depending on the kidney functioning status.

Entecavir

Entecavir is a guanosine analogue that is highly potent against HBV, the dosage ranges from 0.25mg daily to 0.5mg weekly depending on the renal functioning status. It is however, Contraindicated in pregnancy and breastfeeding.

Lamivudine

Lamivudine (3TC) is a nucleoside analogue with activity against both HIV and HBV. In patients with impaired renal function 3TC dose should be reduced ranging from 150mg, 100mg, 50mg and 25mg depending on the kidney functioning status.

Telbivudine

Telbivudine is a relatively new nucleoside analogue with greater activity against HBV than both 3TC and ADF, but its efficacy is limited by a high risk of resistance (25% at 24 months in HBV monoinfected patients).

Tenofovir

Tenofovir (TDF) is a nucleotide analogue with potent activity against both HBV and HIV and is the preferred drug, as part of a full ART regimen, to treat HBV in HIV coinfected patients. Although development of HBV resistance seems to be very rare, it is recommended that TDF is always combined with another drug with anti-HBV activity (e.g. 3TC or FTC) when used as part of ART in HBV/HIV coinfected patients. TDF is active against 3TC/FTC resistant HBV. Although TDF is associated with an increased risk of nephrotoxicity, dose adjustment in individuals with altered creatinine clearance can be considered. The dosage ranges from 300 mg once daily, 300mg every 48hrs then 300mg once every 72-96hrs[228].

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2.1.12 Complications of Hepatitis B Virus Infection

Falure to manage the condition with the drugs above, may lead to the following complications.

Liver Cirrhosis: This is where the infection of the liver with hepatitis B virus causes inflammation which leads to extensive scarring of the liver there by impairing the ability of the liver to function.

Liver Cancer: This is where the extensive scaring of the liver leads to carcinoma there by limiting the functions of the liver.

Liver Failure: In this case the liver is unable to carry out its normal physiological activities.

Kidney Failure: This is where the impairment of the liver affects the physiological function of the kidney since the organs are interdependent.

2.1.13 Public Health interventions

Recognizing the persistent viral hepatitis burden, the World Health Organisation (WHO) adopted a resolution that acknowledges the global viral hepatitis burden, aims to eliminate viral hepatitis as a public health problem by 2030 and helps countries establish national action plans [229]. These target areas focus on prevention (90% reduction in new viral hepatitis infections) and treatment (65% decrease in mortality), increasing the three-dose vaccination coverage rate among children to 90%; preventing mother-to-child transmission by increasing vaccination rate among new-borns to 90% or through other measures; improving blood and injection safety; harm reduction (300 sterile syringes per person per year for people who inject drugs); and further increasing diagnosis (90%) and treatment (80% of eligible) of HBV and HCV infection. Thus far, only nine countries were on track to completely eliminate HBV infection by 2030 using a variety of

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measures (Australia, Brazil, Egypt, Georgia, Germany, Iceland, Japan, the Netherlands and Qatar) [230]

A comprehensive simulation study that modelled the current requirements to achieve global HBV elimination supported the areas of need specified by the WHO: increased vaccination coverage, scale-up of preventative measures for mother-to-child transmission, and implementing wide-scale population-based screening and therapy [232]. Other Public Health interventions to be addressed include improving patient and public knowledge of the disease, coordinate policies between the affected population, governments and other stakeholders, mobilize resources and collect data on quantifiable objectives that enable measurement of progress [232.] Reaching these goals facilitates achieving the Sustainable Development Goal to combat viral hepatitis.

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2.1.14 World Health Organization Response to Hepatitis B Virus Infection

In March 2015, WHO launched its first *"Guidelines for the prevention, care and treatment of persons living with chronic hepatitis B infection"*. The recommendations were:

1. promote the use of simple, non-invasive diagnostic tests to assess the stage of liver disease and eligibility for treatment;

2. prioritize treatment for those with most advanced liver disease and at greatest risk of mortality; and

3. recommend the preferred use of the nucleos(t)ide analogues with a high barrier to drug resistance (tenofovir and entecavir, and entecavir in children aged between 2–11 years) for first- and second-line treatment[233].

These guidelines also recommend lifelong treatment in those with cirrhosis; and regular monitoring for disease progression, toxicity of drugs and early detection of liver cancer. In May 2016, The World Health Assembly adopted the first *"Global Health Sector Strategy on Viral Hepatitis, 2016-2020"*. The strategy highlights the critical role of Universal Health Coverage and the targets of the strategy are aligned with those of the Sustainable Development Goals. The strategy has a vision of eliminating viral hepatitis as a public health problem and this is encapsulated in the global targets of reducing new viral hepatitis infections by 90% and reducing deaths due to viral hepatitis by 65% by 2030. Actions to be taken by countries and WHO Secretariat to reach these targets are outlined in the strategy.

To support countries in moving towards achieving the global hepatitis goals under the Sustainable Development Agenda 2030, WHO is working in the following areas:

1. Raising awareness, promoting partnerships and mobilizing resources;
2. Formulating evidence-based policy and data for action;
3. Preventing transmission; and
4. Scaling up screening, care and treatment services.

WHO also organizes World Hepatitis Day on July 28 every year to increase awareness and understanding of viral Hepatitis. The 2030 Agenda for Sustainable Development calls on the international community to combat Hepatitis, and for inclusive approaches that promote equity and universal health coverage to ensure no one is left behind. In May 2016, WHO presented the first Global Health Sector Strategy on viral hepatitis which focuses on elimination to the World Health Assembly. In August the same year, Member States in the African Region adopted a framework for action (2016-2020) to assist countries to implement the global strategy.

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On 28 July 2017, the world observed World Hepatitis Day. This year, the theme is: "Eliminate Hepatitis" and calls on countries and communities to accelerate progress towards achieving the goal of eliminating viral hepatitis as a public health problem by 2030. The WHO Regional Director for Africa, Dr Matshidiso Moeti on the occasion of July 28th 2017 World Hepatitis Day, urged all Member States to strengthen their national programmes by introducing hepatitis services through a public health approach to benefit all, and rapidly scale up testing and treatment services. An appeal was also made to the general public to get information about viral hepatitis, seek testing for viral hepatitis and learn if they need treatment. International partners, civil society, and the private sector were called upon to support the regional hepatitis response by promoting awareness, advocating for adequate investments and working with Member States to implement the key prevention and treatment interventions. Finally WHO will continue to support Member States to implement the hepatitis strategy to eliminate hepatitis as a public health problem in the African region. [234]

2.1.15 Attitude and Practices Towards Hepatitis B Infection

Atkinson et al defined attitude as the favorable or unfavorable reaction to objects, people, situations or other aspects of the world[235]. Other social psychologists considered attitudes to include factors such as cognition, affection and behavior [236]. They further explained the cognition aspect of a person to mean a person's knowledge of something, the affective component represents an individual's feelings and evaluations that influence the standpoint for or against something and the behavioral aspect to be, the way people act towards a situation or a person and the motivation to make changes. Attitudes as suggested by psychologist are formed through

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experiences in lifetime and are usually determined by beliefs and the evaluation of such beliefs. Attitudes formed by individuals in society can be comprehensive as well as unspecific.

It was indicated that comprehensive attitudes are more stable and are usually strongly held by the owners therefore, very difficult if not impossible to be influenced as compared to unspecific attitudes[237]. A person's behavior can be predicted by using the strength and consistency of his or her attitude. In this regard, any intervention that is aimed at changing the behavior of an individual must first of all have enough information about his or her attitudes and then employ methods that will help change these attitudes. Attitudes of which one is aware of or that are based on one's own experience can predict behavior to a higher degree than attitudes that do not meet these criteria [238]. Also, it was indicated those possible factors that could help influence the attitudes of an individual include, the nature of the sender (e.g. the nurse, doctor, health worker or professional in a counseling situation), the receiver (e.g. the patient), the message itself and the social context in which the information was communicated[239]. Trustworthiness, expertise and interpersonal attraction are important signs that should be exhibited by the sender in order to influence a person's attitude. It is important to state that for a sender to be able to make an impact on the attitude of a receiver factors such as sex, age, self-esteem and knowledge have an important role to play.

Knowledge does not necessarily influence a person's attitude. People may be knowledgeable about a particular risk behavior but may still go ahead to do it. Knowledge about hepatitis B is necessary but the provision of knowledge alone is not sufficient since it does not necessarily lead to the behavior change. Attitudes, values and beliefs (including perceptions about personal vulnerability to infection) as well as cultural norms and the influence of family, peers and the media are all important determinants of whether or not appropriate behavior is adopted by a

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person [240]. Another important motivation for a behavior change among young adults or anybody at risk of a health situation is the feeling of compassion for those already affected. This is backed by the fact that stigmatization of disease is often a sign of denial of potential personal risk [241]. A report from the USA on Health CareWorker's attitudes towards vaccination against hepatitis B found that they were reluctant to be vaccinated, as they fear plasma-derived vaccine as it contains attenuated Hepatitis B virus [242]. However many studies have found a positive correlation between increased knowledge and uptake of HBV vaccination. For example, studies in Nigeria, Spain, and Taiwan found that most vaccinated nurses and dental students acquired knowledge of HBV from their nursing degree and from working in high-risk areas that expose them to HBV [243].

Contrary to these findings, a study conducted in the UK on nurses' reports that, nurses did not finish their vaccination schedule despite having studied a course on vaccination, and midwives who were not immunized showed lack of awareness of the existence of the vaccine [244]. In a study conducted in Saudi Arabia, low immunization uptake was identified among dental staff despite their knowledge and availability of the vaccine [245]. Study, carried out in the U.S., 96 adolescents were individually interviewed and 17063 adolescents and young adults filled in a questionnaire[246]. The participants were European-Americans, African-Americans, multiracial, Native Americans, Asian and Pacific Islanders, and other races.

The study showed that the most common barrier to hepatitis B vaccine acceptance was that the adolescents did not like getting shots (94%) and time-related barriers (50%), as they had to come back two more times to the clinic to get the remaining doses of vaccine. Almost two-thirds of the adolescents that were interviewed could not provide any correct information before their clinic visit about hepatitis B. In a study carried out in the U.S. among Vietnamese-Americans, 1704

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respondents participated in a computer-assisted telephone interviewing survey. The interviews included questions about knowledge, beliefs and communication regarding HBV testing. The study showed that 17.7% reported a family history of hepatitis B and 61.6% had been tested for hepatitis B. Only 26.5% reported that they had been vaccinated against HBV, which was disappointingly low. Studies conducted in Iran and Egypt found high uptake of free vaccine among young surgeons [247,248]. In Sweden despite the availability of free vaccine, seventy six (76%) percent of HCWs were not vaccinated, they either forgot or never made appointment for vaccination [249]. Study in Nigeria found that only twelve percent of the unvaccinated respondents could not afford the vaccine.

A study on knowledge attitude and perceptions of student also revealed that, most of the students had a good attitude towards Hepatitis B virus infection. They indicated that healthy people need vaccination against HBV, and thought that people of their own age need vaccination. Students were also willing to be tested for Hepatitis B Virus infection. Despite the good attitude of the students towards HBV infection, only few of them had ever been vaccinated against the disease, which was disappointingly low. The main reasons stated for the non-patronize of HBV vaccination was that, they believe they were not at risk for getting Hepatitis B Virus, Hepatitis B vaccine cost too much, and they do not believe in the Hepatitis B vaccine[250].

2.1.16 Perception Towards Hepatitis B Infection

In a study made in Singapore the authors looked into the health-seeking behaviours of those infected with HBV by interviewing 39 HBV infected individuals[251]. Those who had a family member that had had HBV-related liver disease or had liver abnormality themselves were more likely to seek help. They wanted to know if their own livers were functioning normally, but were

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at the same time reluctant to find out the results of a test, in fear of it. The authors concluded that the low compliance to follow-up among the patients was partly due to a widespread perception that there was no efficient treatment to the disease. Many patients preferred traditional medication such as herbs instead of western medication, which was perceived not to be as effective as the herbal medicine [251.] .

In a study on knowledge, attitudes and practices among 483 chronically HBV infected people in Malaysia was investigated. The study showed that more than half of the participants felt worried about the diagnosis and felt anxious about spreading the HBV infection to family and friends. A third of the participants felt embarrassed to make their diagnosis public. About 11.6% reported that they would not tell their doctor or dentist about being HBV positive, while most of them would tell their family and friends. Many of the participants had changed their life-style habits after receiving the HBV diagnosis. A majority of those who had smoked and drunk alcohol reduced their intake-level and about half of the participants made healthier food choices and increased their daily exercise level. A large interest about encouraging family members to be screened for HBV was also noticed after receiving the HBV diagnosis [252].

In a study on Assessing Knowledge Attitude and Perception of hepatitis B among senior high students in Dunkwa-on-offin Ghana, revealed that, the perception of students on Hepatitis B Virus infection was good. Results from the study showed that majority of the students (68%) were of the view that there is efficient treatment of Hepatitis B Virus infection. About 29.5% indicated that persons with HBV infection should be isolated away from the people to prevent spread. It was further showed that half of respondents (50%) were of the view that exercising regularly and eating healthy food can prevent Hepatitis B Virus infection. The results of the study showed that most of respondents (64%) believed that healthy people need vaccination

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against HBV infection and 70.5% of them thought that people of their own age need vaccination[253].

More than half of the respondents (53%) indicated that they were willing to be tested for Hepatitis B Virus infection. However, only 4% had ever been vaccinated against the disease. Majority of them (88%) had never received a Hepatitis B vaccine before.

2.2 Theoretical Review

In this study the Health Belief Model (HBM) was chosen as the theoretical framework. It is one of the most commonly used frameworks in research of health behaviour since it was developed in the 1950s. The HBM has six primary concepts. They are used to predict why people decide, or do not decide, to control, prevent or screen for different illness conditions. The primary concepts are perceived susceptibility, benefits, severity, barriers and cues to action and self-efficacy.

Perceived susceptibility is defined as belief in the chance of suffering a risk of getting a disease or a condition, for example hepatitis B. Perceived severity is the ability to believe in the seriousness of a disease and its consequences, that hepatitis B is harmful. Believing in the efficacy of healthcare and advised action, to attempt to reduce the risks or the impact's seriousness, is a part of perceived benefits. For example, "the vaccine against hepatitis B is effective and safe". Perceived barriers are about weighing concrete and emotional costs of following advised action, to return and get the vaccine a total of three times during 6 months. A young adult also has to have certain cues to action, namely strategies to be provided with information and activate readiness. Without confidence in one self to take action, a young adult has higher risk of suffering from anxiety. Strengthening young adults' confidence and providing suitable training and progressive goal setting counteract this [229].

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End notes

1. T.M. Block, Alter HJ, London WT, Bray M. A historical perspective on the discovery and elucidation of the hepatitis B virus. **Antiviral Res**. 2016 Jul;131:109-23. doi: 10.1016/j.antiviral.2016.04.012**.** Epub 2016 Apr 20. PMID: 27107897.

2. Yasuteru Kondo, Masashi Ninomiya, Eiji Kakazu, Osamu Kimura, Tooru Shimosegawa, 2013, *Hepatitis B Surface Antigen Could Contribute to the Immunopathogenesis of Hepatitis B Virus Infection*, **International Scholarly Research Notices**, vol. 2013, Article ID 935295, 8 pages, 2013. https://doi.org/10.1155/2013/935295

3. Angioletta Lasagna, Valentina Zuccaro, Paolo Sacchi, Silvia Chiellino, Raffaele Bruno, Paolo Pedrazzoli, 2021, *Risk of reactivation of occult hepatitis B during immunotherapy*

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in cancer treatment: myth, reality or new horizons?, **Future Oncology**, 10.2217/fon-2020-1196, 17, 13, (1577-1580), (2021).

4. M. Al-Mahtab, Roy, P. P., Khan, M., & Akbar, S. M. 2020. *Nobel Prize for the Discovery of Hepatitis B and C: A Brief History in Time.* **Euroasian journal of hepatogastroenterology**, 10, 98-100

5. J. Qiao, (2019). *Occurrence, diagnosis and management of hepatic fibrosis and cirrhosis: An updated literature review.* **Archives of Hepatitis Research**. 5. 022-026. 10.17352/ahr.000023.

6. C.S. Pinto, Costa, G.B., Allaman, I.B. et al. *Clinical, epidemiological aspects, and trends of Hepatitis B in Brazil from 2007 to 2018*. Sci Rep 11, 13986 (2021). https://doi.org/10.1038/s41598-021-93434-y

7. C. TEO, (2018). *19th-century and early 20th-century jaundice outbreaks, the USA*. Epidemiology and Infection, 146(2), 138-146. doi:10.1017/S0950268817002837

8. H. Ding , Fawad M, Xu X, Hu B. *A framework for identification and classification of liver diseases based on machine learning algorithms*. Front Oncol. 2022 Oct 14;12:1048348. doi: 10.3389/fonc.2022.1048348. PMID: 36313630; PMCID: PMC9614094.

9. M.S. Khuroo, Sofi AA. 2020 *The Discovery of Hepatitis Viruses: Agents and Disease*. J Clin Exp Hepatol. Jul-Aug;10(4):391-401. doi: 10.1016/j.jceh.2020.04.006. Epub 2020 Apr 20. PMID: 32655240; PMCID: PMC7335725.

10. CDC. Travellers' Health; Yellow Book, 2021, *Recommendations for Routine Testing and Follow-up for Chronic Hepatitis B Virus (HBV) Infection*, *CR-009837 10/2021* doi:10.1002/hep.22882

11. T.I. Chauhan , Webb G, Ferguson J. Clinical presentations of Hepatitis B: *A clinical review with representative case histories.* **Clinics and research in hepatology and gastroenterology. 2019.**

12. S. Setia , Gambhir R, Kapoor V. Hepatitis B and C infection*: clinical implications in dental practice*. **European Journal of General Dentistry**. 2013;2(1):13-19. Google Scholar

13. World Health Organization, (2020*). Immunization, Vaccines and Biologicals, hepatitis B*.

14. World Health Organization, (2018*). Advocacy, communication and social mobilization for hepatitis B control: a guide to developing knowledge, attitude and practice surveys*.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

15. G.R. Takuissu, Kenmoe S, Amougou Atsama M, Atenguena Okobalemba E, Mbaga DS, et al. (2022*) Global epidemiology of occult hepatitis B virus infections in blood donors, a systematic review and meta-analysis*. **PLOS ONE** 17(8): e0272920. https://doi.org/10.1371/journal.pone.0272920

16. A.A Alali, Abo-Shehada, M.N. *Prevalence of Hepatitis B Virus infection in the Gulf Cooperation Council: a systematic review and meta-analysis.* **BMC Infect Dis** 22, 819 (2022). https://doi.org/10.1186/s12879-022-07806-4

17. Lee, Hye Won, Jae Seung Lee, and Sang Hoon Ahn. 2021. "*Hepatitis B Virus Cure: Targets and Future Therapies*" **International Journal of Molecular Sciences** 22, no. 1: 213. https://doi.org/10.3390/ijms22010213

18. World Health Organization, 2018*, National Blood Policy formulation and development of a Strategic Framework of Action for Blood Service*.

19. B.I. Ajuwon, Yujuico, I., Roper, K. et al, 2021 *Hepatitis B virus infection in Nigeria: a systematic review and meta-analysis of data published between 2010 and 2019*. **BMC Infect Dis** 21, 1120. https://doi.org/10.1186/s12879-021-06800-6

20. W.G. Diederike, Lucia E. V, Kofi A & Jos Van R, (2018*). Trends in maternal mortality :a 13-year hospital-based study in rural Ghana***. European J of Obst and Gynecol and Repro Biology,** 107:135-39.

21. International Agency for Research on Cancer, 2018, Cancers attributable to infections: age standardized rates (in Africa) per 100 000 individuals in 2018 attributable to infections (Hepatitis B virus), by country. https:// gco.iarc.fr/ causes/infections/tools-map?mode= 1& sex= 0& continent= 1& agent= 2& cancer= 0& key= asr& scale= thres hold. Accessed 29 Sept 2021.

22. GBD 2019 Hepatitis B Collaborators. Global, regional, and national burden of hepatitis B, 1990-2019: *a systematic analysis for the Global Burden of Disease Study 2019***. Lancet Gastroenterol Hepatol.** 2022 Sep;7(9):796-829. doi: 10.1016/S2468-1253(22)00124-8. Epub 2022 Jun 21. PMID: 35738290; PMCID: PMC9349325.

23. C.M. Weinbaum.,Mast E. E &Ward J.W, (2019). *Recommendations for identification and public health management of persons with chronic hepatitis B virus infection.* **Hepatology,** 49(5), 35-44.

24. V.T. Nguyen, Law M.G & Dore G.J, (2019). *Hepatitis B-related hepatocellular carcinoma: epidemiological characteristics and disease burden.* **Journal of Viral Hepatology**, 16:453–463.

25. M. Bittaye, M., Idoko, P., Ekele, B.A. et al, 2019, *Hepatitis B virus sero-prevalence amongst pregnant women in the Gambia,* **BMC Infect Dis** 19, 259 , https://doi.org/10.1186/s12879-019-3883-9

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

26. H.W. Zhang, Yin JH, Li YT, et alRisk factors for acute hepatitis B and its progression to chronic hepatitis in Shanghai, ChinaGut 2018;57:1713-1720.

27. F. Fatehi, Bingham, R.J., Stockley, P.G. et al. An age-structured model of hepatitis B viral infection highlights the potential of different therapeutic strategies. Sci Rep 12, 1252 (2022). https://doi.org/10.1038/s41598-021-04022-z

28. C.M. Weinbaum, Mast E. E &Ward J.W, (2019). *Recommendations for identification and public health management of persons with chronic hepatitis B virus infection***.** **Hepatology**, 49(5), 35-44.

29. T. Wilkins, Zimmerman D, Schade RR. Hepatitis B: diagnosis and treatment. Am Fam Physician. 2017 Apr 15;81(8):965-72. PMID: 20387772.

30. Michel Jadoul, Brian A. et al, 2019, *Prevalence, incidence, and risk factors for hepatitis C virus infection in hemodialysis patients, Kidney International***, Volume 95, Issue 4, Pages 939-947, ISSN 0085-2538, https://doi.org/10.1016/j.kint.**2018.11.038.

31. World Health Organization. "Global hepatitis report 2017: *web annex A: estimations of worldwide prevalence of chronic hepatitis B virus infection:* **a systematic review of data published between 1965 and 2017**." (2018).

32. Ferlay, Jacques, Murielle Colombet, Isabelle Soerjomataram, Colin Mathers, Donald M. Parkin, Marlon Piñeros, Ariana Znaor, and Freddie Bray. "*Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods***."** **International journal of cancer** 144, no. 8 (2019): 1941-1953.

33. B.H. Kim, and Kim, W.R., 2018. *Epidemiology of hepatitis B virus infection in the United States.* **Clinical liver disease,** *12*(1), p.1.

34. G. Beykaso, Mulu, A., Giday, M., Berhe, N., Selamu, M., Hailu, D. and Teklehaymanot, T., 2022. *Occult Hepatitis B Virus Infection and Its Risks of Cryptic Transmission in Southern Ethiopia*. **Infection and Drug Resistance**, *15*, p.619.

35. J. A. Ndako, 2017*, Risk Factors and Prevalence of Hepatitis B Surface Antigen (HBsAg) among Apparently Healthy Volunteers in an Urban Setting, North-Central Nigeria*, **International Journal of Sciences** 03 :9-15 DOI: 10.18483/ijSci.958

36. G. Gemechu, Abagez WE, Alemayehu DH, Tesfaye A, Tadesse D, Kinfu A, Mihret A and Mulu A (2022) *Occult Hepatitis B Virus Infection Among Blood Donors in the Capital City of Addis Ababa, Ethiopia: Implications for Blood Transfusion Safety*. **Front. Gastroenterol**. 1:887260. doi: 10.3389/fgstr.2022.887260

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

37. A.A. Atalay , Abebe RK, Dadhi AE, Bededa WK 2021 *Seroprevalence of hepatitis B virus among pregnant women attending Antenatal care in Dilla University Referral Hospital Gedio Zone, Ethiopia; health facility based cross-sectional study.* PLoS ONE 16(3): e0249216. **https://doi.org/10.1371/journal.pone**.0249216

38. J. Wang, Liu, F., Tan, J.B.X. *et al, 2019 Implementation of infection prevention and control in acute care hospitals in Mainland China – a systematic review*. **Antimicrob Resist Infect Control 8**, 32. https://doi.org/10.1186/s13756-019-0481-y

39. L. Liu, Wang, L., Zhang, H., Ou, W., Li, D., Feng, Y., Zhuang, H. and Shao, Y., 2021. *Changing Epidemiology of Hepatitis B Virus and Hepatitis C Virus Coinfection in a Human Immunodeficiency Virus–Positive Population in China: Results From the Third and Fourth Nationwide Molecular Epidemiologic Surveys*. **Clinical Infectious Diseases,** *73*(4), pp.642-649.

40. World Health Organization, 2018. Global hepatitis report 2017: web annex A: a systematic *estimations of worldwide prevalence of chronic hepatitis B virus infection:* **review of data published between 1965 and 2017.**

41. V.K. Tiwari, Balasundaram, P. and TP, S.R., 2022. *Knowledge, Awareness and Health Seeking Behaviour among Hepatitis patients attending a Tertiary Care Hospital in Delhi.* **Indian Journal of Preventive & Social Medicine**, *53*(1), pp.20-29.

42. T. Gebrecherkos, Girmay, G., Lemma, M. and Negash, M., 2020. *Knowledge, attitude, and practice towards Hepatitis B virus among pregnant women attending antenatal care at the University of Gondar comprehensive specialized hospital, Northwest Ethiopia*. **International journal of hepatology,** *2020*.

43. E.S Park, Lee, A.R., Kim, D.H., Lee, J.H., Yoo, J.J., Ahn, S.H., Sim, H., Park, S., Kang, H.S., Won, J. and Ha, Y.N., 2019. *Identification of a quadruple mutation that confers tenofovir resistance in chronic hepatitis B patients*. **Journal of hepatology**, *70*(6), pp.1093-1102.

44. J.K. Lim, Nguyen, M.H., Kim, W.R., Gish, R., Perumalswami, P. and Jacobson, I.M., 2020. *Prevalence of chronic hepatitis B virus infection in the United States*. **Official journal of the American College of Gastroenterology| ACG, 115(9),** pp.1429-1438.

45. T.D. Yazie and Tebeje, M.G., 2019. *An updated systematic review and meta-analysis of the prevalence of hepatitis B virus in Ethiopia*. **BMC infectious diseases**, *19*(1), pp.1-13.

46. R. Dabsu, and Ejeta, E., 2018. *Seroepidemiology of hepatitis B and C virus infections among pregnant women attending antenatal Clinic in Selected Health Facilities in east Wollega zone, West Oromia, Ethiopia*. **BioMed research international**, *2018*.

47. W.W. Cao, Zhou, R.R., Ou, X., Shi, L.X., Xiao, C.Q., Chen, T.Y., Tan, H., Fan, X.G., Li, B.J. and Li, N., 2018. *Prevalence of hepatitis B virus, hepatitis C virus, human*

DO NOT COPY, LEAD CITY UNIVERSITY, NIGERIA

immunodeficiency virus and Treponema pallidum infections in hospitalized patients before transfusion in Xiangya hospital Central South University, China from 2011 to 2016. **BMC infectious diseases, 18(1), pp.1-7.**

48. E. Collenberg, Ouedraogo T, Ganamé J, Fickenscher H, Kynast- Wolf G, Becher H, Kouyaté B, Kräusslich HG, Sangaré L, Tebit DM. *Seroprevalence of six different viruses among pregnant women and blood donors in rural and urban Burkina Faso: A comparative analysis*. **J Med Virol** 2016; 78: 683-692 [PMID: 16555290 DOI: 10.1002/jmv.20593]

49. N.M.B Biatougou, Ouedraogo, M.S., Soubeiga, S.T., Zohoncon, T.M., Ouedraogo, P., Obiri-Yeboah, D., Tapsoba, A.S.A., Kiendrebeogo, T.I., Sagna, T., Niamba, P. and Traore, A., 2022. *Molecular Epidemiology of Human Herpes Virus Type 8 Among Patients with Compromised Immune System in Ouagadougou, Burkina Faso.* **HIV/AIDS** *(Auckland, NZ)*, *14*, p.311.

50. A.S. Ojo and Owolabi, H.A., *The Hepatitis B Virus and Chronic Liver Disease in Nigeria*: **A Brief Review of Literature**.

51. A.A. Agba and Aguh, I.B., 2020. *Hepatitis B Surface Antigenaemia and Some Associated Risk Factors Among Patients Attending Hospital in Danja Local Government Area of Katsina State, Nigeria*. **International Journal of Science for Global Sustainability**, *6*(2), pp.6-6.

52. Ba, A., Ndiaye, F.K., Djeng, Y.J., Cames, C., Diack, A. and N'diaye, O., 2019. *Impact of highly active antiretroviral therapy on chronic hepatitis B serological markers among Senegalese HIV co-infected children*. **International Journal of Maternal and Child Health and AIDS,** *8*(2), p.131.

53. S.M. Sajjadi, Pourfathollah, A.A., Mohammadi, S., Nouri, B., Hassanzadeh, R. and Fariba, R.A.D., 2018. *The prevalence and trends of hepatitis B, hepatitis C, and HIV among voluntary blood donors in kohgiluyeh and boyer-ahmad transfusion center, Southwestern Iran.* **Iranian journal of public health**, *47*(7), p.944.

54. J.J. Noubiap, Joko WY, Nansseu JR, Tene UG, Siaka C. *Seroepidemiology of human immunodeficiency virus, hepatitis B and C viruses, and syphilis infections among first-time blood donors in Edéa, Cameroon.* **Int J Infect Dis 2013**; 17: e832-e837 [PMID: 23317526 DOI: 10.1016/j.ijid.2012.12.007]

55. S. Cetin, Cetin, M., Turhan, E. and Dolapcioglu, K., 2018. *Seroprevalence of hepatitis B surface antigen and associated risk factors among pregnant women*. **The Journal of Infection in Developing Countries**, *12*(10), pp.904-909.

56. H.E Junior, Theodoro, M., de Almeida Vespoli, J., Senise, J.F. and Castelo, A., 2018. *Mother-to-child transmission of hepatitis C virus*. **European Journal of Obstetrics & Gynecology and Reproductive Biology,** *224*, pp.125-130.

DO NOT COPY, LEAD CITY UNIVERSITY, NIGERIA

57. J.C. Ndubuisi, Aisha, M., Wariso, C.A. and Ejiofor, D.C., *Prevalence of Hepatitis B Virus (HBV) among Antenatal Clinic Attendees in Karu Local Government Area, Nasarawa State, Nigeria.*

58. World Health Organization, 2018. Global hepatitis report 2017: *web annex A: estimations of worldwide prevalence of chronic hepatitis B virus infection***: a systematic review of data published between 1965 and 2017**.

59. J. Umutesi, Klett-Tammen, C., Nsanzimana, S., Krause, G. and Ott, J.J., 2021. *Cross-sectional study of chronic hepatitis B virus infection in Rwandan high-risk groups: unexpected findings on prevalence and its determinants*. **BMJ open**, *11*(12), p.e054039.

60. K.C. Chang, Chang, M.H., Chen, H.L., Wu, J.F., Chang, C.H., Hsu, H.Y. and Ni, Y.H., 2022. *Universal infant hepatitis B virus (HBV) vaccination for 35 years: moving toward the eradication of HBV.* **The Journal of Infectious Diseases,** *225*(3), pp.431-435.

61. Petruzziello, 2018. Suppl-1, M3: *epidemiology of hepatitis B virus (HBV) and hepatitis C virus (HCV) related hepatocellular carcinoma*. **The open virology journal**, *12*, p.26.

62. W.K Seto, Lo, Y.R., Pawlotsky, J.M. and Yuen, M.F., 2018. *Chronic hepatitis B virus infection.* **The Lancet**, *392*(10161), pp.2313-2324.

63. B.S. Nyalika, 2021. *Prevalence and Associated Factors of Hepatitis B Surface Antigen (HBsAg) among People Living with HIV (PLWHIV) Attending at CTC Mawenzi Regional Hospital Kilimanjaro, Northern Tanzania***. Advances in Infectious Diseases**, *11*(2), pp.216-231.

64. D. Kassa, Gebremichael, G., Tilahun, T., Ayalkebet, A., Abrha, Y., Mesfin, G., Belay, Y., Demissie, M., Gebrexiabher, A. and Assefa, Y., 2019*. Prevalence of sexually transmitted infections (HIV, hepatitis B virus, herpes simplex virus type 2, and syphilis) in pregnant women in Ethiopia: trends over 10 years (2005–2014).* **International Journal of Infectious Diseases,** *79*, pp.50-57.

65. K.R. Mysore and Leung, D.H., 2018. Hepatitis B and C. *Clinics in Liver Disease*, *22*(4), pp.703-722 Edrees, W.H., Al-Ofairi, B.A., Alrahabi, L.M., Al-Munkari, I.M., Alawi, A.S., Al-Mashdali, A.H.T., Samin, G.B., Naseer, Y.A., Bamousa, Z.A. and Al-Shehari, W.A., 2022*. Seroprevalence Of The Viral Markers Of Hepatitis B, Hepatitis C, And Hiv Among Medical Waste Handlers In Some Hospitals In Sana'a City-Yemen.* **Universal J Pharm Res,** *7*(3), pp.12-19.

66. F. Bonino, Colombatto, P. and Brunetto, M.R., 2022. *HBeAg-Negative/Anti-HBe-Positive Chronic Hepatitis B: A 40-Year-Old History.* **Viruses,** *14*(8), p.1691.

DO NOT COPY LEAD CITY UNIVERSITY, NIGERIA

67. H.I Mohammed, Pennap, G.R., Oti, V.B. and Adoga, M.P., 2019. *Markers of hepatitis B virus infection in a subset of young people in central Nigeria.* **Scientific African,** *5*, p.e00121.

68. Y.L. Qin, Li, B., Zhou, Y.S., Zhang, X., Li, L., Song, B., Liu, P., Yuan, Y., Zhao, Z.P., Jiao, J. and Li, J., 2018. *Prevalence and associated knowledge of hepatitis B infection among healthcare workers in Freetown, Sierra Leone*. **BMC infectious diseases,** *18*(1), pp.1-8.

69. N. Khetsuriani, Zaika, O., Chitadze, N., Slobodianyk, L., Allahverdiyeva, V., O'Connor, P. and Huseynov, S., 2021. *Seroprevalence of hepatitis B virus infection markers among children in Ukraine, 2017*. **Vaccine,** *39*(10), pp.1485-1492.

70. Acikgoz, Cimrin, D., Kizildag, S., Esen, N., Balci, P. and Sayiner, A.A., 2020. *Hepatitis A, B and C seropositivity among first-year healthcare students in western Turkey: a seroprevalence study.* **BMC Infectious Diseases**, *20*(1), pp.1-8.

71. R. Aliyu-zubair, Yakubu, A.M., Ogurinde, G.O., Ibrahim, A. and Olayinka, A., 2021. *Prevalence of hepatitis B markers seropositivity in sickle cell (SCA) children in ABUTH Shika, Kaduna State*. **Ibom Medical Journal,** *14*(3), pp.371-384.

72. W.H. Edrees, Banafa, A.M. and Al-Awar, M.S., 2022. *Risk factors and seroprevalence of hepatitis B virus antigen among university students in the Sana'a city, Yemen.* **Al-Razi University Journal for Medical Sciences, 6(1).**

73. W.H. Edrees, Al-Ofairi, B.A., Alrahabi, L.M., Al-Munkari, I.M., Alawi, A.S., Al-Mashdali, A.H.T., Samin, G.B., Naseer, Y.A., Bamousa, Z.A. and Al-Shehari, W.A., 2022. *Seroprevalence of the viral markers of hepatitis b, hepatitis c, and hiv among medical waste handlers in some hospitals in sana'a city-yemen***. Universal J Pharm Res,** *7*(3), pp.12-19.

74. Y.T. Yang, Huang, A.L. and Zhao, Y., 2019. *The prevalence of hepatitis B core antibody in vaccinated Chinese children: A hospital-based study*. **Vaccine,** *37*(3), pp.458-463.

75. N. Mabunda, Zicai, A.F., Ismael, N., Vubil, A., Mello, F., Blackard, J.T., Lago, B., Duarte, V., Moraes, M., Lewis, L. and Jani, I., 2020. *Molecular and serological characterization of occult hepatitis B among blood donors in Maputo, Mozambique***.** **Memórias do Instituto Oswaldo** *Cruz*, *115*.

76. E.E. Yambasu, Reid, A., Owiti, P., Manzi, M., Murray, M.J.S. and Edwin, A.K., 2018. *Hidden dangers-prevalence of blood borne pathogens, hepatitis B, C, HIV and syphilis, among blood donors in Sierra Leone in 2016: opportunities for improvement: a retrospective, cross-sectional study***. *Pan*** **African Medical Journal**, *30*(1).

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

77. Y. Bialfew, Hailu, G. and Samuel, T., 2018. *Prevalence and associated factors of hepatitis B virus infection among blood donors in Debre Markos blood Bank Centre, Northwest Ethiopia, 2018*. **Epidemiology (Sunnyvale),** *8*(363), pp.2161-1165.

78. N. Tawfeq al-nwany, Ahmad, N., Nawi, A.M., Hassan, M.R., Hod, R. and Baharom, M., 2021. *Seroprevalence of Hepatitis B Virus Infection and Its Associated Factors Among Blood Donors in Yemen.* **The Malaysian Journal of Medical Sciences***: MJMS*, *28*(5), p.54.

79. M. Abebe, Alemnew, B. and Biset, S., 2020. *Prevalence of hepatitis B virus and hepatitis C virus among blood donors in nekemte blood bank, Western Oromia, Ethiopia: retrospective 5 years study.* **Journal of blood medicine,** *11*, p.543.

80. R.O. Fite, Kooti, W., Azeze, G.A., Tesfaye, B. and Hagisso, S.N., 2020. *Seroprevalence and factors associated with hepatitis B virus infection in blood donors in Ethiopia: a systematic review and meta-analysis.* **Archives of virology,** *165*(5), pp.1039-1048.

81. N.R. Hussein, 2018. *Risk factors of hepatitis B virus infection among blood donors in Duhok city,* **Kurdistan Region, Iraq. Caspian journal of internal medicine**, *9*(1), p.22.

82. J.K. Lim, Nguyen, M.H., Kim, W.R., Gish, R., Perumalswami, P. and Jacobson, I.M., 2020. *Prevalence of chronic hepatitis B virus infection in the United States*. **Official journal of the American College of Gastroenterology**| *ACG*, *115*(9), pp.1429-1438.

83. J. Tanaka, Akita, T., Ko, K., Miura, Y., Satake, M. and Epidemiological Research Group on Viral Hepatitis and its Long-term Course, Ministry of Health, Labour and Welfare of Japan, 2019. *Countermeasures against viral hepatitis B and C in Japan: an epidemiological point of view*. **Hepatology Research,** *49*(9), pp.990-1002.

84. M. Tan, Bhadoria, A.S., Cui, F., Tan, A., Van Holten, J., Easterbrook, P., Ford, N., Han, Q., Lu, Y., Bulterys, M. and Hutin, Y., 2021. *Estimating the proportion of people with chronic hepatitis B virus infection eligible for hepatitis B antiviral treatment worldwide: a systematic review and meta-analysis.* **The Lancet Gastroenterology & Hepatology,** *6*(2), pp.106-119.

85. G. Indolfi, Easterbrook, P., Dusheiko, G., Siberry, G., Chang, M.H., Thorne, C., Bulterys, M., Chan, P.L., El-Sayed, M.H., Giaquinto, C. and Jonas, M.M., 2019. *Hepatitis B virus infection in children and adolescents.* **The Lancet Gastroenterology & Hepatology**, *4*(6), pp.466-476.

86. K.R. Mysore and Leung, D.H., 2018. *Hepatitis B and C*. **Clinics in Liver Disease**, *22*(4), pp.703-722.

87. L.Y. Mak, Wong, D.K.H., Pollicino, T., Raimondo, G., Hollinger, F.B. and Yuen, M.F., 2020. *Occult hepatitis B infection and hepatocellular carcinoma: Epidemiology, virology,*

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

hepatocarcinogenesis and clinical significance. **Journal of Hepatology**, *73*(4), pp.952-964.

88. A.L. McNaughton, Lourenço, J., Bester, P.A., Mokaya, J., Lumley, S.F., Obolski, U., Forde, D., Maponga, T.G., Katumba, K.R., Goedhals, D. and Gupta, S., 2020. *Hepatitis B virus seroepidemiology data for Africa: Modelling intervention strategies based on a systematic review and meta-analysis.* **PLoS medicine**, *17*(4), p.e1003068.

89. B.H. Kim and Kim, W.R., 2018. *Epidemiology of hepatitis B virus infection in the United States.* **Clinical liver disease**, *12*(1), p.1.

90. J.D. Makuza, Rwema, J.O.T., Ntihabose, C.K., Dushimiyimana, D., Umutesi, J., Nisingizwe, M.P., Serumondo, J., Semakula, M., Riedel, D.J. and Nsanzimana, S., 2019. *Prevalence of hepatitis B surface antigen (HBsAg) positivity and its associated factors in Rwanda*. **BMC infectious diseases**, *19*(1), pp.1-10.

91. F. Yang, Ma, L., Yang, Y., Liu, W., Zhao, J., Chen, X., Wang, M., Zhang, H., Cheng, S., Shen, F. and Wang, H., 2019. *Contribution of hepatitis B virus infection to the aggressivene*

92. B.V. Chihota, Wandeler, G., Chilengi, R., Mulenga, L., Chung, R.T., Bhattacharya, D., Egger, M. and Vinikoor, M.J., 2020. *High rates of hepatitis B virus (HBV) functional cure among human immunodeficiency virus-HBV coinfected patients on antiretroviral therapy in Zambia.* **The journal of infectious diseases,** *221*(2), pp.218-222.

93. J.M Jones, Kracalik, I., Levi, M.E., Bowman III, J.S., Berger, J.J., Bixler, D., Buchacz, K., Moorman, A., Brooks, J.T. and Basavaraju, S.V., 2020. *Assessing solid organ donors and monitoring transplant recipients for human immunodeficiency virus, hepatitis B virus, and hepatitis C virus infection—US Public Health Service Guideline, 2020*. MMWR Recommendations and Reports, *69*(4), p.1.

94. R.K Sterling, Wahed, A.S., King, W.C., Kleiner, D.E., Khalili, M., Sulkowski, M., Chung, R.T., Jain, M.K., Lisker-Melman, M., Wong, D.K. and Ghany, M.G., 2019. *Spectrum of liver disease in hepatitis B virus (HBV) patients co-infected with human immunodeficiency virus (HIV): results of the HBV-HIV cohort study*. **The American journal of gastroenterology,** *114*(5), p.746.

95. S. Leumi, Bigna, J.J., Amougou, M.A., Ngouo, A., Nyaga, U.F. and Noubiap, J.J., 2020. Global burden of hepatitis B infection in people living with human immunodeficiency virus: a systematic review and meta-analysis. *Clinical Infectious Diseases*, *71*(11), pp.2799-2806.

96. P. Mahale, Engels, E.A. and Koshiol, J., 2019. *Hepatitis B virus infection and the risk of cancer in the elderly US population.* **International journal of cancer**, *144*(3), pp.431-439.

DO NOT COPY, LEAD CITY UNIVERSITY, NIGERIA

97. T.T. Flygel, Sovershaeva, E., Claassen-Weitz, S., Hjerde, E., Mwaikono, K.S., Odland, J.Ø., Ferrand, R.A., Mchugh, G., Gutteberg, T.J., Nicol, M.P. and Cavanagh, J.P., 2020. *Composition of gut microbiota of children and adolescents with perinatal human immunodeficiency virus infection taking antiretroviral therapy in Zimbabwe*. **The Journal of infectious diseases,** *221*(3), pp.483-492.

98. R.C. Paul, Rahman, M., Wiesen, E., Patel, M., Banik, K.C., Sharif, A.R., Sultana, S., Rahman, M., Liyanage, J., Abeysinghe, N. and Kamili, S., 2018. *Hepatitis B surface antigen seroprevalence among prevaccine and vaccine era children in Bangladesh*. **The American Journal of Tropical Medicine and Hygiene**, *99*(3), p.764.

99. C. Gomes, Wong, R.J. and Gish, R.G., 2019. *Global perspective on hepatitis B virus infections in the era of effective vaccines.* **Clinics in liver disease**, *23*(3), pp.383-399.

100. J.K. Lim, J.K., Nguyen, M.H., Kim, W.R., Gish, R., Perumalswami, P. and Jacobson, I.M., 2020. *Prevalence of chronic hepatitis B virus infection in the United States*. **Official journal of the American College of Gastroenterology**| *ACG*, *115*(9), pp.1429-1438.

101. H.Y. Hsu, H.Y. and Chang, M.H., 2019. *Hepatitis B virus infection and the progress toward its elimination*. **The Journal of Pediatrics**, *205*, pp.12-20.

102. T. Xiang, Liang, B., Wang, H., Quan, X., He, S., Zhou, H., He, Y., Yang, D., Wang, B. and Zheng, X., 2021. *Safety and immunogenicity of a SARS-CoV-2 inactivated vaccine in patients with chronic hepatitis B virus infection*. **Cellular & molecular immunology**, *18*(12), pp.2679-2681.

103. E.W Hall, Gounder, P., Angles, J., Nelson, N.P., Rosenberg, E.S. and Weng, M.K., 2022. *Evaluating the cost-effectiveness of hepatitis B vaccination strategies in high-impact settings for adults*. **Journal of Viral Hepatitis**, *29*(12), pp.1115-1126.

104. World Health Organization, 2018. Global hepatitis report 2017: web annex A: *estimations of worldwide prevalence of chronic hepatitis B virus infection: a systematic review of data published between 1965 and 2017.*

105. M.M. Sani, Hafsat, W.I., Sakinatu, M.A., Ibrahim, A., Sani, M. and Alhassan, M.Y., 2018. *Prevalence of hepatitis B viral infection at paediatric gastroenterology clinic of ABUTH, Zaria.* **Nigerian Journal of Basic and Clinical Sciences**, *15*(2), p.114.

106. L.A. Beste, Ioannou, G.N., Chang, M.F., Forsberg, C.W., Korpak, A.M., Boyko, E.J., Sporleder, J.L., Smith, N.L., Maynard, C., Chartier, M. and Dominitz, J.A., 2020. *Prevalence of hepatitis B virus exposure in the veterans health administration and association with military-related risk factors*. **Clinical Gastroenterology and Hepatology,** *18*(4), pp.954-962.

107. H. Zhao, Zhou, X. and Zhou, Y.H., 2020. *Hepatitis B vaccine development and implementation. Human Vaccines & Immunotherapeutics, 16*(7), pp.1533-1544.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

108. B. Bancha, B., Kinfe, A.A., Chanko, K.P., Workie, S.B. and Tadese, T., 2020. *Prevalence of hepatitis B viruses and associated factors among pregnant women attending antenatal clinics in public hospitals of Wolaita Zone, South Ethiopia*. *PloS one*, *15*(5), p.e0232653.

109. E.T. Yelemkoure, Yonli, A.T., Montesano, C., Ouattara, A.K., Diarra, B., Zohoncon, T.M., Nadembega, C.W., Ouedraogo, P., Sombié, C., Soubeiga, S.T. and Tao, I., 2018. *Prevention of mother-to-child transmission of hepatitis B virus in Burkina Faso: screening, vaccination and evaluation of post-vaccination antibodies against hepatitis B surface antigen in newborns.* **Journal of Public Health in Africa**, *9*(3).

110. M. Miyakawa, Yoshida, L.M., Nguyen, H.A.T., Takahashi, K., Le, T.H., Yasunami, M., Ariyoshi, K., Dang, D.A. and Moriuchi, H., 2021. *Hepatitis B virus infection among pregnant mothers and children after the introduction of the universal vaccination program in Central Vietnam. Scientific Reports*, *11*(1), pp.1-11.

111. T.D. Yazie and Tebeje, M.G., 2019. *An updated systematic review and meta-analysis of the prevalence of hepatitis B virus in Ethiopia*. **BMC infectious diseases**, *19*(1), pp.1-13.

112. Prabhu, M., Susich, M.K., Packer, C.H., Hersch, A.R., Riley, L.E. and Caughey, A.B., 2022. *Universal hepatitis B antibody screening and vaccination in pregnancy: a cost-effectiveness analysis*. *Obstetrics & Gynecology*, *139*(3), pp.357-367.

113. He, T., Zhou, Y., Xu, P., Ling, N., Chen, M., Huang, T., Zhang, B., Yang, Z., Ao, L., Li, H. and Chen, Z., 2022. *Safety and antibody response to inactivated COVID-19 vaccine in patients with chronic hepatitis B virus infection*. **Liver International**.

114. M.T. Frempong, Ntiamoah, P., Annani-Akollor, M.E., Owiredu, W.K., Addai-Mensah, O., Owiredu, E.W., Adu-Gyasi, D., Agyapong, E.O. and Sallah, L., 2019. *Hepatitis B and C infections in HIV-1 and non-HIV infected pregnant women in the Brong-Ahafo Region, Ghana*. **PloS one**, *14*(7), p.e0219922.

115. G. Ng'wamkai, Msigwa, K.V., Chengula, D., Mgaya, F., Chuma, C., Msemwa, B., Silago, V., Majigo, M., Mshana, S.E. and Mirambo, M.M., 2019. *Treponema pallidum infection predicts sexually transmitted viral infections (hepatitis B virus, herpes simplex virus-2, and human immunodeficiency virus) among pregnant women from rural areas of Mwanza region, Tanzania.* **BMC pregnancy and childbirth**, *19*(1), pp.1-13.

116. Jackson, K. and Gish, R.G., 2020. *Point of Care Diagnostic Testing for Hepatitis B Virus.* **Current Hepatology Reports**, *19*(3), pp.245-253.

117. Bigna, J.J., Kenne, A.M., Hamroun, A., Ndangang, M.S., Foka, A.J., Tounouga, D.N., Lenain, R., Amougou, M.A. and Nansseu, J.R., 2019. *Gender development and hepatitis B and C infections among pregnant women in Africa: a systematic review and meta-analysis.* **Infectious diseases of poverty**, *8*(1), pp.1-12.

DO NOT COPY LEAD CITY UNIVERSITY, NIGERIA

118. Gindin, Y., Gaggar, A., Lok, A.S., Janssen, H.L., Ferrari, C., Subramanian, G.M., Jiang, Z., Masur, H., Emmanuel, B., Poonia, B. and Kottilil, S., 2021. *DNA Methylation and Immune Cell Markers Demonstrate Evidence of Accelerated Aging in Patients with Chronic Hepatitis B Virus or Hepatitis C Virus, with or without Human Immunodeficienct Virus Co-infection.* **Clinical Infectious Diseases**, *73*(1), pp.e184-e190.

119. Omote, V., Kashibu, E., Ojumah, I., Adda, D., Etaghene, J. and Ukwamedua, H., 2018. *Serological screening of hepatitis B virus and hepatitis C virus among patients attending a tertiary hospital in Jalingo, Taraba state, Nigeria*.

120. dos Santos Marcon, P., Tovo, C.V., Kliemann, D.A., Fisch, P. and de Mattos, A.A., 2018. *Incidence of hepatocellular carcinoma in patients with chronic liver disease due to hepatitis B or C and coinfected with the human immunodeficiency virus: A retrospective cohort study*. **World Journal of Gastroenterology**, *24*(5), p.613.

121. H.Z Gong, Hu, K.R., Lyu, W., Zheng, H.Y., Zhu, W.G., Wan, X. and Li, J., 2020. *Risk factors for the co-infection with HIV, hepatitis B and C virus in syphilis patients*. *Acta Dermato-Venereologica*, *100*(17), pp.1-6.

122. Y.F Shih, and Liu, C.J., 2020. *Hepatitis C virus and hepatitis B virus co-infection*. *Viruses*, *12*(7), p.741.

123. T. Weitzel, Rodríguez, F., Noriega, L.M., Marcotti, A., Duran, L., Palavecino, C., Porte, L., Aguilera, X., Wolff, M. and Cortes, C.P., 2020. *Hepatitis B and C virus infection among HIV patients within the public and private healthcare systems in Chile: A cross-sectional serosurvey. PloS One*, *15*(1), p.e0227776.

124. Z.M Younossi, Stepanova, M., Younossi, I., Papatheodoridis, G., Janssen, H.L., Agarwal, K., Nguyen, M.H., Gane, E., Tsai, N. and Nader, F., 2019. *Patient-reported outcomes in patients chronic viral hepatitis without cirrhosis: The impact of hepatitis B and C viral replication.* **Liver International**, *39*(10), pp.1837-1844.

125. Airewele, N.E. and Shiffman, M.L., 2021. *Chronic hepatitis B virus in patients with chronic hepatitis C virus*. **Clinics in Liver Disease**, *25*(4), pp.817-829.

126. Wedemeyer, H., Schöneweis, K., Bogomolov, P., Blank, A., Voronkova, N., Stepanova, T., Sagalova, O., Chulanov, V., Osipenko, M., Morozov, V. and Geyvandova, N., 2022. *Safety and efficacy of bulevirtide in combination with tenofovir disoproxil fumarate in patients with hepatitis B virus and hepatitis D virus coinfection (MYR202): a multicentre, randomised, parallel-group, open-label, phase 2 trial*. **The Lancet Infectious Diseases**.

127. X.W. Jiang, Ye, J.Z., Li, Y.T. and Li, L.J., 2018. *Hepatitis B reactivation in patients receiving direct-acting antiviral therapy or interferon-based therapy for hepatitis C: a systematic review and meta-analysis.* **World journal of gastroenterology**, *24*(28), p.3181.

DO NOT COPY LEAD CITY UNIVERSITY, NIGERIA

128. J.G. Park, Lee, Y.R., Park, S.Y., Lee, H.J., Tak, W.Y., Kweon, Y.O., Jang, S.Y., Chun, J.M., Han, Y.S., Hur, K. and Lee, H.W., 2018. *Tenofovir, entecavir, and lamivudine in patients with severe acute exacerbation and hepatic decompensation of chronic hepatitis B.* **Digestive and Liver Disease**, *50*(2), pp.163-167.

129. J.W. Jang, Choi, J.Y., Kim, Y.S., Yoo, J.J., Woo, H.Y., Choi, S.K., Jun, C.H., Lee, C.H., Sohn, J.H., Tak, W.Y. and Lee, Y.R., 2018. *Effects of virologic response to treatment on short-and long-term outcomes of patients with chronic hepatitis B virus infection and decompensated cirrhosis.* **Clinical gastroenterology and hepatology**, *16*(12), pp.1954-1963.

130. Yip, T.C.F., Lai, J.C.T. and Wong, G.L.H., 2020. *Secondary prevention for hepatocellular carcinoma in patients with chronic hepatitis B: are all the nucleos (t) ide analogues the same?*. **Journal of Gastroenterology**, *55*(11), pp.1023-1036.

131. Jeng, W.J. and Lok, A.S., 2021. *Should treatment indications for chronic hepatitis B be expanded?.* **Clinical Gastroenterology and Hepatology**, *19*(10), pp.2006-2014.

132. Rao, H., Shang, J., Xie, Q., Lian, J., Gao, P., Shi, J., Chen, X., Wang, J., Xu, M., Zhang, L. and Zhao, Y., 2022. *Tenofovir disoproxil fumarate therapy in patients with chronic hepatitis B and advanced fibrosis or compensated cirrhosis*. *iLIVER*, *1*(3), pp.145-153.

133. P. Hosseini, and Yazdani, S., 2021. *The role of hepatitis B virus in people with chronic liver disease.* **Annals of the Romanian Society for Cell Biology**, *25*(6), pp.21023-21030.

134. Xu, Y. and Nie, Z.W., 2018. *Telbivudine and adefovir dipivoxil combination therapy improves renal function in patients with chronic hepatitis B: A STROBE-compliant article*. *Medicine*, *97*(48).

135. P. Dilokthornsakul, Sawangjit, R., Tangkijvanich, P., Chayanupatkul, M., Tanwandee, T., Sukeepaisarnjaroen, W., Sriuttha, P. and Permsuwan, U., 2022. E*conomic Evaluation of Oral Nucleos (t) ide Analogues for Patients with Chronic Hepatitis B in Thailand*. **Applied Health Economics and Health Policy**, pp.1-10.

136. Lu, C.M., Cheng, J.S., Sun, W.C., Chen, W.C., Tsay, F.W., Wang, H.M., Tsai, T.J., Kao, S.S., Li, Y.D., Li, Y.R. and Lin, H.S., 2022. *Randomized Controlled Study of Tenofovir versus Lamivudine Followed by Tenofovir in Severe Exacerbation of Hepatitis B*. **Antimicrobial Agents and Chemotherapy**, *66*(2), pp.e01664-21.

137. M. Pazgan-Simon, Simon, K.A., Jarowicz, E., Rotter, K., Szymanek-Pasternak, A. and Zuwala-Jagiello, J., 2018. *Hepatitis B virus treatment in hepatocellular carcinoma patients prolongs survival and reduces the risk of cancer recurrence*. *Clinical and experimental hepatology*, *4*(3), pp.210-216.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

138. Mursy, S.M.E.M. and Mohamed, S.O.O., 2019. *Knowledge, attitude, and practice towards Hepatitis B infection among nurses and midwives in two maternity hospitals in Khartoum, Sudan*. **BMC public health**, *19*(1), pp.1-7.

139. M. Rostamzadeh, Afkhamzadeh, A., Afrooz, S., Mohamadi, K. and Rasouli, M.A., 2018. *Dentists' knowledge, attitudes and practices regarding Hepatitis B and C and HIV/AIDS in Sanandaj, Iran*. **BMC oral health**, *18*(1), pp.1-8.

140. D.B. Shrestha, Khadka, M., Khadka, M., Subedi, P., Pokharel, S. and Thapa, B.B., 2020. *Hepatitis B vaccination status and knowledge, attitude, and practice regarding Hepatitis B among preclinical medical students of a medical college in Nepal*. *PloS one*, *15*(11), p.e0242658.

141. T.T. Hang Pham, Le, T.X., Nguyen, D.T., Luu, C.M., Truong, B.D., Tran, P.D., Toy, M., Bozkurt, S. and So, S., 2019. *Knowledge, attitudes and medical practice regarding hepatitis B prevention and management among healthcare workers in Northern Vietnam*. *PloS one*, *14*(10), p.e0223733.

142. J.K Aniaku, Amedonu, E.K. and Fusheini, A., 2019. *Assessment of knowledge, attitude and vaccination status of hepatitis B among nursing training students in Ho, Ghana*. *Annals of global health*, *85*(1).

143. Nguyen, T.T.L., Pham, T.T.H., So, S., Hoang, T.H.V., Nguyen, T.T.U., Ngo, T.B., Nguyen, M.P., Thai, Q.H., Nguyen, N.K., Le Ho, T.Q.A. and Tran, Q.P., 2021. *Knowledge, attitudes and practices toward hepatitis B virus infection among students of medicine in Vietnam.* **International journal of environmental research and public health**, *18*(13), p.7081.

144. Hang Pham, T.T., Le, T.X., Nguyen, D.T., Luu, C.M., Truong, B.D., Tran, P.D., Toy, M. and So, S., 2019. *Knowledge, attitudes and practices of hepatitis B prevention and immunization of pregnant women and mothers in northern Vietnam*. *PloS one*, *14*(4), p.e0208154.

145. A.N Balegha, Yidana, A. and Abiiro, G.A., 2021. *Knowledge, attitude and practice of hepatitis B infection prevention among nursing students in the Upper West Region of Ghana: A cross-sectional study*. *PloS one*, *16*(10), p.e0258757.

146. Rathi, A., Kumar, V., Majhi, J., Jain, S., Lal, P. and Singh, S., 2018. *Assessment of knowledge, attitude, and practices toward prevention of hepatitis B infection among medical students in a high-risk setting of a newly established medical institution*. **Journal of laboratory physicians,** *10*(04), pp.374-379.

147. E. Akazong, E., Tume, C., Njouom, R., Ayong, L., Fondoh, V. and Kuiate, J.R., 2020. *Knowledge, attitude and prevalence of hepatitis B virus among healthcare workers: a*

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

cross-sectional, hospital-based study in Bamenda Health District, NWR, Cameroon. *BMJ open*, *10*(3), p.e031075.

148. T. Gebrecherkos, T., Girmay, G., Lemma, M. and Negash, M., 2020. *Knowledge, attitude, and practice towards Hepatitis B virus among pregnant women attending antenatal care at the University of Gondar comprehensive specialized hospital, Northwest* Ethiopia. **International journal of hepatology**, *2020*.

149. S. Saquib, S., Ibrahim, W., Othman, A., Assiri, M., Al-Shari, H. and Al-Qarni, A., 2019. *Exploring the knowledge, attitude and practice regarding hepatitis B infection among dental students in Saudi Arabia: A cross-sectional study*. **Open access Macedonian journal of medical sciences**, *7*(5), p.805.

150. Hebo, H.J., Gemeda, D.H. and Abdusemed, K.A., 2019. *Hepatitis B and C viral infection: prevalence, knowledge, attitude, practice, and occupational exposure among healthcare workers of Jimma University Medical Center, southwest Ethiopia*. **The Scientific World Journal,** *2019*.

151. Roien, R., Mousavi, S.H., Ozaki, A., Baqeri, S.A., Hosseini, S.M.R., Ahmad, S. and Shrestha, S., 2021. *Assessment of knowledge, attitude, and practice of health-care workers towards hepatitis B virus prevention in Kabul, Afghanistan*. **Journal of Multidisciplinary Healthcare**, *14*, p.3177.

152. M. Dagnew, Million, Y., Destaw, B., Adefris, M., Moges, F. and Tiruneh, M., 2020. *Knowledge, Attitude, and Associated Factors Towards Vertical Transmission of Hepatitis B Virus Among Pregnant Women Attending Antenatal Care in Tertiary Hospitals in Amhara Region, Northwest Ethiopia: A Cross-Sectional Study*. **International Journal of Women's Health,** *12*, p.859.

153. Y. Rajamoorthy, Taib, N.M., Munusamy, S., Anwar, S., Wagner, A.L., Mudatsir, M., Müller, R., Kuch, U., Groneberg, D.A., Harapan, H. and Khin, A.A., 2019. *Knowledge and awareness of hepatitis B among households in Malaysia: a community-based cross-sectional survey*. **BMC public health**, *19*(1), pp.1-11.

154. Aroke, D., Kadia, B.M., Anutebeh, E.N., Belanquale, C.A., Misori, G.M., Awa, A., Mbanga, C.M. and Ngek, L.T., 2018. *Awareness and vaccine coverage of hepatitis B among Cameroonian medical students*. **BioMed research international**, *2018*.

155. T. Ssekamatte, Isunju, J.B., Zirimala, P.A.K., Etajak, S., Kamukama, S., Seviiri, M., Nakafeero, M., Nalugya, A., Tsebeni Wafula, S., Atusingwize, E. and Bukenya, J.N., 2021. *A positive attitude among primary healthcare providers predicts better hepatitis B prevention practices: evidence from a cross-sectional survey in Wakiso district, Central Uganda. Health psychology and behavioral medicine*, *9*(1), pp.298-314.

156. B. Dehghani, Dehghani, A. and Sarvari, J., 2020. *Knowledge and awareness regarding hepatitis B, hepatitis C, and human immunodeficiency viruses among college students: A*

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

report from Iran. International Quarterly of Community Health Education, *41*(1), pp.15-23.

157. B. Kannan, Sivakumar, P. and Ganapathy, D., 2020. *Awareness among dental students about hepatitis B infection--A review. Drug Invention Today*, *13*(3).

158. B. Othman, Al-Najjar, M.A., Othman, D., Al-Qudah, R. and Basheti, I., 2020. *Prevalence, knowledge of and attitude towards hepatitis B virus among pregnant females in Jordan*. **Journal of Viral Hepatitis**, *27*(11), pp.1108-1118.

159. H.M. Al-Shamiri, AlShalawi, F.E., AlJumah, T.M., AlHarthi, M.M., AlAli, E.M. and AlHarthi, H.M., 2018. *Knowledge, attitude and practice of hepatitis B virus infection among dental students and interns in Saudi Arabia*. **Journal of clinical and experimental dentistry,** *10*(1), p.e54.

160. Naziru, R. and Zziwa, S., 2021. *Knowledge, Attitude, and Perception on Hepatitis B Vaccination Among Non-health Workers Attending Selected Health Facilities in Mbale City, Uganda.*

161. Ravichandran, R.K., Jain, J., Ananda, S.R., Jaduram, B. and Gunasekaran, S., 2019. *Knowledge, attitude and practices regarding hepatitis B and infection control among clinical dental students*. **Int J Applied Dent Sci,** *5*(3), pp.42-6.

162. Machmud, P.B., Glasauer, S., Gottschick, C. and Mikolajczyk, R., 2021. *Knowledge, Vaccination Status, and Reasons for Avoiding Vaccinations against Hepatitis B in Developing Countries: A Systematic Review*. *Vaccines*, *9*(6), p.625.

163. Chhabra, D., Mishra, S., Gawande, K., Sharma, A., Kishore, S. and Bhadoria, A.S., 2019. *Knowledge, attitude, and practice study on hepatitis B among medical and nursing undergraduate students of an apex healthcare institute at Uttarakhand foothills: A descriptive analysis. Journal of Family Medicine and Primary Care*, *8*(7), p.2354.

164. Modawi, H.A., 2020. *Knowledge, attitude, and practice (KAP) about Hepatitis B Infection among nursing students in Sabya College, Saudi Arabia: Array. Electronic Physician, 12*(3), pp.7752-7758.

165. Khurram, M., Qaisar, A., Zafar, K.J., Wahid, A., Hassan, F. and Javed, M., 2020. *Assessment of Knowledge and Attitude towards Hepatitis B Infection Among Dental Students in two Teaching Hospitals of Punjab, Pakistan. Annals of Punjab Medical College, 14*(1), pp.78-82.

166. Zara, B., Allah, N.U.M., Javed, W., Siddique, S., Mahmood, H. and Hassan, F., 2020. *A cross-sectional assessment of knowledge, attitude, and practices toward Hepatitis B virus infection among dentists of tertiary hospitals in Islamabad, Pakistan. Pakistan Oral & Dental Journal*, *40*(2), pp.66-71.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

167. Benarji, K.A., Anitha, A., Suresh, B., Aparna, V., Praveena, A. and Penumatsa, L.A., 2021. *Knowledge and attitude of dental students toward hepatitis B virus and its vaccination–A cross-sectional study*. **Journal of Oral and Maxillofacial Pathology***: JOMFP*, *25*(3), p.553.

168. Rathi, A., Kumar, V., Majhi, J., Jain, S., Lal, P. and Singh, S., 2018. *Assessment of knowledge, attitude, and practices toward prevention of hepatitis B infection among medical students in a high-risk setting of a newly established medical institution*. **Journal of laboratory physicians,** *10*(04), pp.374-379.

169. Aniaku, J.K., Amedonu, E.K. and Fusheini, A., 2019. *Assessment of knowledge, attitude and vaccination status of hepatitis B among nursing training students in Ho, Ghana*. Annals of global health, *85*(1).

170. Osei, E., Niyilapah, J. and Kofi Amenuvegbe, G., 2019. *Hepatitis B knowledge, testing, and vaccination history among undergraduate public health students in Ghana*. **BioMed research international,** *2019*.

171. Demsiss, W., Seid, A. and Fiseha, T., 2018. Hepatitis B and C: *Seroprevalence, knowledge, practice and associated factors among medicine and health science students in Northeast Ethiopia. PLoS One*, *13*(5), p.e0196539.

172. Coppeta, L., Pompei, A., Balbi, O., De Zordo, L.M., Mormone, F., Policardo, S., Lieto, P., Pietroiusti, A. and Magrini, A., 2019. *Persistence of immunity for hepatitis B virus among heathcare workers and italian medical students 20 years after vaccination*. **International journal of environmental research and public health**, *16*(9), p.1515.

173. Aroke, D., Kadia, B.M., Anutebeh, E.N., Belanquale, C.A., Misori, G.M., Awa, A., Mbanga, C.M. and Ngek, L.T., 2018. *Awareness and vaccine coverage of hepatitis B among Cameroonian medical students.* **BioMed research international**, *2018*.

174. Wibabara, Y., Banura, C., Kalyango, J., Karamagi, C., Kityamuwesi, A., Amia, W.C. and Ocama, P., 2019. *Hepatitis B vaccination status and associated factors among undergraduate students of Makerere University College of Health Sciences.* ***PloS one***, *14*(4), p.e0214732.

175. Bianchi, F.P., Gallone, M.S., Gallone, M.F., Larocca, A.M., Vimercati, L., Quarto, M. and Tafuri, S., 2019. *HBV seroprevalence after 25 years of universal mass vaccination and management of non-responders to the anti-Hepatitis B vaccine: An Italian study among medical students.* **Journal of Viral Hepatitis**, *26*(1), pp.136-144.

176. Edrees, W.H., Banafa, A.M. and Al-Awar, M.S., 2022. *Risk factors and seroprevalence of hepatitis B virus antigen among university students in the Sana'a city, Yemen*. **Al-Razi University Journal for Medical Sciences**, *6*(1).

DO NOT COPY LEAD CITY UNIVERSITY, NIGERIA

177. Madiba, T.K., Nkambule, N.R., Kungoane, T. and Bhayat, A., 2018. *Knowledge and practices related to hepatitis B infection among dental and oral hygiene students at a university in Pretoria.*

178. Al-Shamiri, H.M., AlShalawi, F.E., AlJumah, T.M., AlHarthi, M.M., AlAli, E.M. and AlHarthi, H.M., 2018. *Knowledge, attitude and practice of hepatitis B virus infection among dental students and interns in Saudi Arabia*. **Journal of clinical and experimental dentistry**, *10*(1), p.e54.

179. Hu, Y.C., Yeh, C.C., Chen, R.Y., Su, C.T., Wang, W.C., Bai, C.H., Chan, C.F. and Su, F.H., 2018. *Seroprevalence of hepatitis B virus in Taiwan 30 years after the commencement of the national vaccination program*. *PeerJ*, *6*, p.e4297.

180. Saç, R., Taşar, M.A., Yalaki, Z., Güneylioğlu, M.M., Özsoy, G., Karadağlı, S., Göçmen, S., Akbaş, N. and Alioğlu, B., 2019. *Hepatitis A, hepatitis B, measles, mumps, rubella and varicella seroprevalence in Turkish adolescent nursing students*. *Nobel Med*, *15*(1), pp.33-40.

181. Khandelwal, V., Gupta, N., Nayak, U.A., Kulshreshtha, N. and Baliga, S., 2018. *Knowledge of hepatitis B virus infection and its control practices among dental students in an Indian city.* **International Journal of Adolescent Medicine and Health,** *30*(5).

182. Bini, C., Grazzini, M., Chellini, M., Mucci, N., Arcangeli, G., Tiscione, E. and Bonanni, P., 2018. *Is hepatitis B vaccination performed at infant and adolescent age able to provide long-term immunological memory? An observational study on healthcare students and workers in Florence, Italy*. *Human vaccines & immunotherapeutics*, *14*(2), pp.450-455.

183. Aljumah, A.A., Babatin, M., Hashim, A., Abaalkhail, F., Bassil, N., Safwat, M. and Sanai, F.M., 2019. *Hepatitis B care pathway in Saudi Arabia: current situation, gaps and actions. Saudi journal of gastroenterology:* **official journal of the Saudi Gastroenterology Association**, *25*(2), p.73.

184. Auta, A., Adewuyi, E.O., Kureh, G.T., Onoviran, N. and Adeloye, D., 2018. *Hepatitis B vaccination coverage among health-care workers in Africa: A systematic review and meta-analysis*. *Vaccine*, *36*(32), pp.4851-4860.

185. Rostamzadeh, M., Afkhamzadeh, A., Afrooz, S., Mohamadi, K. and Rasouli, M.A., 2018. *Dentists' knowledge, attitudes and practices regarding Hepatitis B and C and HIV/AIDS in Sanandaj, Iran*. **BMC oral health**, *18*(1), pp.1-8.

186. Kaviani, M. and Kia, J., 2019. *Determination of hepatitis B antibody titration and related factors in dental students in Guilan University of Medical Sciences*. **International Journal of Scientific Research in Dental and Medical Sciences,** *1*(3), pp.40-47.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

187. Tu, T., Block, J.M., Wang, S., Cohen, C. and Douglas, M.W., 2020. *The lived experience of chronic hepatitis B: a broader view of its impacts and why we need a cure*. *Viruses*, *12*(5), p.515.

188. Trevisan, A., Giuliani, A., Scapellato, M.L., Anticoli, S., Carsetti, R., Zaffina, S., Brugaletta, R., Vonesch, N., Tomao, P. and Ruggieri, A., 2020. *Sex disparity in response to hepatitis B vaccine related to the age of vaccination.* **International journal of environmental research and public health**, *17*(1), p.327.

189. Komas, N.P., Ghosh, S., Abdou-Chekaraou, M., Pradat, P., Al Hawajri, N., Manirakiza, A., Laghoe, G.L., Bekondi, C., Brichler, S., Ouavéné, J.O. and Sépou, A., 2018. *Hepatitis B and hepatitis D virus infections in the Central African Republic, twenty-five years after a fulminant hepatitis outbreak, indicate continuing spread in asymptomatic young adults*. **PLoS neglected tropical diseases**, *12*(4), p.e0006377.

190. Rajamoorthy, Y., Taib, N.M., Munusamy, S., Anwar, S., Wagner, A.L., Mudatsir, M., Müller, R., Kuch, U., Groneberg, D.A., Harapan, H. and Khin, A.A., 2019. *Knowledge and awareness of hepatitis B among households in Malaysia: a community-based cross-sectional survey*. **BMC public health**, *19*(1), pp.1-11.

191. Adjei, C.A., Stutterheim, S.E., Naab, F. and Ruiter, R.A., 2019. *Chronic Hepatitis B stigma in Ghana: a qualitative study with patients and providers*. **BMJ open**, *9*(6), p.e025503.

192. Hang Pham, T.T., Le, T.X., Nguyen, D.T., Luu, C.M., Truong, B.D., Tran, P.D., Toy, M., Bozkurt, S. and So, S., 2019. *Knowledge, attitudes and medical practice regarding hepatitis B prevention and management among healthcare workers in Northern Vietnam*. **PloS one**, *14*(10), p.e0223733.

193. Alrahmah, W.S., Ebrahim, H., Younus, M., Ansari, F.H. and Ansari, S.H., 2018. *Knowledge and Attitude of Dental Students towards the Treatment of Patients with Hepatitis and HIV; A Survey Done in Riyadh, Saudi Arabia*. **Donnish Journal of Dentistry and Oral Hygiene**, *4*(2), pp.31-9.

194. Xu, F., Song, H., An, B., Xiao, Q., Cheng, G. and Tan, G., 2019. *NF-κB-dependent IFIT3 induction by HBx promotes hepatitis B virus replication. Frontiers in microbiology*, *10*, p.2382.

195. Madhavan, A., Palappallil, D.S., Balakrishnapanicker, J. and Asokan, A., 2021. *Immune response to hepatitis B vaccine: An evaluation*. *Perspectives in Clinical Research*, *12*(4), p.209.

196. Han, Z., Zhang, Y., Bai, X., Yin, Y., Xu, C. and Hou, H., 2019. *Mother-to-child transmission of hepatitis B virus after amniocentesis: A retrospective matched cohort study.* **Prenatal Diagnosis**, *39*(6), pp.431-440.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

197. Rajamoorthy, Y., Radam, A., Taib, N.M., Rahim, K.A., Munusamy, S., Wagner, A.L., Mudatsir, M., Bazrbachi, A. and Harapan, H., 2019. *Willingness to pay for hepatitis B vaccination in Selangor, Malaysia: a cross-sectional household survey*. **PLoS One**, *14*(4), p.e0215125.

198. Yuan, Q., Wang, F., Zheng, H., Zhang, G., Miao, N., Sun, X., Woodring, J., Chan, P.L. and Cui, F., 2019. *Hepatitis B vaccination coverage among health care workers in China*. **PloS one**, *14*(5), p.e0216598.

199. Hebo, H.J., Gemeda, D.H. and Abdusemed, K.A., 2019. *Hepatitis B and C viral infection: prevalence, knowledge, attitude, practice, and occupational exposure among healthcare workers of Jimma University Medical Center, southwest Ethiopia*. **The Scientific World Journal**, *2019*.

200. Feng, J., Yang, G., Liu, Y., Gao, Y., Zhao, M., Bu, Y., Yuan, H., Yuan, Y., Yun, H., Sun, M. and Gao, H., 2019. *LncRNA PCNAP1 modulates hepatitis B virus replication and enhances tumor growth of liver cancer*. *Theranostics*, *9*(18), p.5227.

201. Nguyen, M.H., Yang, H.I., Le, A., Henry, L., Nguyen, N., Lee, M.H., Zhang, J., Wong, C., Wong, C. and Trinh, H., 2019. *Reduced incidence of hepatocellular carcinoma in cirrhotic and noncirrhotic patients with chronic hepatitis B treated with Tenofovir—A propensity Score–Matched study*. **The Journal of infectious diseases**, *219*(1), pp.10-18.

202. Whitford, K., Liu, B., Micallef, J., Yin, J.K., Macartney, K., Van Damme, P. and Kaldor, J.M., 2018. *Long-term impact of infant immunization on hepatitis B prevalence: a systematic review and meta-analysis.* **Bulletin of the World Health Organization**, *96*(7), p.484.

203. Zhou, L., He, R., Fang, P., Li, M., Yu, H., Wang, Q., Yu, Y., Wang, F., Zhang, Y., Chen, A. and Peng, N., 2021. *Hepatitis B virus rigs the cellular metabolome to avoid innate immune recognition*. *Nature Communications*, *12*(1), pp.1-13.

204. Liu, R., Zhao, L., Cheng, X., Han, H., Li, C., Li, D., Liu, A., Gao, G., Zhou, F., Liu, F. and Jiang, Y., 2021. *Clinical characteristics of COVID-19 patients with hepatitis B virus infection—a retrospective study. Liver International*, *41*(4), pp.720-730.

205. Yi, H., Zhang, Y., Yang, X., Li, M., Hu, H., Xiong, J., Wang, N., Jin, J., Zhang, Y., Song, Y. and Wang, X., 2020. *Hepatitis B core antigen impairs the polarization while promoting the production of inflammatory cytokines of M2 macrophages via the TLR2 pathway.* **Frontiers in immunology**, *11*, p.535.

206. Tan, G., Xu, F., Song, H., Yuan, Y., Xiao, Q., Ma, F., Qin, F.X.F. and Cheng, G., 2018. *Identification of TRIM14 as a type I IFN-stimulated gene controlling hepatitis B virus replication by targeting HBx*. **Frontiers in immunology**, *9*, p.1872.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

207. Mouzannar, K., Fusil, F., Lacombe, B., Ollivier, A., Ménard, C., Lotteau, V., Cosset, F.L., Ramière, C. and André, P., 2019. *Farnesoid X receptor-α is a proviral host factor for hepatitis B virus that is inhibited by ligands in vitro and in vivo.* **The FASEB Journal**, *33*(2), pp.2472-2483.

208. Das, S., Ramakrishnan, K., Behera, S.K., Ganesapandian, M., Xavier, A.S. and Selvarajan, S., 2019. *Hepatitis B vaccine and immunoglobulin: key concepts*. **Journal of clinical and translational hepatology**, *7*(2), p.165.

209. Splawn, L.M., Bailey, C.A., Medina, J.P. and Cho, J.C., 2018. *Heplisav-B vaccination for the prevention of hepatitis B virus infection in adults in the United States*. **Drugs of today (Barcelona, Spain***: 1998)*, *54*(7), pp.399-405.

210. Auta, A., Adewuyi, E.O., Kureh, G.T., Onoviran, N. and Adeloye, D., 2018. *Hepatitis B vaccination coverage among health-care workers in Africa: A systematic review and meta-analysis. Vaccine*, *36*(32), pp.4851-4860.

211. Yuan, Q., Wang, F., Zheng, H., Zhang, G., Miao, N., Sun, X., Woodring, J., Chan, P.L. and Cui, F., 2019. *Hepatitis B vaccination coverage among health care workers in China*. **PloS one**, *14*(5), p.e0216598.

212. Khan, J., Shil, A. and Mohanty, S.K., 2019. *Hepatitis B vaccination coverage across India: exploring the spatial heterogeneity and contextual determinants.* **BMC Public Health,** *19*(1), pp.1-14.

213. Rajamoorthy, Y., Radam, A., Taib, N.M., Rahim, K.A., Munusamy, S., Wagner, A.L., Mudatsir, M., Bazrbachi, A. and Harapan, H., 2019. *Willingness to pay for hepatitis B vaccination in Selangor, Malaysia: a cross-sectional household survey*. **PLoS One**, *14*(4), p.e0215125.

214. Hyer, R.N. and Janssen, R.S., 2019. *Immunogenicity and safety of a 2-dose hepatitis B vaccine, HBsAg/CpG 1018, in persons with diabetes mellitus aged 60–70 years. Vaccine*, *37*(39), pp.5854-5861.

215. Omotowo, I.B., Meka, I.A., Ijoma, U.N., Okoli, V.E., Obienu, O., Nwagha, T., Ndu, A.C., Onodugo, D.O., Onyekonwu, L.C. and Ugwu, E.O., 2018. *Uptake of hepatitis B vaccination and its determinants among health care workers in a tertiary health facility in Enugu, South-East, Nigeria.* **BMC infectious diseases**, *18*(1), pp.1-9.

216. Intongkam, S., Samakarnthai, P., Pakchotanon, R., Narongroeknawin, P., Assavatanabodee, P. and Chaiamnuay, S., 2019. *Efficacy and safety of hepatitis B vaccination in rheumatoid arthritis patients receiving disease-modifying antirheumatic drugs and/or biologics therapy.* **JCR: Journal of Clinical Rheumatology**, *25*(8), pp.329-334.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

217. Kashi, D.S., Oliver, S.J., Wentz, L.M., Roberts, R., Carswell, A.T., Tang, J.C., Jackson, S., Izard, R.M., Allan, D., Rhodes, L.E. and Fraser, W.D., 2021. *Vitamin D and the hepatitis B vaccine response: a prospective cohort study and a randomized, placebo-controlled oral vitamin D3 and simulated sunlight supplementation trial in healthy adults.* **European Journal of Nutrition,** *60*(1), pp.475-491.

218. Sood, A.B., O'Keefe, G., Bui, D. and Jain, N., 2018. *Vogt-Koyanagi-Harada disease associated with hepatitis B vaccination.* **Ocular immunology and inflammation**.

219. Solay, A.H. and Eser, F., 2019. *High dose hepatitis B vaccine is not effective in patients using immunomodulatory drugs: a pilot study.* **Human Vaccines & Immunotherapeutics**.

220. Dayyab, F.M., Iliyasu, G., Ahmad, B.G., Bako, A.T., Ngamariju, S.S. and Habib, A.G., 2020. *Hepatitis B vaccine knowledge and self-reported vaccination status among healthcare workers in a conflict region in northeastern Nigeria*. **Therapeutic advances in vaccines and immunotherapy**, *8*, p.2515135519900743.

221. Rajamoorthy, Y., Radam, A., Taib, N.M., Rahim, K.A., Wagner, A.L., Mudatsir, M., Munusamy, S. and Harapan, H., 2018. *The relationship between perceptions and self-paid hepatitis B vaccination: a structural equation modeling approach*. **PloS one**, *13*(12), p.e0208402.

222. Bartholomeus, E., De Neuter, N., Meysman, P., Suls, A., Keersmaekers, N., Elias, G., Jansens, H., Hens, N., Smits, E., Van Tendeloo, V. and Beutels, P., 2018. *Transcriptome profiling in blood before and after hepatitis B vaccination shows significant differences in gene expression between responders and non-responders*. *Vaccine*, *36*(42), pp.6282-6289.

223. Van Damme, P., Dionne, M., Leroux-Roels, G., Van Der Meeren, O., Di Paolo, E., Salaun, B., Surya Kiran, P. and Folschweiller, N., 2019. *Persistence of HB sAg-specific antibodies and immune memory two to three decades after hepatitis B vaccination in adults.* **Journal of viral hepatitis,** *26*(9), pp.1066-1075.

224. Perez Cuevas, M.B., Kodani, M., Choi, Y., Joyce, J., O'Connor, S.M., Kamili, S. and Prausnitz, M.R., 2018. *Hepatitis B vaccination using a dissolvable microneedle patch is immunogenic in mice and rhesus macaques*. **Bioengineering & translational medicine,** *3*(3), pp.186-196.

225. Moturi, E., Tevi-Benissan, C., Hagan, J.E., Shendale, S., Mayenga, D., Murokora, D., Patel, M., Hennessey, K. and Mihigo, R., 2018. *Implementing a birth dose of hepatitis B vaccine in Africa: findings from assessments in 5 countries*. **Journal of immunological sciences,** (5), p.31.

226. Schillie, S., Harris, A., Link-Gelles, R., Romero, J., Ward, J. and Nelson, N., 2018. *Recommendations of the Advisory Committee on Immunization Practices for use of a*

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hepatitis B vaccine with a novel adjuvant. **Morbidity and Mortality Weekly Report**, *67*(15), p.455.

227. Kisangau, E.N., Awour, A., Juma, B., Odhiambo, D., Muasya, T., Kiio, S.N., Too, R. and Lowther, S.A., 2019. *Prevalence of hepatitis B virus infection and uptake of hepatitis B vaccine among healthcare workers, Makueni County, Kenya 2017*. **Journal of Public Health**, *41*(4), pp.765-771.

228. Saco, T.V., Strauss, A.T. and Ledford, D.K., 2018. *Hepatitis B vaccine nonresponders: possible mechanisms and solutions*. *Annals of Allergy, Asthma & Immunology*, *121*(3), pp.320-327.

229. Bento, D., Jesus, S., Lebre, F., Gonçalves, T. and Borges, O., 2019. Chitosan plus compound 48/80: *formulation and preliminary evaluation as a hepatitis B vaccine adjuvant. Pharmaceutics*, *11*(2), p.72.

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Chapter Three

Methodology

3.1 Research Design

This study was a cross sectional study.

3.2 Population and Sample

The study was conducted among all undergraduate students of the Lead city university including diploma students and community health students.

Inclusion Criteria

Male and Female undergraduates, those who are sexually active, those who are full time students, those who consented to participate in the study.

Exclusion Criteria

Students who were too ill to participate in the study, Part time students are also excluded and those who objected to the study.

3.3 Sample and Sampling Techniques

A multistage sampling technique was used for this study, the first stage is where all participants are grouped into clusters according to their faculties and then the second stage, the participant were grouped into smaller clusters according to their departments under these faculties.

The sample size for this study will drawn from the estimated five thousand female undergraduate students schooling at lead city university using the Leslie fisher's formula.

Using a sample size determination formula, $ZXPXQ/D2$

Where; N =sample size,

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Z= confidence level (95%=1.96),

p = estimated prevalence of knowledge/attitude towards HBV (50% = 0.5)

d= margin of error (0.05),

Q = (1-P) proportion of people without knowledge on the disease =1- 0.5 =0.5

N = 3.8416 x 0.5 x 0.5 = 384.

0.0025.

Representative sample of 400 (16+384) was used from the population at confidence level of 95% and a margin of error 0.05 where the additional 16 represent possible non responses. These numbers of respondents were chosen based on the formula above.

3.4 Research Instrument

The research instrument for the study was a self-administered questionnaire which were distributed to students within the university.

The questionnaire was adopted from studies related to this research which includes:

- Assessing the knowledge, attitude and perception of Hepatitis b viral infection among young adults in Sagnarigu district of the northern region, Ghana[1].
- Hepatitis B vaccination status and knowledge, attitude, and practice regarding Hepatitis B among preclinical medical students of a medical college in Nepal[2].

The questionnaire was reviewed. The questionnaire will have four sections:

Section A: Socio-demographic data

Section B: Awareness of Hepatitis B virus

Section C: Attitude of students towards Hepatitis B vaccination

Section D: Status of hepatitis B vaccination

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3.5 Validity and Reliability of the Research Instrument

The validity and reliability test was not required since the questionnaire for the study was adopted from previous studies.

No need to conduct pretest.

Context difference.

Operational definition and measurement of the key terms.

3.6 Data Collection Approach

The data collection approach was a self administered questionnaire. The purpose of the study was introduced orally and informed consent was obtained from each participant prior to the process. The procedure for data collection from the participants was explained and questionnaires was shared.

3.7 Data Analysis

Upon completion of data collection, statistical package for social sciences (SPSS version 26 was used for the analysis. Frequency distribution tables and descriptive statistics like percentages: mode, and mean was used to describe the characteristics in the study subjects. This statistical package helped for clarity and easy understanding of raw data. The chi--square (X2) test was used to compare the association between dependent and independent variables in which the conclusion was drawn on the result of the test. .

3.8 Ethical Consideration

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Ethical approval was obtained from the lead city university health research committee in fulfillment of the following:

- Voluntary participation
- Participation based on informed consent
- Privacy and anonymity of participants.

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Chapter four

Results and Discussion of Findings

This chapter presents the analysis of the data that was collected from the respondents. It is presented largely descriptively in the form of tables and charts. The results is organized into four thematic areas comprising; demographic characteristics of respondents, awareness of Hepatitis B virus among students, attitude of students towards Hepatitis B Virus vaccination among students and the utilization status of hepatitis vaccination among students.

4.1 Demographic Data Analysis

A total of 395 participants were recruited for the study at the study area. Majority 245 (62.3%) of the respondents falls between age range 15 - 20 years. majority of the respondents 256 (63.7%) were female (table 4.1).

Based on the findings, 289(81%) of the participant are Yoruba while only 28(7.8%) are Igbo. Meanwhile, 292(74.3%) respondents indicated that they are Christians.(table 4.1)

The analysis indicates that, majority of the participants 201(51%) were first year students, whilst 121 (30.7) were second year students. The results also showed that most of the study participant 372(93.9%).

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Table 4.1: Socio-demographic characteristics of respondents

Variable	**Frequency**	**Percentage**
Age		
Below 15	28	7.1
15 - 19	245	62.3
20 - 24	76	19.3
25+	44	11.2
Sex		
Male	139	34.6
Female	256	63.7
Ethnicity		
Yoruba	289	81
Others	68	19
Religion		
Christian	292	74.3
Muslim	98	24.9
Others	2	0.5
Year Of Study		
Year 1	201	51
Year 2-5	192	49
Marital Status		
Single	372	93.9
Ever Married	24	6.2

Source: field survey, 2022

4.2.1 Awareness of Hepatitis B Virus Among Students

In this study, participants were asked whether they have ever heard of hepatitis B virus infection before, 192(49.4%) said yes while 197(50.6%) said no (figure 4.1).

Questions were asked to know the awareness of the symptoms of hepatitis B virus, majority of the respondent 260(66.2) do not know if jaundice is a symptom of hepatitis B virus, also 265(67.3) do not know if dark urine is a symptom of hepatitis B virus, likewise majority of respondents do not know for pale stool 298(76.2), vomiting 280(71.2), diarrhea 294(75.2), abdominal discomfort 254(64.3).

Hepatitis B transmission route varies according to the prevalence rate of the virus. Countries with very high prevalence rate usually have vertical transmission as the main route of transmission which is mostly found during childhood. Countries with intermediate prevalence rates normally have horizontal transmission as its major route where the disease is transmitted through sexual contact or through injecting of drugs18. As at the time of the study, the findings showed that the study participant did not know whether hepatitis b virus infection can be transmitted through injection drug use 256(65.0) or sharing of hair clipper/razor blade 219(55.4) or infected unscreen blood preoducts 205(51.9) or tattoos/acupuncture 255(64.7) or sexually 212(53.7) or mother to child 251(63.7) while 81(20.5) were of the opinion that hepatitis b can be transmitted through closely living with positive person.

Prevention is considered as one best way to safeguard populations' health. Prevention against any disease is proportional to knowledge and practice of the population and is reflective of the importance that is paid to health related issues by the society. In this

study, participants were asked whether hepatitis B virus is preventable, 222(56.5) agreed while 165(42.0) did not know.

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Table 4.2: Hepatitis B Knowledge virus among students

AWARENESS LEVEL	Frequency	percentage
YES	192	49.40%
NO	197	50.60%

Source: field survey, 2022

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Table 4.3: Awareness of Hepatitis B Virus among Students

Symptoms	Yes	No	Do Not Know
Jaundice	101(25.7)	32(8.1)	260(66.2)
Dark Urine	104(26.4)	25(6.3)	265(67.3)
Pale Stool	71(18.2)	22(5.6)	298(76.2)
Vomiting	84(21.4)	29(7.4)	280(71.2)
Diarrhea	70(17.9)	27(6.9)	294(75.2)
Abdominal Discomfort	127(32.2)	14(3.5)	254(64.3)
Transmission			
Injection Drug Use	105(26.6)	33(8.4)	256(65.0)
Sharing Of Hair Clipper/Razor Blade	149(37.7)	27(6.8)	219(55.4)
Infected Unscreen Blood Preoducts	179(45.3)	11(2.8)	205(51.9)
Tattoos/Acupuncture	118(29.9)	21(5.3)	255(64.7)
Sexually	167(42.3)	16(4.1)	212(53.7)
Closely Living With Positive Person	81(20.5)	71(18.0)	243(61.5)
Mother To Child	130(33.0)	13(3.3)	251(63.7)
Prevention			
Can Hepatitis B Be Prevented	222(56.5)	6(1.5)	165(42.0)
Not Sharing Injection	185(46.8)	10(2.5)	200(50.6)
Not Sharing Of Hair Clipper/Razor Blade	174(44.1)	12(3.0)	209(52.9)
Screening Of Blood Products	193(48.9)	5(1.3)	197(49.9)
Avoiding Tattoos	142(35.9)	14(4.3)	236(59.7)
Sexual Fidelity	165(41.8)	17(4.3)	213(53.9)

Avoiding Direct Contact With Body Fluid	176(44.6)	11(2.8)	208(52.7)
Vaccination	194(49.1)	5(1.3)	196(49.6)
Immunoglobin To Children Of Infected Mothers	152(38.6)	7(1.8)	235(59.6)
Hand Washing	130(33.0)	28(7.1)	236(59.9)
Counselling	153(38.8)	21(5.3)	220(55.8)

Source: field survey, 2022

Based on the findings, it was revealed that the highest source of information about the vaccine is the hospital 18(36%) followed by radio, television and school which had the same score of 7(14%).

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4.2.2 Attitude of Students Towards Hepatitis B Vaccination Among Students

Fortunately, hepatitis B virus infection is largely preventable by hepatitis B vaccine which is 95% effective in preventing such disease and its chronic consequences. Transmission of infection is rare among persons who have been immunized. Analysis also revealed that a vast majority 301(76.6%) of the subjects said healthy people need the HBV vaccine whiles 92(23.4%) of the subjects could not tell whether healthy people need the vaccine or not (Table 4. 4).

It was revealed that, 220(56.0%) of the respondent agreed that hepatitis b vaccination should be made compulsory while 173(44.0%) disagreed. Also it was revealed that 177(44.9%) of the respondents are scared of vaccination. Findings also shows that 132(33.6%) of the respondents will continue friendship with a person with hepatitis b virus while 261(66.4%) would not. Majority of the respondents 241(62.0%) agreed that hepatitis b virus positive students should not be allowed in school.

Findings revealed that, 236(60.4%) are willing to be tested for hepatitis b virus infection, whilst 155(39.6%) said otherwise.

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Table 4.5: Attitudes towards HBV infection

Variables	correct	incorrect
Healthy people need vaccination	301(76.6)	92(23.4)
Hepatitis b vaccination should be made compulsory	220(56.0)	173(44.0)
I need vaccination at my age	242(62.1)	148(37.9)
I am always careful, so i dont need vaccination	227(57.6)	167(42.4)
I am not at risk, therefore dont need vaccination	242(61.6)	151(38.4)
I am scared of vaccination	177(44.9)	217(55.1)
I dont trust the vaccine	183(53.4)	210(46.6)
I will continue friendship with a person with hepatitis b	132(33.6)	261(66.4)
Hbv positive students should be allowed in school	148(38.0)	241(62.0)

Source: field survey, 2022

It was also revealed from the study that, 226 (68.5%) said they were willing to take the vaccine, whilst 104 (31.5%) respondents said they do not want to be vaccinated (Table 4. 6).

Table 4.6: Vaccination Willingness

VACCINATION WILLINGNESS RATE	Frequency	percentage
YES	226	68.5
NO	104	31.5

Source: field survey, 2022

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4.2.2.1 Rating Of Respondent Level Of Attitude Toward HBV Infection

Respondents were asked series of questions in relation to the attitude towards hepatitis B virus infection (Table 4.4). Majority, 212 (55%) of the respondents scored between the range of 6-10 indicating good attitude, followed by 137(36%) falling within the range of 0-4 signifying bad attitude and 36(9.4%) scoring 5 implying neutral attitude.

Table 4.7: Rating of respondents' level of attitude towards HBV infection

VARIABLE	Frequency	percentage
BAD ATTITUDE 0-4 (LOW)	137	36%
MODERATE ATTITUDE 5 (AVERAGE)	36	9.40%
GOOD ATTITUDE 6-10 (HIGH)	212	55%

Source: field survey, 2022

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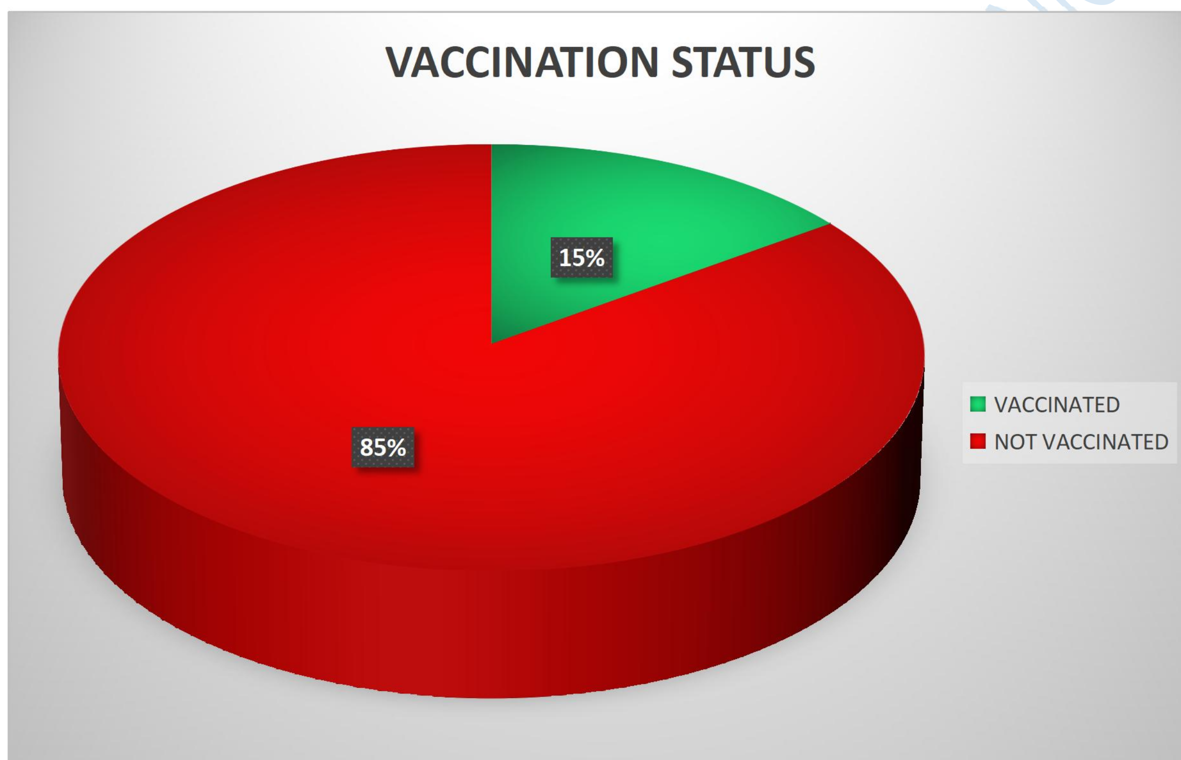
4.2.3 Prevalence of Hepatitis B Vaccination among Students

Question about the vaccination status of the participants was asked, majority of the respondent 371(85%) are not vaccinated while 56(15%) are vaccinated.



Source: field survey, 2022

Figure 4.5: vaccination status

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Out of those that are vaccinated, 22(50%) were vaccinated as an adult while 20(45.5%) were vaccinated as a child while the is only 1(2.3%) each for those vaccinated as a pregnant woman or as as a traveller.

Table 4.9: Vaccination Year

at what age	Frequency	percentage
Child	20	45.5
Adult	22	50
pregnant woman	1	2.3
Traveler	1	2.3

Source: field survey, 2022

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Finding shows that out of those that are vaccinated, 14(35%) shows that they received two doses of the vaccination, followed by 13(32.5%) who received three doses of the vaccination, while 12(30%) received just a single dose of the vaccination.

Table 4.10: Number of Doses

How Many Doses	Frequency	percentage
One	12	30
Two	14	35
Three	13	32.5
Four	1	2.5

Source: field survey, 2022

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4.2.4 Association between Variables

4.2.4.1 Test for association between age and awareness rate of hepatitis B virus

This study assessed if there was a significant association between the age range of respondents and the awareness rate. Pearson chi-square value of $\chi 2 = 25.410$, $P = 0.000$ at 0.05 level of significance showed that there was a significant association between age range of respondents and the awareness rate. The age range with the highest level of awareness is 26 above.

Table 4.11 : Table showing the association of age and awareness rate

	Yes	NO	P-VALUE	CHI-SQUARE VALUE
Age			0.000	25.410
15-20	112(41.80%)	156(58.2%)		
21-25	42(56.8%)	32(43.2%)		
26 Above	35(81.4%)	8(18.6%)		

Source: field survey, 2022

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4.2.4.2 Association between age and attitude of repondents towards hepatitis B

There is a general good attitude towards hepatitis B infection. The age group that has the highest percentage of good attitude is the 26 above. This can be correlated to the high level of awareness of this age group.

Table 4.12: association of age with attitude of respondents towards hepatitis B

	Bad Attitude	Good Attitude	P VALUE	chi-square value
AGE			0.016	8.212
15-20	120 (44.1%)	152(55.9%)		
21-25	26(35.1%)	48(64.9%)		
26 Above	9(22%)	32(78%)		

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4.2.4.3 Association between year of study and vaccination willingness

The year of study with the highest percentage of vaccination willingness is second year while the one with the lowest willingness percentage first year. This can be associated to the first year new in the school environment and they are more cautious of what to do .

Table 4.13: Association between year of study and vaccination willingness

	Yes	No	P-Value	Chi-Square Value
Year Of Study			0.0000	27.172
1st Year	55.30%	44.70%		
2nd Year	84.30%	15.70%		
3rd Year	75.90%	24.10%		
4th Year	76.70%	23.30%		

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4.2.4.4 Association of gender and vaccination willingness

More female respondents (71.61%) are willing to be vaccinated than the male respondent (62.30%)

Table 4.14 : showing the relationship between gender and vaccination willingness

	Male	Female	P-Value	Chi-Square Value
Vaccination Willingness			3.011	0.83
Yes	62.30%	71.60%		
No	37.70%	28.40%		

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4.3 Discussion of Findings

According to the World Health Organization1, hepatitis B is the world's most common liver infection caused by a DNA virus called hepatitis B virus (HBV). The virus is highly contagious, 50 to 100 times more contagious than HIV, and spreads from person to person through blood, semen, vaginal fluids, and mucous membranes. Worldwide, there are more than 2 billion people with evidence of recent or past HBV

infection, and 350 million are chronic carriers. His hepatitis B, a silent killer, has become a major threat to global health, yet has failed to capture the attention of Nigerian health authorities, policy makers, the general public and decision makers, Lack of knowledge about how to prevent HBV infection is associated with increased occupational and everyday risks, so it is important to educate people about the disease so that they can take steps to prevent them from contracting the disease. It is important to recognize

The results of this study showed that slightly below average respondents (49.4%) knew about hepatitis B virus infection. Most of the respondents did not know the symptoms, transmission routes, or even prevention methods. These results correlate with other studies. Idrisu Abdulai (2017) surveyed the knowledge, attitudes and perceptions of his hepatitis B virus infection among his 400 young adults in the Northern Region of Ghana. His results showed that participants perceive at his 89% knowledge rate, but the knowledge level of respondents in this recent survey is average. Another survey conducted among 344 University of Ibadan students found a higher recognition rate (89.4%) compared to that of the current survey.

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The reason may be that most of the students are under the age of 20 (Table 4.1), and it is also possible that some students were unable to make their own decisions. The results of this study show that people's attitudes towards hepatitis B virus infection are positive. They indicated that healthy people should be vaccinated against HBV (76.6%) and felt that people their age should be vaccinated (62.1%).

Additionally ,56% agree to make her hepatitis B vaccination mandatory. However, 62% would not agree to continue a friendship with her hepatitis B patient. Most (69%) also wanted her to be tested for hepatitis B virus infection, but 31% of her respondents said she did not want to be vaccinated.

These current findings are consistent with those conducted in northern Ghana by Iddrisu Abdulai (2017)2. This indicates that most people (87.5%) are willing to have her tested for hepatitis B virus infection. The results of the current study contradict those of the study by Ibrahim & Adepoju 2019, which showed that fewer people (37%) plan or want to be tested for hepatitis B virus infection. 3. Respondents' high motivation may be due to their belief that vaccines are safe. They found that the vaccination rate among students was very low at 15%, and the non-vaccination rate was 85%. The results show that the vaccination status of this current study is very similar to that of the study conducted by Ibrahim & Adepoju at the University of Ibadan4.

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Endnotes

1. World Health Organisation, 2014. *Global routine vaccination coverage*. Weekly Epidemiol Rec, 89:517–522.

2. Iddrisu Abdulai (2017), *Assessing the knowledge, attitude and perception of hepatitis b viral infection among young adults in sagnarigu district of the northern region*

3. Ibrahim & Adepoju (2020), *Analysis of the knowledge of and attitude to Hepatitis B virus among Students of the University of Ibadan, Nigeria*

4. Osei, E., Niyilapah, J. and Kofi Amenuvegbe, G., 2019. *Hepatitis B knowledge, testing, and vaccination history among undergraduate public health students in Ghana*. **BioMed research international**, *2019*.

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Chapter Five

Conclusion

This chapter is divided into three sections. The first section presents the summary of findings from the study in relation to the set objectives. The second section gives the conclusions and the last section suggests recommendations.

5.1 Summary of Findings

An examination of the demographic characteristics of the people showed that there were more female respondents (63.7%) as compared to their male counterpart. It was also found that majority of the respondents (69.4%) were within 15-25 years age. Majority of the respondents (74.3%) were Christians compared to the other religions. A look at the awareness of hepatitis b virus among students revealed average level of awareness among them, as those that are aware is 49.4%.

The attitude of people on Hepatitis B Virus infection was also assessed in the study. Results from the study showed that majority of the people (55%) had good attitude as this percentage had an average score of 3 and the perception was not bad as less than half of them scored within the range of 0-2. Also, majority (56%) of the participant were of the view that hepatitis b vaccination should be made compulsory. The results of the study also showed that most of respondents (78%) believed that healthy people need vaccination against HBV. Almost all of the respondents (69%)

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indicated that they were willingness to be vaccinated against Hepatitis B Virus infection. However, only 15% had ever been vaccinated against the hepatitis B virus infection.

5.2 Conclusion

This study provides some evidence of a student's level of awareness, attitudes, and use of her hepatitis B virus (HBV) infection at a major university in the city. The results showed that about half of the Respondents are aware of HBV infection. The level of knowledge about HBV infection was also low. The study also showed that respondents' attitudes to hepatitis B virus infection were good, although most were able to answer the attitude questions correctly but they were unable to find the best way to prevent infection. They showed that healthy people needed to be vaccinated against HBV and thought that people of the same age needed to be vaccinated. They also agreed to be tested for hepatitis B virus infection. Some people were few.

5.3 Recommendation

1. Universities should raise awareness about the benefits and safety of HB vaccination.

2. Universities should work with ministry of health to get free kit to conduct the Hepatitis B virus test

3. Lectures on hepatitis B virus and vaccination should be part of the school orientation program for the new students.

4. Hepatitis B virus test should be made a compulsory part of medical test done for new students

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5. Governments and nongovernmental organizations should consider expanding currently available prevention facilities and adopting sustainable infection control and prevention strategies.

6. Hepatitis B vaccines should be made available at the university hospital for students to be vaccinated.

7. Post exposure prophylaxis should also be made available at the university hospital.

5.4 Contributions to Knowledge.

This study highlighted the extent of an unimmunized student and related it to HBV infection and awareness and attitudes towards her hepatitis B vaccination. This will help universities and university hospitals understand the scope of vaccination and develop strategies to promote and improve the student's hepatitis B virus vaccination.

5.5 Suggestions for further research

1. Further research is needed to know the hepatitis B virus prevalence among Nigerian college students.

2. Qualitative study to know why students are not willing to be vaccinated against HBV.

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Bibliography

Books

Angioletta Lasagna, Valentina Zuccaro, Paolo Sacchi, Silvia Chiellino, Raffaele Bruno, Paolo Pedrazzoli, 2021, *Risk of reactivation of occult hepatitis B during immunotherapy in cancer treatment: myth, reality or new horizons*?, Future Oncology, 10.2217/fon-2020-1196, 17, 13, (1577-1580).

Bento, D., Jesus, S., Lebre, F., Gonçalves, T. and Borges, O., 2019. *Chitosan plus compound 48/80: formulation and preliminary evaluation as a hepatitis B vaccine adjuvant*. Pharmaceutics, *11*(2), p.72.

Block TM, Alter HJ, London WT, Bray M., 2016, *A historical perspective on the discovery and elucidation of the hepatitis B virus.* Antiviral Res. 2016 Jul;131:109-23. doi: 10.1016/j.antiviral.2016.04.012. Epub 2016 Apr 20. PMID: 27107897.

Bonino, F., Colombatto, P. and Brunetto, M.R., 2022. *HBeAg-Negative/Anti-HBe-Positive Chronic Hepatitis B: A 40-Year-Old History*. Viruses, *14*(8), p.1691.

CDC. Travellers' Health; Yellow Book, 2021, *Recommendations for Routine Testing and Follow-up for Chronic Hepatitis B Virus (HBV) Infection*, *CR-009837 10/2021* doi:10.1002/hep.22882

Ding H, Fawad M, Xu X, Hu B. 2022, *A framework for identification and classification of liver diseases based on machine learning algorithms*. Front Oncol. Oct 14;12:1048348. doi: 10.3389/fonc.2022.1048348. PMID: 36313630; PMCID: PMC9614094.

Fatehi, F., Bingham, R.J., Stockley, P.G. et al. *An age-structured model of hepatitis B viral infection highlights the potential of different therapeutic strategies*. Sci Rep 12, 1252 (2022). https://doi.org/10.1038/s41598-021-04022-z

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

Hutin, Y., Desai, S. and Bulterys, M., 2018. *Preventing hepatitis B virus infection: milestones and targets*. Bulletin of the World Health Organization, *96*(7), pp.443-443A.

Khuroo MS, Sofi AA. 2020, *The Discovery of Hepatitis Viruses: Agents and Disease*. J Clin Exp Hepatol. 2020 Jul-Aug;10(4):391-401. doi: 10.1016/j.jceh.2020.04.006. Epub 2020 Apr 20. PMID: 32655240; PMCID: PMC7335725.

Mysore, K.R. and Leung, D.H., 2018. *Hepatitis B and C*. *Clinics in Liver Disease*, *22*(4), pp.703-722.

Prevention of mother-to-child transmission of hepatitis B virus, 2020, guidelines on antiviral prophylaxis in pregnancy, World Health Organization ebook pub, 2020. Licence: CC BY-NC-SA 3.0 IGO.

Shih, Y.F. and Liu, C.J., 2020. *Hepatitis C virus and hepatitis B virus co-infection*. *Viruses*, *12*(7), p.741.

TEO, C. 2018. *19th-century and early 20th-century jaundice outbreaks, the USA*. Epidemiology and Infection, 146(2), 138-146. doi:10.1017/S0950268817002837

World Health Organization, 2018. Global hepatitis report 2017: web annex A: *estimations of worldwide prevalence of chronic hepatitis B virus infection: a systematic review of data published between 1965 and 2017*.

World Health Organization, 2018. Hepatitis B mhGAP operations manual, pg 95, WHO/CDS/CSR/LYO 2: 6-14

World Health Organization, 2019. Hepatitis B vaccines: WHO position paper, July 2017–Recommendations. *Vaccine*, *37*(2), pp.223-225.

World Health Organization. 2022. *Hepatitis B*. World Health Organization., http://www.who.int/news-room/factsheets/detail/hepatitis-b

World Hepatitis Alliance, 2018 *Find the missing millions: barriers to diagnosis global report*. Djs research ebook.

Journals

Abebe, M., Alemnew, B. and Biset, S., 2020, *Prevalence of hepatitis B virus and hepatitis C virus among blood donors in nekemte blood bank, Western Oromia, Ethiopia: retrospective 5 years study*. ***Journal of blood medicine***, *11*, p.543.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

Acikgoz, A., Cimrin, D., Kizildag, S., Esen, N., Balci, P. and Sayiner, A.A., 2020, *Hepatitis A, B and C seropositivity among first-year healthcare students in western Turkey: a seroprevalence study*, ***BMC Infectious Diseases***, *20*(1), pp.1-8.

Adjei, C.A., Stutterheim, S.E., Naab, F. and Ruiter, R.A., 2019, *Chronic Hepatitis B stigma in Ghana: a qualitative study with patients and providers*, ***BMJ open***, *9*(6), p.e025503.

Agba, A.A. and Aguh, I.B., 2020, *Hepatitis B Surface Antigenaemia and Some Associated Risk Factors Among Patients Attending Hospital in Danja Local Government Area of Katsina State, Nigeria*. ***International Journal Of Science for Global Sustainability***, *6*(2), pp.6-6.

Airewele, N.E. and Shiffman, M.L., 2021, *Chronic hepatitis B virus in patients with chronic hepatitis C virus.* **Clinics in Liver Disease**, *25*(4), pp.817-829.

Akazong, E., Tume, C., Njouom, R., Ayong, L., Fondoh, V. and Kuiate, J.R., 2020, *Knowledge, attitude and prevalence of hepatitis B virus among healthcare workers: a cross-sectional, hospital-based study in Bamenda Health District, NWR, Cameroon*, ***BMJ open***, *10*(3), p.e031075.

Alali, A.A., Abo-Shehada, M.N., 2022, *Prevalence of Hepatitis B Virus infection in the Gulf Cooperation Council: a systematic review and meta-analysis*. **BMC Infect Dis** 22, 819. https://doi.org/10.1186/s12879-022-07806-4

Aliyu-zubair, R., Yakubu, A.M., Ogurinde, G.O., Ibrahim, A. and Olayinka, A., 2021, *Prevalence of hepatitis B markers seropositivity in sickle cell (SCA) children in ABUTH Shika, Kaduna State,* ***Ibom Medical Journal***, *14*(3), pp.371-384.

Aljumah, A.A., Babatin, M., Hashim, A., Abaalkhail, F., Bassil, N., Safwat, M. and Sanai, F.M., 2019, *Hepatitis B care pathway in Saudi Arabia: current situation, gaps and actions. Saudi journal of gastroenterology:* **official journal of the Saudi Gastroenterology Association,** *25*(2), p.73.

Al-Mahtab, M., Roy, P. P., Khan, M., & Akbar, S. M., 2020, *Nobel Prize for the Discovery of Hepatitis B and C: A Brief History in Time*. **Euroasian journal of hepatogastroenterology**, 10, 98-100

Alrahmah, W.S., Ebrahim, H., Younus, M., Ansari, F.H. and Ansari, S.H., 2018, *Knowledge and Attitude of Dental Students towards the Treatment of Patients with Hepatitis and HIV; A Survey Done in Riyadh, Saudi Arabia*. **Donnish Journal of Dentistry and Oral Hygiene**, *4*(2), pp.31-9.

Al-Shamiri, H.M., AlShalawi, F.E., AlJumah, T.M., AlHarthi, M.M., AlAli, E.M. and AlHarthi, H.M., 2018. *Knowledge, attitude and practice of hepatitis B virus infection among dental students and interns in Saudi Arabia*. **Journal of clinical and experimental dentistry**, *10*(1), p.e54.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

Al-Shamiri, H.M., AlShalawi, F.E., AlJumah, T.M., AlHarthi, M.M., AlAli, E.M. and AlHarthi, H.M., 2018. *Knowledge, attitude and practice of hepatitis B virus infection among dental students and interns in Saudi Arabia*. **Journal of clinical and experimental dentistry**, *10*(1), p.e54.

Aniaku, J.K., Amedonu, E.K. and Fusheini, A., 2019. *Assessment of knowledge, attitude and vaccination status of hepatitis B among nursing training students in Ho, Ghana*. **Annals of global health**, *85*(1).

Aroke, D., Kadia, B.M., Anutebeh, E.N., Belanquale, C.A., Misori, G.M., Awa, A., Mbanga, C.M. and Ngek, L.T., 2018. *Awareness and vaccine coverage of hepatitis B among Cameroonian medical students*. **BioMed research international**.

Atalay AA, Abebe RK, Dadhi AE, Bededa WK, 2021, *Seroprevalence of hepatitis B virus among pregnant women attending Antenatal care in Dilla University Referral Hospital Gedio Zone, Ethiopia; health facility based cross-sectional study.* **PLoS ONE** 16(3): e0249216. https://doi.org/10.1371/journal.pone.0249216

Auta, A., Adewuyi, E.O., Kureh, G.T., Onoviran, N. and Adeloye, D., 2018. *Hepatitis B vaccination coverage among health-care workers in Africa: A systematic review and meta-analysis*. **Vaccine**, *36*(32), pp.4851-4860.

B.I. Ajuwon, Yujuico, I., Roper, K. et al, 2021, *Hepatitis B virus infection in Nigeria: a systematic review and meta-analysis of data published between 2010 and 2019*. **BMC Infect Dis** 21, 1120. https://doi.org/10.1186/s12879-021-06800-6

Ba, A., Ndiaye, F.K., Djeng, Y.J., Cames, C., Diack, A. and N'diaye, O., 2019. *Impact of highly active antiretroviral therapy on chronic hepatitis B serological markers among Senegalese HIV co-infected children.* **International Journal of Maternal and Child Health and AIDS**, *8*(2), p.131.

Balegha, A.N., Yidana, A. and Abiiro, G.A., 2021. *Knowledge, attitude and practice of hepatitis B infection prevention among nursing students in the Upper West Region of Ghana: A cross-sectional study*. **PloS one**, *16*(10), p.e0258757.

Bancha, B., Kinfe, A.A., Chanko, K.P., Workie, S.B. and Tadese, T., 2020. *Prevalence of hepatitis B viruses and associated factors among pregnant women attending antenatal clinics in public hospitals of Wolaita Zone, South Ethiopia.* **PloS one**, *15*(5), p.e0232653.

Bartholomeus, E., De Neuter, N., Meysman, P., Suls, A., Keersmaekers, N., Elias, G., Jansens, H., Hens, N., Smits, E., Van Tendeloo, V. and Beutels, P., 2018. *Transcriptome profiling in blood before and after hepatitis B vaccination shows significant differences in gene expression between responders and non-responders*. **Vaccine**, *36*(42), pp.6282-6289.

DO NOT COPY. LEADCITY UNIVERSITY, NIGERIA

Benarji, K.A., Anitha, A., Suresh, B., Aparna, V., Praveena, A. and Penumatsa, L.A., 2021. *Knowledge and attitude of dental students toward hepatitis B virus and its vaccination–A cross-sectional study*. **Journal of Oral and Maxillofacial Pathology***: JOMFP*, *25*(3), p.553.

Beste, L.A., Ioannou, G.N., Chang, M.F., Forsberg, C.W., Korpak, A.M., Boyko, E.J., Sporleder, J.L., Smith, N.L., Maynard, C., Chartier, M. and Dominitz, J.A., 2020. *Prevalence of hepatitis B virus exposure in the veterans health administration and association with military-related risk factors.* **Clinical Gastroenterology and Hepatology**, *18*(4), pp.954-962.

Beykaso, G., Mulu, A., Giday, M., Berhe, N., Selamu, M., Hailu, D. and Teklehaymanot, T., 2022. *Occult Hepatitis B Virus Infection and Its Risks of Cryptic Transmission in Southern Ethiopia*. **Infection and Drug Resistance**, *15*, p.619.

Bialfew, Y., Hailu, G. and Samuel, T., 2018. *Prevalence and associated factors of hepatitis B virus infection among blood donors in Debre Markos blood Bank Centre, Northwest Ethiopia, 2018*. **Epidemiology (Sunnyvale)**, *8*(363), pp.2161-1165.

Bianchi, F.P., Gallone, M.S., Gallone, M.F., Larocca, A.M., Vimercati, L., Quarto, M. and Tafuri, S., 2019. *HBV seroprevalence after 25 years of universal mass vaccination and management of non-responders to the anti-Hepatitis B vaccine: An Italian study among medical students.* **Journal of Viral Hepatitis**, *26*(1), pp.136-144.

Biatougou, N.M.B., Ouedraogo, M.S., Soubeiga, S.T., Zohoncon, T.M., Ouedraogo, P., Obiri-Yeboah, D., Tapsoba, A.S.A., Kiendrebeogo, T.I., Sagna, T., Niamba, P. and Traore, A., 2022. *Molecular Epidemiology of Human Herpes Virus Type 8 Among Patients with Compromised Immune System in Ouagadougou, Burkina Faso.* **HIV/AIDS (Auckland, NZ)**, *14*, p.311.

Bigna, J.J., Kenne, A.M., Hamroun, A., Ndangang, M.S., Foka, A.J., Tounouga, D.N., Lenain, R., Amougou, M.A. and Nansseu, J.R., 2019. *Gender development and hepatitis B and C infections among pregnant women in Africa: a systematic review and meta-analysis***. Infectious diseases of poverty**, *8*(1), pp.1-12.

Bini, C., Grazzini, M., Chellini, M., Mucci, N., Arcangeli, G., Tiscione, E. and Bonanni, P., 2018. *Is hepatitis B vaccination performed at infant and adolescent age able to provide long-term immunological memory? An observational study on healthcare students and workers in Florence, Italy.* **Human vaccines & immunotherapeutics**, *14*(2), pp.450-455.

Bittaye, M., Idoko, P., Ekele, B.A. et al, 2019, *Hepatitis B virus sero-prevalence amongst pregnant women in the Gambia*, **BMC Infect Dis** 19, 259 , https://doi.org/10.1186/s12879-019-3883-9

Cao, W.W., Zhou, R.R., Ou, X., Shi, L.X., Xiao, C.Q., Chen, T.Y., Tan, H., Fan, X.G., Li, B.J. and Li, N., 2018. *Prevalence of hepatitis B virus, hepatitis C virus, human*

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

immunodeficiency virus and Treponema pallidum infections in hospitalized patients before transfusion in Xiangya hospital Central South University, China from 2011 to 2016. **BMC infectious diseases,** *18*(1), pp.1-7.

Cetin, S., Cetin, M., Turhan, E. and Dolapcioglu, K., 2018. *Seroprevalence of hepatitis B surface antigen and associated risk factors among pregnant women.* **The Journal of Infection in Developing Countries,** *12*(10), pp.904-909.

Chang, K.C., Chang, M.H., Chen, H.L., Wu, J.F., Chang, C.H., Hsu, H.Y. and Ni, Y.H., 2022. *Universal infant hepatitis B virus (HBV) vaccination for 35 years: moving toward the eradication of HBV.* **The Journal of Infectious Diseases**, *225*(3), pp.431-435.

Chauhan A, Webb G, Ferguson J. 2019, *Clinical presentations of Hepatitis B: A clinical review with representative case histories.* **Clinics and research in hepatology and gastroenterology**. 2019.

Chhabra, D., Mishra, S., Gawande, K., Sharma, A., Kishore, S. and Bhadoria, A.S., 2019. *Knowledge, attitude, and practice study on hepatitis B among medical and nursing undergraduate students of an apex healthcare institute at Uttarakhand foothills: A descriptive analysis*. **Journal of Family Medicine and Primary Care**, *8*(7), p.2354.

Chihota, B.V., Wandeler, G., Chilengi, R., Mulenga, L., Chung, R.T., Bhattacharya, D., Egger, M. and Vinikoor, M.J., 2020. *High rates of hepatitis B virus (HBV) functional cure among human immunodeficiency virus-HBV coinfected patients on antiretroviral therapy in Zambia.* **The journal of infectious diseases**, *221*(2), pp.218-222.

Collenberg E, Ouedraogo T, Ganamé J, Fickenscher H, Kynast- Wolf G, Becher H, Kouyaté B, Kräusslich HG, Sangaré L, Tebit DM. 2016, *Seroprevalence of six different viruses among pregnant women and blood donors in rural and urban Burkina Faso: A comparative analysis*. **J Med Virol** 2016; 78: 683-692 PMID: 16555290 DOI: 10.1002/jmv.20593

Coppeta, L., Pompei, A., Balbi, O., De Zordo, L.M., Mormone, F., Policardo, S., Lieto, P., Pietroiusti, A. and Magrini, A., 2019. *Persistence of immunity for hepatitis B virus among heathcare workers and italian medical students 20 years after vaccination.* **International journal of environmental research and public health**, *16*(9), p.1515.

Dabsu, R. and Ejeta, E., 2018. *Seroepidemiology of hepatitis B and C virus infections among pregnant women attending antenatal Clinic in Selected Health Facilities in east Wollega zone, West Oromia, Ethiopia*. **BioMed research international**, *2018*.

Dagnew, M., Million, Y., Destaw, B., Adefris, M., Moges, F. and Tiruneh, M., 2020. *Knowledge, Attitude, and Associated Factors Towards Vertical Transmission of Hepatitis B Virus Among Pregnant Women Attending Antenatal Care in Tertiary Hospitals in Amhara Region, Northwest Ethiopia: A Cross-Sectional Study*. **International Journal of Women's Health**, *12*, p.859.

DO NOT COPY. EDO CITY UNIVERSITY, NIGERIA

Das, S., Ramakrishnan, K., Behera, S.K., Ganesapandian, M., Xavier, A.S. and Selvarajan, S., 2019. *Hepatitis B vaccine and immunoglobulin: key concepts*. **Journal of clinical and translational hepatology**, *7*(2), p.165.

Dayyab, F.M., Iliyasu, G., Ahmad, B.G., Bako, A.T., Ngamariju, S.S. and Habib, A.G., 2020. *Hepatitis B vaccine knowledge and self-reported vaccination status among healthcare workers in a conflict region in northeastern Nigeria*. **Therapeutic advances in vaccines and immunotherapy**, *8*, p.2515135519900743.

De Lima, A., Kanis, S.L., Escher, J.C. and van der Woude, C.J., 2018. *Hepatitis B vaccination effective in children exposed to anti-tumour necrosis factor alpha in utero*. **Journal of Crohn's and Colitis,** *12*(8), pp.948-953.

De Martel C, Georges D, Bray F, Ferlay J, Clifford GM. 2020, *Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis*. **Lancet Glob Health.** 2020;8(2):e180–90.

Dehghani, B., Dehghani, A. and Sarvari, J., 2020. *Knowledge and awareness regarding hepatitis B, hepatitis C, and human immunodeficiency viruses among college students: A report from Iran*. **International Quarterly of Community Health Education**, *41*(1), pp.15-23.

Demsiss, W., Seid, A. and Fiseha, T., 2018. Hepatitis B and C: *Seroprevalence, knowledge, practice and associated factors among medicine and health science students in Northeast Ethiopia.* ***PLoS One*****,** *13*(5), p.e0196539.

Diederike W.G, Lucia E. V, Kofi A & Jos Van R, (2018). *Trends in maternal mortality :a 13-year hospital-based study in rural Ghana*. **European J of Obst and Gynecol and Repro Biology**, 107:135-39.

Dilokthornsakul, P., Sawangjit, R., Tangkijvanich, P., Chayanupatkul, M., Tanwandee, T., Sukeepaisarnjaroen, W., Sriuttha, P. and Permsuwan, U., 2022. *Economic Evaluation of Oral Nucleos (t) ide Analogues for Patients with Chronic Hepatitis B in Thailand*. **Applied Health Economics and Health Policy**, pp.1-10.

Dos Santos Marcon, P., Tovo, C.V., Kliemann, D.A., Fisch, P. and de Mattos, A.A., 2018. *Incidence of hepatocellular carcinoma in patients with chronic liver disease due to hepatitis B or C and coinfected with the human immunodeficiency virus: A retrospective cohort study*. **World Journal of Gastroenterology**, *24*(5), p.613.

Edrees, W.H., Al-Ofairi, B.A., Alrahabi, L.M., Al-Munkari, I.M., Alawi, A.S., Al-Mashdali, A.H.T., Samin, G.B., Naseer, Y.A., Bamousa, Z.A. and Al-Shehari, W.A., 2022. *Seroprevalence of the viral markers of hepatitis b, hepatitis c, and hiv among medical waste handlers in some hospitals in sana'a city-yemen*. **Universal J Pharm Res,** *7*(3), pp.12-19.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

Edrees, W.H., Banafa, A.M. and Al-Awar, M.S., 2022. *Risk factors and seroprevalence of hepatitis B virus antigen among university students in the Sana'a city, Yemen.* **Al-Razi University Journal for Medical Sciences,** *6*(1).

Elon IW, Iliya J, Yaya A, Ayomikun A, Difa AJ, et al, 2020, *Dual Carriage of Hepatitis B Surface and Hepatitis B Envelope Antigen in Children in a Tertiary Health Facility in the Poorest Region of Nigeria,* 2000-2015. **Int J Virol AIDS** 7:060. doi.org/10.23937/2469-567X/1510060

Feng, J., Yang, G., Liu, Y., Gao, Y., Zhao, M., Bu, Y., Yuan, H., Yuan, Y., Yun, H., Sun, M. and Gao, H., 2019. *LncRNA PCNAP1 modulates hepatitis B virus replication and enhances tumor growth of liver cancer*. ***Theranostics*****,** *9*(18), p.5227.

Ferlay, Jacques, Murielle Colombet, Isabelle Soerjomataram, Colin Mathers, Donald M. Parkin, Marlon Piñeros, Ariana Znaor, and Freddie Bray., 2018 *"Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods."* **International journal of cancer** 144, no. 8 (2019): 1941-1953.

Fite, R.O., Kooti, W., Azeze, G.A., Tesfaye, B. and Hagisso, S.N., 2020. *Seroprevalence and factors associated with hepatitis B virus infection in blood donors in Ethiopia: a systematic review and meta-analysis*. **Archives of virology**, *165*(5), pp.1039-1048.

Flygel, T.T., Sovershaeva, E., Claassen-Weitz, S., Hjerde, E., Mwaikono, K.S., Odland, J.Ø., Ferrand, R.A., Mchugh, G., Gutteberg, T.J., Nicol, M.P. and Cavanagh, J.P., 2020. *Composition of gut microbiota of children and adolescents with perinatal human immunodeficiency virus infection taking antiretroviral therapy in Zimbabwe*. ***The Journal of infectious diseases*****,** *221*(3), pp.483-492.

Frempong, M.T., Ntiamoah, P., Annani-Akollor, M.E., Owiredu, W.K., Addai-Mensah, O., Owiredu, E.W., Adu-Gyasi, D., Agyapong, E.O. and Sallah, L., 2019. *Hepatitis B and C infections in HIV-1 and non-HIV infected pregnant women in the Brong-Ahafo Region, Ghana*. **PloS one**, *14*(7), p.e0219922.

G.U. Mustapha, Ibrahim, A., M.S. Balogun, et al, 2020 *Seroprevalence of hepatitis B virus among antenatal clinic attendees in Gamawa Local Government Area, Bauchi State, Nigeria*. **BMC Infect Dis 20**, 194. https://doi.org/10.1186/s12879-020-4863-9

GBD 2019 Hepatitis B Collaborators. Global, regional, and national burden of hepatitis B, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. **Lancet Gastroenterol Hepatol**. 2022 Sep;7(9):796-829. doi: 10.1016/S2468-1253(22)00124-8. Epub 2022 Jun 21. PMID: 35738290; PMCID: PMC9349325.

Gebrecherkos, T., Girmay, G., Lemma, M. and Negash, M., 2020. *Knowledge, attitude, and practice towards Hepatitis B virus among pregnant women attending antenatal care at the University of Gondar comprehensive specialized hospital, Northwest Ethiopia*. **International journal of hepatology,** *2020*.

DO NOT COPY, FACULTY UNIVERSITY NIGERIA

Gemechu G, Abagez WE, Alemayehu DH, Tesfaye A, Tadesse D, Kinfu A, Mihret A and Mulu A, 2022, *Occult Hepatitis B Virus Infection Among Blood Donors in the Capital City of Addis Ababa, Ethiopia: Implications for Blood Transfusion Safety*. **Front. Gastroenterol**. 1:887260. doi: 10.3389/fgstr.2022.887260

Gindin, Y., Gaggar, A., Lok, A.S., Janssen, H.L., Ferrari, C., Subramanian, G.M., Jiang, Z., Masur, H., Emmanuel, B., Poonia, B. and Kottilil, S., 2021. *DNA Methylation and Immune Cell Markers Demonstrate Evidence of Accelerated Aging in Patients with Chronic Hepatitis B Virus or Hepatitis C Virus, with or without Human Immunodeficienct Virus Co-infection.* **Clinical Infectious Diseases**, *73*(1), pp.e184-e190.

Gomes, C., Wong, R.J. and Gish, R.G., 2019. *Global perspective on hepatitis B virus infections in the era of effective vaccines.* **Clinics in liver disease**, *23*(3), pp.383-399.

Gong, H.Z., Hu, K.R., Lyu, W., Zheng, H.Y., Zhu, W.G., Wan, X. and Li, J., 2020. *Risk factors for the co-infection with HIV, hepatitis B and C virus in syphilis patients*. ***Acta Dermato-Venereologica,*** *100*(17), pp.1-6.

Hall, E.W., Gounder, P., Angles, J., Nelson, N.P., Rosenberg, E.S. and Weng, M.K., 2022. *Evaluating the cost-effectiveness of hepatitis B vaccination strategies in high-impact settings for adults.* **Journal of Viral Hepatitis**, *29*(12), pp.1115-1126.

Han, Z., Zhang, Y., Bai, X., Yin, Y., Xu, C. and Hou, H., 2019. *Mother-to-child transmission of hepatitis B virus after amniocentesis: A retrospective matched cohort study*. **Prenatal Diagnosis**, *39*(6), pp.431-440.

Hang Pham, T.T., Le, T.X., Nguyen, D.T., Luu, C.M., Truong, B.D., Tran, P.D., Toy, M., Bozkurt, S. and So, S., 2019. *Knowledge, attitudes and medical practice regarding hepatitis B prevention and management among healthcare workers in Northern Vietnam.* **PloS one**, *14*(10), p.e0223733.

Hang Pham, T.T., Le, T.X., Nguyen, D.T., Luu, C.M., Truong, B.D., Tran, P.D., Toy, M. and So, S., 2019. *Knowledge, attitudes and practices of hepatitis B prevention and immunization of pregnant women and mothers in northern Vietnam*. **PloS one**, *14*(4), p.e0208154.

He, T., Zhou, Y., Xu, P., Ling, N., Chen, M., Huang, T., Zhang, B., Yang, Z., Ao, L., Li, H. and Chen, Z., 2022. *Safety and antibody response to inactivated COVID-19 vaccine in patients with chronic hepatitis B virus infection*. **Liver International**.

Hebo, H.J., Gemeda, D.H. and Abdusemed, K.A., 2019. *Hepatitis B and C viral infection: prevalence, knowledge, attitude, practice, and occupational exposure among healthcare workers of Jimma University Medical Center, southwest Ethiopia*. **The Scientific World Journal**, *2019*.

DO NOT COPY, FAD CITY UNIVERSITY, NIGERIA

Hebo, H.J., Gemeda, D.H. and Abdusemed, K.A., 2019. *Hepatitis B and C viral infection: prevalence, knowledge, attitude, practice, and occupational exposure among healthcare workers of Jimma University Medical Center, southwest Ethiopia*. **The Scientific World Journal,** *2019*.

Hechter, R.C., Qian, L., Luo, Y., Grant, D.S.L., Baxter, R., Klein, N.P., Nunley, K.V., Aukes, L., Hogea, C., Krishnarajah, G. and Patterson, B.J., 2019. *Impact of an electronic medical record reminder on hepatitis B vaccine initiation and completion rates among insured adults with diabetes mellitus.* **Vaccine**, *37*(1), pp.195-201.

Hosseini, P. and Yazdani, S., 2021. *The role of hepatitis B virus in people with chronic liver disease.* **Annals of the Romanian Society for Cell Biology**, *25*(6), pp.21023-21030.

Hsu, H.Y. and Chang, M.H., 2019. *Hepatitis B virus infection and the progress toward its elimination*. **The Journal of Pediatrics**, *205*, pp.12-20.

Hu, Y.C., Yeh, C.C., Chen, R.Y., Su, C.T., Wang, W.C., Bai, C.H., Chan, C.F. and Su, F.H., 2018. *Seroprevalence of hepatitis B virus in Taiwan 30 years after the commencement of the national vaccination program*. **PeerJ,** *6*, p.e4297.

Huang, H., Xu, C., Liu, L., Chen, L., Zhu, X., Chen, J., Feng, J., Chen, T., Xu, B., Yang, J. and Xu, B., 2021. *Increased protection of earlier use of immunoprophylaxis in preventing perinatal transmission of hepatitis B virus*. **Clinical Infectious Diseases**, *73*(9), pp.e3317-e3323.

Hussein, N.R., 2018. *Risk factors of hepatitis B virus infection among blood donors in Duhok city, Kurdistan Region, Iraq*. **Caspian journal of internal medicine**, *9*(1), p.22.

Hyer, R., McGuire, D.K., Xing, B., Jackson, S. and Janssen, R., 2018. *Safety of a two-dose investigational hepatitis B vaccine, HBsAg-1018, using a toll-like receptor 9 agonist adjuvant in adults*. **Vaccine**, *36*(19), pp.2604-2611.

Hyer, R.N. and Janssen, R.S., 2019. *Immunogenicity and safety of a 2-dose hepatitis B vaccine, HBsAg/CpG 1018, in persons with diabetes mellitus aged 60–70 years*. **Vaccine**, *37*(39), pp.5854-5861.

Indolfi, G., Easterbrook, P., Dusheiko, G., Siberry, G., Chang, M.H., Thorne, C., Bulterys, M., Chan, P.L., El-Sayed, M.H., Giaquinto, C. and Jonas, M.M., 2019. *Hepatitis B virus infection in children and adolescents*. **The Lancet Gastroenterology & Hepatology**, *4*(6), pp.466-476.

Intongkam, S., Samakarnthai, P., Pakchotanon, R., Narongroeknawin, P., Assavatanabodee, P. and Chaiamnuay, S., 2019. *Efficacy and safety of hepatitis B vaccination in rheumatoid arthritis patients receiving disease-modifying antirheumatic drugs and/or biologics therapy*. **JCR: Journal of Clinical Rheumatology**, *25*(8), pp.329-334.

DO NOT COPY: LEAD CITY UNIVERSITY, NIGERIA

J. A. Ndako, 2017, *Risk Factors and Prevalence of Hepatitis B Surface Antigen (HBsAg) among Apparently Healthy Volunteers in an Urban Setting, North-Central Nigeria,* **International Journal of Sciences** 03 :9-15 DOI: 10.18483/ijSci.958

Jackson, K. and Gish, R.G., 2020. *Point of Care Diagnostic Testing for Hepatitis B Virus*. **Current Hepatology Reports**, *19*(3), pp.245-253.

Jackson, S., Lentino, J., Kopp, J., Murray, L., Ellison, W., Rhee, M., Shockey, G., Akella, L., Erby, K., Heyward, W.L. and Janssen, R.S., 2018. *Immunogenicity of a two-dose investigational hepatitis B vaccine, HBsAg-1018, using a toll-like receptor 9 agonist adjuvant compared with a licensed hepatitis B vaccine in adults*. **Vaccine**, *36*(5), pp.668-674.

Jang, J.W., Choi, J.Y., Kim, Y.S., Yoo, J.J., Woo, H.Y., Choi, S.K., Jun, C.H., Lee, C.H., Sohn, J.H., Tak, W.Y. and Lee, Y.R., 2018. *Effects of virologic response to treatment on short- and long-term outcomes of patients with chronic hepatitis B virus infection and decompensated cirrhosis*. **Clinical gastroenterology and hepatology**, *16*(12), pp.1954-1963.

Jeng, W.J. and Lok, A.S., 2021. *Should treatment indications for chronic hepatitis B be expanded?*. **Clinical Gastroenterology and Hepatology**, *19*(10), pp.2006-2014.

Jiang, X.W., Ye, J.Z., Li, Y.T. and Li, L.J., 2018. *Hepatitis B reactivation in patients receiving direct-acting antiviral therapy or interferon-based therapy for hepatitis C: a systematic review and meta-analysis.* **World journal of gastroenterology**, *24*(28), p.3181.

Jones, J.M., Kracalik, I., Levi, M.E., Bowman III, J.S., Berger, J.J., Bixler, D., Buchacz, K., Moorman, A., Brooks, J.T. and Basavaraju, S.V., 2020. *Assessing solid organ donors and monitoring transplant recipients for human immunodeficiency virus, hepatitis B virus, and hepatitis C virus infection—US Public Health Service Guideline*, 2020. **MMWR Recommendations and Reports,** *69*(4), p.1.

Junior, H.P., Theodoro, M., de Almeida Vespoli, J., Senise, J.F. and Castelo, A., 2018. *Mother-to-child transmission of hepatitis C virus*. **European Journal of Obstetrics & Gynecology and Reproductive Biology**, *224*, pp.125-130.

Kannan, B., Sivakumar, P. and Ganapathy, D., 2020. *Awareness among dental students about hepatitis B infection--A review*. **Drug Invention Today**, *13*(3).

Kashi, D.S., Oliver, S.J., Wentz, L.M., Roberts, R., Carswell, A.T., Tang, J.C., Jackson, S., Izard, R.M., Allan, D., Rhodes, L.E. and Fraser, W.D., 2021. *Vitamin D and the hepatitis B vaccine response: a prospective cohort study and a randomized, placebo-controlled oral vitamin D3 and simulated sunlight supplementation trial in healthy adults.* **European Journal of Nutrition**, *60*(1), pp.475-491.

DO NOT COPY LEAD CITY UNIVERSITY, NIGERIA

Kassa, D., Gebremichael, G., Tilahun, T., Ayalkebet, A., Abrha, Y., Mesfin, G., Belay, Y., Demissie, M., Gebrexiabher, A. and Assefa, Y., 2019. *Prevalence of sexually transmitted infections (HIV, hepatitis B virus, herpes simplex virus type 2, and syphilis) in pregnant women in Ethiopia: trends over 10 years (2005–2014).* **International Journal of Infectious Diseases,** *79*, pp.50-57.

Kaviani, M. and Kia, J., 2019. *Determination of hepatitis B antibody titration and related factors in dental students in Guilan University of Medical Sciences*. **International Journal of Scientific Research in Dental and Medical Sciences**, *1*(3), pp.40-47.

Khan, J., Shil, A. and Mohanty, S.K., 2019. *Hepatitis B vaccination coverage across India: exploring the spatial heterogeneity and contextual determinants.* **BMC Public Health**, *19*(1), pp.1-14.

Khandelwal, V., Gupta, N., Nayak, U.A., Kulshreshtha, N. and Baliga, S., 2018. *Knowledge of hepatitis B virus infection and its control practices among dental students in an Indian city*. **International Journal of Adolescent Medicine and Health**, *30*(5).

Khetsuriani, N., Zaika, O., Chitadze, N., Slobodianyk, L., Allahverdiyeva, V., O'Connor, P. and Huseynov, S., 2021. *Seroprevalence of hepatitis B virus infection markers among children in Ukraine*. **Vaccine**, *39*(10), pp.1485-1492.

Khurram, M., Qaisar, A., Zafar, K.J., Wahid, A., Hassan, F. and Javed, M., 2020. *Assessment of Knowledge and Attitude towards Hepatitis B Infection Among Dental Students in two Teaching Hospitals of Punjab, Pakistan.* **Annals of Punjab Medical College**, *14*(1), pp.78-82.

Kim, B.H. and Kim, W.R., 2018. *Epidemiology of hepatitis B virus infection in the United States*. **Clinical liver disease**, *12*(1), p.1.

Kisangau, E.N., Awour, A., Juma, B., Odhiambo, D., Muasya, T., Kiio, S.N., Too, R. and Lowther, S.A., 2019. *Prevalence of hepatitis B virus infection and uptake of hepatitis B vaccine among healthcare workers, Makueni County, Kenya* 2017. **Journal of Public Health**, *41*(4), pp.765-771.

Komas, N.P., Ghosh, S., Abdou-Chekaraou, M., Pradat, P., Al Hawajri, N., Manirakiza, A., Laghoe, G.L., Bekondi, C., Brichler, S., Ouavéné, J.O. and Sépou, A., 2018. *Hepatitis B and hepatitis D virus infections in the Central African Republic, twenty-five years after a fulminant hepatitis outbreak, indicate continuing spread in asymptomatic young adults*. **PLoS neglected tropical diseases**, *12*(4), p.e0006377.

Lee, Hye Won, Jae Seung Lee, and Sang Hoon Ahn. 2021. *"Hepatitis B Virus Cure: Targets and Future Therapies"* **International Journal of Molecular Sciences** 22, no. 1: 213. https://doi.org/10.3390/ijms22010213

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

Leumi, S., Bigna, J.J., Amougou, M.A., Ngouo, A., Nyaga, U.F. and Noubiap, J.J., 2020. *Global burden of hepatitis B infection in people living with human immunodeficiency virus: a systematic review and meta-analysis.* **Clinical Infectious Diseases**, *71*(11), pp.2799-2806.

Lim, J.K., Nguyen, M.H., Kim, W.R., Gish, R., Perumalswami, P. and Jacobson, I.M., 2020. *Prevalence of chronic hepatitis B virus infection in the United States.* **Official journal of the American College of Gastroenterology**| *ACG*, *115*(9), pp.1429-1438.

Liu, L., Wang, L., Zhang, H., Ou, W., Li, D., Feng, Y., Zhuang, H. and Shao, Y., 2021. Changing *Epidemiology of Hepatitis B Virus and Hepatitis C Virus Coinfection in a Human Immunodeficiency Virus–Positive Population in China: Results From the Third and Fourth Nationwide Molecular Epidemiologic Surveys.* **Clinical Infectious Diseases**, *73*(4), pp.642-649.

Liu, R., Zhao, L., Cheng, X., Han, H., Li, C., Li, D., Liu, A., Gao, G., Zhou, F., Liu, F. and Jiang, Y., 2021. *Clinical characteristics of COVID-19 patients with hepatitis B virus infection—a retrospective study*. **Liver International**, *41*(4), pp.720-730.

Lu, C.M., Cheng, J.S., Sun, W.C., Chen, W.C., Tsay, F.W., Wang, H.M., Tsai, T.J., Kao, S.S., Li, Y.D., Li, Y.R. and Lin, H.S., 2022. *Randomized Controlled Study of Tenofovir versus Lamivudine Followed by Tenofovir in Severe Exacerbation of Hepatitis B*. **Antimicrobial Agents and Chemotherapy**, *66*(2), pp.e01664-21.

Mabunda, N., Zicai, A.F., Ismael, N., Vubil, A., Mello, F., Blackard, J.T., Lago, B., Duarte, V., Moraes, M., Lewis, L. and Jani, I., 2020. *Molecular and serological characterization of occult hepatitis B among blood donors in Maputo, Mozambique*. **Memórias do Instituto Oswaldo Cruz**, *115*.

Machmud, P.B., Glasauer, S., Gottschick, C. and Mikolajczyk, R., 2021. *Knowledge, Vaccination Status, and Reasons for Avoiding Vaccinations against Hepatitis B in Developing Countries: A Systematic Review*. **Vaccines**, *9*(6), p.625.

Madhavan, A., Palappallil, D.S., Balakrishnapanicker, J. and Asokan, A., 2021. *Immune response to hepatitis B vaccine: An evaluation*. **Perspectives in Clinical Research**, *12*(4), p.209.

Mahale, P., Engels, E.A. and Koshiol, J., 2019. *Hepatitis B virus infection and the risk of cancer in the elderly US population*. **International journal of cancer**, *144*(3), pp.431-439.

Mak, L.Y., Wong, D.K.H., Pollicino, T., Raimondo, G., Hollinger, F.B. and Yuen, M.F., 2020. *Occult hepatitis B infection and hepatocellular carcinoma: Epidemiology, virology, hepatocarcinogenesis and clinical significance*. **Journal of Hepatology**, *73*(4), pp.952-964.

Makuza, J.D., Rwema, J.O.T., Ntihabose, C.K., Dushimiyimana, D., Umutesi, J., Nisingizwe, M.P., Serumondo, J., Semakula, M., Riedel, D.J. and Nsanzimana, S., 2019. *Prevalence of*

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

hepatitis B surface antigen (HBsAg) positivity and its associated factors in Rwanda. ***BMC infectious diseases***, *19*(1), pp.1-10.

McNaughton, A.L., Lourenço, J., Bester, P.A., Mokaya, J., Lumley, S.F., Obolski, U., Forde, D., Maponga, T.G., Katumba, K.R., Goedhals, D. and Gupta, S., 2020. *Hepatitis B virus seroepidemiology data for Africa: Modelling intervention strategies based on a systematic review and meta-analysis.* **PLoS medicine**, *17*(4), p.e1003068.

Michel Jadoul, Brian A. et al, 2019, *Prevalence, incidence, and risk factors for hepatitis C virus infection in hemodialysis patients*, **Kidney International**, Volume 95, Issue 4, Pages 939-947, ISSN 0085-2538, https://doi.org/10.1016/j.kint.2018.11.038.

Miglietta, A., Quinten, C., Lopalco, P.L. and Duffell, E., 2018. *Impact of hepatitis B vaccination on acute hepatitis B epidemiology in European Union/European Economic Area countries, 2006 to 2014*. ***Eurosurveillance***, *23*(6), pp.17-00278.

Miyakawa, M., Yoshida, L.M., Nguyen, H.A.T., Takahashi, K., Le, T.H., Yasunami, M., Ariyoshi, K., Dang, D.A. and Moriuchi, H., 2021. *Hepatitis B virus infection among pregnant mothers and children after the introduction of the universal vaccination program in Central Vietnam*. **Scientific Reports**, *11*(1), pp.1-11.

Modawi, H.A., 2020. *Knowledge, attitude, and practice (KAP) about Hepatitis B Infection among nursing students in Sabya College, Saudi Arabia: Array.* **Electronic Physician**, *12*(3), pp.7752-7758.

Mohammed, H.I., Pennap, G.R., Oti, V.B. and Adoga, M.P., 2019. *Markers of hepatitis B virus infection in a subset of young people in central Nigeria*. **Scientific African**, *5*, p.e00121.

Moturi, E., Tevi-Benissan, C., Hagan, J.E., Shendale, S., Mayenga, D., Murokora, D., Patel, M., Hennessey, K. and Mihigo, R., 2018. *Implementing a birth dose of hepatitis B vaccine in Africa: findings from assessments in 5 countries*. **Journal of immunological sciences**, (5), p.31.

Mouchet, J., Salvo, F., Raschi, E., Poluzzi, E., Antonazzo, I.C., De Ponti, F. and Begaud, B., 2018. *Hepatitis B vaccination and the putative risk of central demyelinating diseases–A systematic review and meta-analysis*. **Vaccine**, *36*(12), pp.1548-1555.

Mouzannar, K., Fusil, F., Lacombe, B., Ollivier, A., Ménard, C., Lotteau, V., Cosset, F.L., Ramière, C. and André, P., 2019. *Farnesoid X receptor-α is a proviral host factor for hepatitis B virus that is inhibited by ligands in vitro and in vivo*. **The FASEB Journal**, *33*(2), pp.2472-2483.

Mursy, S.M.E.M. and Mohamed, S.O.O., 2019. *Knowledge, attitude, and practice towards Hepatitis B infection among nurses and midwives in two maternity hospitals in Khartoum, Sudan*. **BMC public health**, *19*(1), pp.1-7.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

Mysore, K.R. and Leung, D.H., 2018. Hepatitis B and C. *Clinics in Liver Disease*, *22*(4), pp.703-722 Edrees, W.H., Al-Ofairi, B.A., Alrahabi, L.M., Al-Munkari, I.M., Alawi, A.S., Al-Mashdali, A.H.T., Samin, G.B., Naseer, Y.A., Bamousa, Z.A. and Al-Shehari, W.A., 2022. *Seroprevalence Of The Viral Markers Of Hepatitis B, Hepatitis C, And Hiv Among Medical Waste Handlers In Some Hospitals In Sana'a City-Yemen*. **Universal J Pharm Res**, *7*(3), pp.12-19.

Ndubuisi, J.C., Aisha, M., Wariso, C.A. and Ejiofor, D.C., *Prevalence of Hepatitis B Virus (HBV) among Antenatal Clinic Attendees in Karu Local Government Area, Nasarawa State, Nigeria.*

Ng'wamkai, G., Msigwa, K.V., Chengula, D., Mgaya, F., Chuma, C., Msemwa, B., Silago, V., Majigo, M., Mshana, S.E. and Mirambo, M.M., 2019. *Treponema pallidum infection predicts sexually transmitted viral infections (hepatitis B virus, herpes simplex virus-2, and human immunodeficiency virus) among pregnant women from rural areas of Mwanza region, Tanzania.* **BMC pregnancy and childbirth**, *19*(1), pp.1-13.

Nguyen V.T, Law M.G & Dore G.J, (2019). *Hepatitis B-related hepatocellular carcinoma: epidemiological characteristics and disease burden.* **Journal of Viral Hepatology***, 16:453–463.*

Nguyen, M.H., Yang, H.I., Le, A., Henry, L., Nguyen, N., Lee, M.H., Zhang, J., Wong, C., Wong, C. and Trinh, H., 2019. *Reduced incidence of hepatocellular carcinoma in cirrhotic and noncirrhotic patients with chronic hepatitis B treated with Tenofovir—A propensity Score–Matched study***. The Journal of infectious diseases**, *219*(1), pp.10-18.

Nguyen, T.T.L., Pham, T.T.H., So, S., Hoang, T.H.V., Nguyen, T.T.U., Ngo, T.B., Nguyen, M.P., Thai, Q.H., Nguyen, N.K., Le Ho, T.Q.A. and Tran, Q.P., 2021. *Knowledge, attitudes and practices toward hepatitis B virus infection among students of medicine in Vietnam.* **International journal of environmental research and public health**, *18*(13), p.7081.

Nishida, N., Sugiyama, M., Sawai, H., Nishina, S., Sakai, A., Ohashi, J., Khor, S.S., Kakisaka, K., Tsuchiura, T., Hino, K. and Sumazaki, R., 2018. *Key HLA-DRB1-DQB1 haplotypes and role of the BTNL2 gene for response to a hepatitis B vaccine*. **Hepatology,** *68*(3), pp.848-858.

Noubiap JJ, Joko WY, Nansseu JR, Tene UG, Siaka C. 2013, *Seroepidemiology of human immunodeficiency virus, hepatitis B and C viruses, and syphilis infections among first-time blood donors in Edéa, Cameroon*. **Int J Infect Dis** 2013; 17: e832-e837 [PMID: 23317526 DOI: 10.1016/j.ijid.2012.12.007]

Nyalika, B.S., 2021. *Prevalence and Associated Factors of Hepatitis B Surface Antigen (HBsAg) among People Living with HIV (PLWHIV) Attending at CTC Mawenzi Regional Hospital Kilimanjaro, Northern Tanzania.* **Advances in Infectious Diseases**, *11*(2), pp.216-231.

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

Ojo, A.S. and Owolabi, H.A., *The Hepatitis B Virus and Chronic Liver Disease in Nigeria: A Brief Review of Literature.*

Omote, V., Kashibu, E., Ojumah, I., Adda, D., Etaghene, J. and Ukwamedua, H., 2018. *Serological screening of hepatitis B virus and hepatitis C virus among patients attending a tertiary hospital in Jalingo, Taraba state, Nigeria.*

Omotowo, I.B., Meka, I.A., Ijoma, U.N., Okoli, V.E., Obienu, O., Nwagha, T., Ndu, A.C., Onodugo, D.O., Onyekonwu, L.C. and Ugwu, E.O., 2018. *Uptake of hepatitis B vaccination and its determinants among health care workers in a tertiary health facility in Enugu, South-East, Nigeria*. **BMC infectious diseases**, *18*(1), pp.1-9.

Osei, E., Niyilapah, J. and Kofi Amenuvegbe, G., 2019. *Hepatitis B knowledge, testing, and vaccination history among undergraduate public health students in Ghana*. ***BioMed research international.***

Othman, B., Al-Najjar, M.A., Othman, D., Al-Qudah, R. and Basheti, I., 2020. *Prevalence, knowledge of and attitude towards hepatitis B virus among pregnant females in Jordan*. **Journal of Viral Hepatitis**, *27*(11), pp.1108-1118.

Park, E.S., Lee, A.R., Kim, D.H., Lee, J.H., Yoo, J.J., Ahn, S.H., Sim, H., Park, S., Kang, H.S., Won, J. and Ha, Y.N., 2019. *Identification of a quadruple mutation that confers tenofovir resistance in chronic hepatitis B patients*. ***Journal of hepatology*,** *70*(6), pp.1093-1102.

Park, J.G., Lee, Y.R., Park, S.Y., Lee, H.J., Tak, W.Y., Kweon, Y.O., Jang, S.Y., Chun, J.M., Han, Y.S., Hur, K. and Lee, H.W., 2018. *Tenofovir, entecavir, and lamivudine in patients with severe acute exacerbation and hepatic decompensation of chronic hepatitis B.* **Digestive and Liver Disease**, *50*(2), pp.163-167.

Paul, R.C., Rahman, M., Wiesen, E., Patel, M., Banik, K.C., Sharif, A.R., Sultana, S., Rahman, M., Liyanage, J., Abeysinghe, N. and Kamili, S., 2018. *Hepatitis B surface antigen seroprevalence among prevaccine and vaccine era children in Bangladesh*. **The American Journal of Tropical Medicine and Hygiene,** *99*(3), p.764.

Pazgan-Simon, M., Simon, K.A., Jarowicz, E., Rotter, K., Szymanek-Pasternak, A. and Zuwala-Jagiello, J., 2018. *Hepatitis B virus treatment in hepatocellular carcinoma patients prolongs survival and reduces the risk of cancer recurrence*. **Clinical and experimental hepatology,** *4*(3), pp.210-216.

Perez Cuevas, M.B., Kodani, M., Choi, Y., Joyce, J., O'Connor, S.M., Kamili, S. and Prausnitz, M.R., 2018. *Hepatitis B vaccination using a dissolvable microneedle patch is immunogenic in mice and rhesus macaques*. ***Bioengineering & translational medicine***, *3*(3), pp.186-196.

Petruzziello, A., 2018. *Suppl-1, M3: epidemiology of hepatitis B virus (HBV) and hepatitis C virus (HCV) related hepatocellular carcinoma*. **The open virology journal**, *12*, p.26.

DO NOT COPY, LEAD CITY UNIVERSITY, NIGERIA

Pinto, C.S., Costa, G.B., Allaman, I.B. et al. *Clinical, epidemiological aspects, and trends of Hepatitis B in Brazil from 2007 to 2018*. **Sci Rep** 11, 13986 (2021). https://doi.org/10.1038/s41598-021-93434-y

Pleyer, C., Ali, M.A., Cohen, J.I., Tian, X., Soto, S., Ahn, I.E., Gaglione, E.M., Nierman, P., Marti, G.E., Hesdorffer, C. and Lotter, J., 2021. *Effect of Bruton tyrosine kinase inhibitor on efficacy of adjuvanted recombinant hepatitis B and zoster vaccines*. **Blood**, *137*(2), pp.185-189.

Posuwan, N., Vorayingyong, A., Jaroonvanichkul, V., Wasitthankasem, R., Wanlapakorn, N., Vongpunsawad, S. and Poovorawan, Y., 2018. *Implementation of hepatitis B vaccine in high-risk young adults with waning immunity*. **PLoS One**, *13*(8), p.e0202637.

Prabhu, M., Susich, M.K., Packer, C.H., Hersch, A.R., Riley, L.E. and Caughey, A.B., 2022. *Universal hepatitis B antibody screening and vaccination in pregnancy: a cost-effectiveness analysis*. **Obstetrics & Gynecology**, *139*(3), pp.357-367.

Qiao, J. (2019). *Occurrence, diagnosis and management of hepatic fibrosis and cirrhosis: An updated literature review***. Archives of Hepatitis Research**. 5. 022-026. 10.17352/ahr.000023.

Qin, Y.L., Li, B., Zhou, Y.S., Zhang, X., Li, L., Song, B., Liu, P., Yuan, Y., Zhao, Z.P., Jiao, J. and Li, J., 2018. *Prevalence and associated knowledge of hepatitis B infection among healthcare workers in Freetown, Sierra Leone*. **BMC infectious diseases**, *18*(1), pp.1-8.

Rajamoorthy, Y., Radam, A., Taib, N.M., Rahim, K.A., Munusamy, S., Wagner, A.L., Mudatsir, M., Bazrbachi, A. and Harapan, H., 2019. *Willingness to pay for hepatitis B vaccination in Selangor, Malaysia: a cross-sectional household survey*. **PLoS One**, *14*(4), p.e0215125.

Rajamoorthy, Y., Radam, A., Taib, N.M., Rahim, K.A., Wagner, A.L., Mudatsir, M., Munusamy, S. and Harapan, H., 2018. *The relationship between perceptions and self-paid hepatitis B vaccination: a structural equation modeling approach*. **PloS one**, *13*(12), p.e0208402.

Rajamoorthy, Y., Taib, N.M., Munusamy, S., Anwar, S., Wagner, A.L., Mudatsir, M., Müller, R., Kuch, U., Groneberg, D.A., Harapan, H. and Khin, A.A., 2019. *Knowledge and awareness of hepatitis B among households in Malaysia: a community-based cross-sectional survey*. **BMC public health**, *19*(1), pp.1-11.

Rao, H., Shang, J., Xie, Q., Lian, J., Gao, P., Shi, J., Chen, X., Wang, J., Xu, M., Zhang, L. and Zhao, Y., 2022. *Tenofovir disoproxil fumarate therapy in patients with chronic hepatitis B and advanced fibrosis or compensated cirrhosis*. **iLIVER,** *1*(3), pp.145-153.

Rathi, A., Kumar, V., Majhi, J., Jain, S., Lal, P. and Singh, S., 2018. *Assessment of knowledge, attitude, and practices toward prevention of hepatitis B infection among medical students in a high-risk setting of a newly established medical institution*. **Journal of laboratory physicians,** *10*(04), pp.374-379

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

.

Ravichandran, R.K., Jain, J., Ananda, S.R., Jaduram, B. and Gunasekaran, S., 2019. *Knowledge, attitude and practices regarding hepatitis B and infection control among clinical dental students.* **Int J Applied Dent Sci**, *5*(3), pp.42-6.

Roien, R., Mousavi, S.H., Ozaki, A., Baqeri, S.A., Hosseini, S.M.R., Ahmad, S. and Shrestha, S., 2021. *Assessment of knowledge, attitude, and practice of health-care workers towards hepatitis B virus prevention in Kabul, Afghanistan.* **Journal of Multidisciplinary Healthcare**, *14*, p.3177.

Rostamzadeh, M., Afkhamzadeh, A., Afrooz, S., Mohamadi, K. and Rasouli, M.A., 2018. *Dentists' knowledge, attitudes and practices regarding Hepatitis B and C and HIV/AIDS in Sanandaj, Iran.* **BMC oral health**, *18*(1), pp.1-8.

Saç, R., Taşar, M.A., Yalaki, Z., Güneylioğlu, M.M., Özsoy, G., Karadağlı, S., Göçmen, S., Akbaş, N. and Alioğlu, B., 2019. *Hepatitis A, hepatitis B, measles, mumps, rubella and varicella seroprevalence in Turkish adolescent nursing students*. **Nobel Med**, *15*(1), pp.33-40.

Saco, T.V., Strauss, A.T. and Ledford, D.K., 2018. *Hepatitis B vaccine nonresponders: possible mechanisms and solutions.* **Annals of Allergy, Asthma & Immunology**, *121*(3), pp.320-327.

Sajjadi, S.M., Pourfathollah, A.A., Mohammadi, S., Nouri, B., Hassanzadeh, R. and Fariba, R.A.D., 2018. *The prevalence and trends of hepatitis B, hepatitis C, and HIV among voluntary blood donors in kohgiluyeh and boyer-ahmad transfusion center, Southwestern Iran.* **Iranian journal of public health**, *47*(7), p.944.

Sani, M.M., Hafsat, W.I., Sakinatu, M.A., Ibrahim, A., Sani, M. and Alhassan, M.Y., 2018. *Prevalence of hepatitis B viral infection at paediatric gastroenterology clinic of ABUTH, Zaria.* **Nigerian Journal of Basic and Clinical Sciences**, *15*(2), p.114.

Saquib, S., Ibrahim, W., Othman, A., Assiri, M., Al-Shari, H. and Al-Qarni, A., 2019. *Exploring the knowledge, attitude and practice regarding hepatitis B infection among dental students in Saudi Arabia: A cross-sectional study*. **Open access Macedonian journal of medical sciences**, *7*(5), p.805.

Schillie, S., Harris, A., Link-Gelles, R., Romero, J., Ward, J. and Nelson, N., 2018. *Recommendations of the Advisory Committee on Immunization Practices for use of a hepatitis B vaccine with a novel adjuvant*. **Morbidity and Mortality Weekly Report**, *67*(15), p.455.

Setia S, Gambhir R, Kapoor V. *Hepatitis B and C infection: clinical implications in dental practice*. **European Journal of General Dentistry**. 2013;2(1):13-19. Google Scholar

DO NOT COPY, LEAD CITY UNIVERSITY, NIGERIA

Seto, W.K., Lo, Y.R., Pawlotsky, J.M. and Yuen, M.F., 2018. *Chronic hepatitis B virus infection.* ***The Lancet***, *392*(10161), pp.2313-2324.

Shrestha, D.B., Khadka, M., Khadka, M., Subedi, P., Pokharel, S. and Thapa, B.B., 2020. *Hepatitis B vaccination status and knowledge, attitude, and practice regarding Hepatitis B among preclinical medical students of a medical college in Nepal*. **PloS one**, *15*(11), p.e0242658.

Solay, A.H. and Eser, F., 2019. *High dose hepatitis B vaccine is not effective in patients using immunomodulatory drugs: a pilot study.* **Human Vaccines & Immunotherapeutics**.

Sood, A.B., O'Keefe, G., Bui, D. and Jain, N., 2018. *Vogt-Koyanagi-Harada disease associated with hepatitis B vaccination*. **Ocular immunology and inflammation**.

Splawn, L.M., Bailey, C.A., Medina, J.P. and Cho, J.C., 2018. *Heplisav-B vaccination for the prevention of hepatitis B virus infection in adults in the United States*. **Drugs of today (Barcelona, Spain: 1998)**, *54*(7), pp.399-405.

Tanaka, J., Akita, T., Ko, K., Miura, Y., Satake, M. and Epidemiological Research Group on Viral Hepatitis and its Long-term Course, Ministry of Health, Labour and Welfare of Japan, 2019. *Countermeasures against viral hepatitis B and C in Japan: an epidemiological point of view*. **Hepatology Research**, *49*(9), pp.990-1002.

Tawfeq al-nwany, N., Ahmad, N., Nawi, A.M., Hassan, M.R., Hod, R. and Baharom, M., 2021. *Seroprevalence of Hepatitis B Virus Infection and Its Associated Factors Among Blood Donors in Yemen*. **The Malaysian Journal of Medical Sciences***: MJMS*, *28*(5), p.54.

Thi T. Hang Pham et al, 2019, *Knowledge, attitudes and medical practice regarding hepatitis B prevention and management among healthcare workers in Northern Vietnam: a cross-sectional study*, **Plus one***,* doi.org/10.1371 /journal.pone.0223733.

Umutesi, J., Klett-Tammen, C., Nsanzimana, S., Krause, G. and Ott, J.J., 2021. *Cross-sectional study of chronic hepatitis B virus infection in Rwandan high-risk groups: unexpected findings on prevalence and its determinants.* **BMJ open**, *11*(12), p.e054039.

Van Damme, P., Dionne, M., Leroux-Roels, G., Van Der Meeren, O., Di Paolo, E., Salaun, B., Surya Kiran, P. and Folschweiller, N., 2019. *Persistence of HB sAg-specific antibodies and immune memory two to three decades after hepatitis B vaccination in adults*. ***Journal of viral hepatitis*****,** *26*(9), pp.1066-1075.

Wang, H., Men, P., Xiao, Y., Gao, P., Lv, M., Yuan, Q., Chen, W., Bai, S. and Wu, J., 2019. *Hepatitis B infection in the general population of China: a systematic review and meta-analysis*. **BMC infectious diseases**, *19*(1), pp.1-10.

Wedemeyer, H., Schöneweis, K., Bogomolov, P., Blank, A., Voronkova, N., Stepanova, T., Sagalova, O., Chulanov, V., Osipenko, M., Morozov, V. and Geyvandova, N., 2022. *Safety*

DO NOT COPY. LEAD CITY UNIVERSITY, NIGERIA

and efficacy of bulevirtide in combination with tenofovir disoproxil fumarate in patients with hepatitis B virus and hepatitis D virus coinfection (MYR202): a multicentre, randomised, parallel-group, open-label, phase 2 trial. **The Lancet Infectious Diseases**.

Weinbaum C.M.,Mast E. E &Ward J.W, (2019). *Recommendations for identification and public health management of persons with chronic hepatitis B virus infection*. **Hepatology**, 49(5), 35-44.

Weitzel, T., Rodríguez, F., Noriega, L.M., Marcotti, A., Duran, L., Palavecino, C., Porte, L., Aguilera, X., Wolff, M. and Cortes, C.P., 2020. *Hepatitis B and C virus infection among HIV patients within the public and private healthcare systems in Chile*: A cross-sectional serosurvey. **PloS One**, *15*(1), p.e0227776..

Xu, F., Song, H., An, B., Xiao, Q., Cheng, G. and Tan, G., 2019. NF-κB-dependent IFIT3 induction by HBx promotes hepatitis B virus replication. **Frontiers in microbiology**, *10*, p.2382.

Xu, Y. and Nie, Z.W., 2018. *Telbivudine and adefovir dipivoxil combination therapy improves renal function in patients with chronic hepatitis B: A STROBE-compliant article*. **Medicine**, *97*(48).

Yambasu, E.E., Reid, A., Owiti, P., Manzi, M., Murray, M.J.S. and Edwin, A.K., 2018. *Hidden dangers-prevalence of blood borne pathogens, hepatitis B, C, HIV and syphilis, among blood donors in Sierra Leone in 2016: opportunities for improvement: a retrospective, cross-sectional study*. **Pan African Medical Journal**, *30*(1).

Yazie, T.D. and Tebeje, M.G., 2019. *An updated systematic review and meta-analysis of the prevalence of hepatitis B virus in Ethiopia*. **BMC infectious diseases**, *19*(1), pp.1-13.

Yelemkoure, E.T., Yonli, A.T., Montesano, C., Ouattara, A.K., Diarra, B., Zohoncon, T.M., Nadembega, C.W., Ouedraogo, P., Sombié, C., Soubeiga, S.T. and Tao, I., 2018. *Prevention of mother-to-child transmission of hepatitis B virus in Burkina Faso: screening, vaccination and evaluation of post-vaccination antibodies against hepatitis B surface antigen in newborns.* **Journal of Public Health in Africa**, *9*(3).

Yip, T.C.F., Lai, J.C.T. and Wong, G.L.H., 2020. *Secondary prevention for hepatocellular carcinoma in patients with chronic hepatitis B: are all the nucleos (t) ide analogues the same?*. **Journal of Gastroenterology**, *55*(11), pp.1023-1036.

Younossi, Z.M., Stepanova, M., Younossi, I., Papatheodoridis, G., Janssen, H.L., Agarwal, K., Nguyen, M.H., Gane, E., Tsai, N. and Nader, F., 2019. *Patient-reported outcomes in patients chronic viral hepatitis without cirrhosis: The impact of hepatitis B and C viral replication*. **Liver International**, *39*(10), pp.1837-1844.

DO NOT COPY, LEAD CITY UNIVERSITY, NIGERIA

Yuan, Q., Wang, F., Zheng, H., Zhang, G., Miao, N., Sun, X., Woodring, J., Chan, P.L. and Cui, F., 2019. *Hepatitis B vaccination coverage among health care workers in China.* **PloS one**, *14*(5), p.e0216598.

Zara, B., Allah, N.U.M., Javed, W., Siddique, S., Mahmood, H. and Hassan, F., 2020. *A cross-sectional assessment of knowledge, attitude, and practices toward Hepatitis B virus infection among dentists of tertiary hospitals in Islamabad, Pakistan*. ***Pakistan Oral & Dental Journal*, *40*(2), pp.66-71**.

Websites

Federal Ministry of Health. National AIDS/STIS control program. 2016. https:// www. hepb.org/ assets/ Uploads/ Nigeria- Hepatitis- Guide lines- TX- guide lines. Accessed 29 Sept 2021.

The Journey to hepatitis elimination in Nigeria. In: Hepatitis Foundation: media centre, 2020. https:// www. hepb. org/ blog/ journ ey- hepat itis- elimi nation niger ia/. Accessed 29 Sept 2021.

World Health Organization (WHO). Hepatitis B. Fact sheet [monograph on the internet]. 2015. [cited 2016 Mar 30]. Available from: http://www.who.int/mediacentre/factsheets/fs204/en/.

World Health Organization, (2018). *Advocacy, communication and social mobilization for hepatitis B control: a guide to developing knowledge, attitude and practice surveys*.

World Health Organization, (2020*). Immunization, Vaccines and Biologicals, hepatitis B.*

World Health Organization, 2018, *National Blood Policy formulation and development of a Strategic Framework of Action for Blood Service*.

INFORMED CONSENT

Title of study

Awareness and attitudes towards hepatitis b virus among students and their vaccination status in a tertiary institution in oyo state. A case study of lead city university.

Principal Investigator

Ogunwumiju mayokun emmanuel

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Lead City University, toll gate, Ibadan,

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Ogunwumijumayokun@gmail.com

Purpose of Study

My name is Ogunwumiju Mayokun Emmanuel, a master of public health student at the faculty of public health, lead city university, Ibadan. I am conducting a study on awareness and attitudes towards hepatitis b virus among students and their vaccination status in a tertiary institution.

I am interested in awareness of hepatitis b virus among students in a tertiary institution, the attitude of students towards hepatitis b vaccination among students of tertiary institution and also to know the status of hepatitis vaccination among students of tertiary institution. I hereby solicit your support in completing this questionnaire.

Research Procedure

If you agree to be in this study, you will be asked to answer questions about yourself pertaining to the purpose of this study described above. These questions will be asked using a structured questionnaire. The questionnaire will take about 5 to 10 minutes of your time to complete.

Risks and Benefits

There are no known risks if you take part in this study. There are also no incentives but the information you provide would hopefully serve as an important input to intervene in programs that aim at improving children health.

Compensation

Participant will not be compensated for participation in this study. Participation is voluntary.

Confidentiality

All information you provide will be confidential and used for research purpose only. Your name will not be required and will never be used in connection with any information you give. Your

response is completely anoynymous, no personal identifying information will be collected. Every effort will be made by the researcher to preserve your confidentiality. Only the research team will have access to the answered questionnaires. Confidentiality and privacy will be maintained.

Contact Information

If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, if you have questions regarding your rights as a research participant, you may contact the researcher whose contact information is provided on the first page,

Voluntary Participation

Your decision to participate in this study is completely voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason.

Withdrawal from the Study/Withdrawal of Authorization

If you decide to participate in this study, you may withdraw from your participation at any point without penalty. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

Consent

I have read and i understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that i am free to withdraw at any time, without giving a reason and without cost. I understand that i will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature ______________________________ date __________

Investigator's signature _____________________________ date __________

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Appendix I

Lead City University, Ibadan.

I am **OGUNWUMIJU Mayokun Emmanuel**, a student of the Lead City University, Ibadan**.** I am conducting this study as a partial fulfillment for the award of masters degree in public health. This study is to assess the Awareness, Attitude and Utilization of Hepatitis B Vaccination among Undergraduate Students in a Tertiary Institution.

The information you will give is purely academic and it will be treated with a lot of confidentiality. I am requesting you to kindly participate in this study by responding to the following questions.

Please tick as appropriate

Section A: Socio-Demographic Data

1. Age: Below 15 [ ] 15- 20years [ ] 21-25 [ ] 26-30 [ ] 31-35 [ ] 36-40 [ ] 40 Above [ ]

2. Sex: Male [ ]Female [ ]

3. Ethnicity

4. Religion: Christian[ ] Muslim[ ] Others,Specify….......

5. Year of study: 1st year [ ] 2nd year [ ] 3rd year[ ] 4th year[ ] 5th year [ ]

6. Marital Status: Single [ ]Married [ ] Divorced[ ]Separated [ ]Widowed [ ]

7. Course of study:

Section B: Awareness of Hepatitis B Vaccine

8. Have you ever heard of Hepatitis B? Yes[ ] No[ ]

9. If Yes, what is hepatitis B……….

10. Which of the following do you know to be a symptoms of hepatitis B

a. Jaundice Yes No [ ] Don't know [ ]

b. Dark urine Yes No[ ]Don't know [ ]

c. Pale stools Yes No[ ]Don't know [ ]

d. Vomiting Yes [ ]No[ ] Don't know [ ]

e. Diarrhea Yes [ ] No [ ] Don't know [ ]

f. Abdominal discomfort Yes[ ] No[ ] Don't know[ ]

11. How can one come in contact with hepatitis B?

a. Injection drug use Yes [ ]No [ ]Don't know [ ]

b. Sharing of hair clipper/ razor blade Yes [ ]No [ ]Don't know [ ]

c. Infected unscreened blood products Yes [ ]No [ ] Don't know [ ]

d. Tattoos/ acupuncture Yes[ ] No[ ]Don't know [ ]

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e. Sexually Yes [ ]No [ ]Don't know [ ]

f. Closely living with positive person Yes [ ]No [ ]Don't know [ ]

g. Mother to child Yes [ ]No [ ]Don't know[ ]

12.Can hepatitis B be prevented? Yes [ ] No[ ] Don't know [ ]

13. How can one prevent hepatitis B?

a. Not sharing injection Yes[ ]No[ ] Don’t know[ ]

b. Not sharing of hair clipper/ razor blade Yes[ ]No[ ] Don’t know[ ]

c. Screening of blood products Yes[ ]No[ ] Don’t know[ ]

d Avoiding tattoos/ acupuncture Yes[ ]No[ ] Don’t know[ ]

e. Sexual fidelity Yes[ ]No[ ] Don’t know[ ]

f. Avoiding direct contact with body fluid Yes[ ]No[ ] Don’t know[ ]

g. Vaccination Yes[ ]No[ ] Don’t know[ ]

h. Immunoglobulin to children of infected mothers Yes [ ]No [ ] Don't know[ ]

I. Hand washing Yes[ ]No[ ] Don’t know[ ]

j. Counselling Yes[ ]No[ ] Don’t know[ ]

14. Have you ever done any of the following?

a. Sharing injection Yes[ ] No[ ]

b. Sharing of hair clipper/ razor blade Yes [ ] No[ ]

c. Transfused with unscreened of blood products Yes [ ] No [ ]

d Tattoos/ acupuncture Yes [ ] No[ ]

e Pedicure/manicure Yes [ ] No[ ]

f Multiple sexual partners Yes [ ] No [ ]

g. Regular direct contact with body fluid Yes [ ] No[ ]

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h. Had sex without condom Yes [ ] No [ ]

i. Had casual sex Yes [ ] No [ ]

j. Had sex with commercial sex worker Yes [ ] No [ ]

15. Have you ever been told that you any chronic disease? Yes [ ] No [ ]

16. If yes, which of the following?

a. Hepatitis B Yes [ ] No [ ]

b. Hypertension Yes [ ] No [ ]

c. Diabetes mellitus Yes [ ] No [ ]

d. Asthma Yes [ ] No [ ]

e Others, specify........... . .. .

17. Have you ever heard of hepatitis B vaccine? Yes [ ] No [ ]

18. If yes, from where?

a. Radio Yes [ ] No [ ]

b. Television Yes [ ] No [ ]

c. Hospital Yes [ ] No [ ]

d.Social media Yes [ ] No [ ]

e. Friends Yes [ ] No [ ]

f. School Yes [ ] No [ ]

g. Others, specify..................

19. What do you know about Hepatitis B vaccine?

....

20. Will you like to receive hepatitis B vaccine? Yes [ ] No [ ]

21. If yes, why?.........

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22. If no, why?...........

Section C: Attitude to Hepatitis B Vaccination

S/N		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
23	Healthy people need vaccination					
24	Hepatitis B vaccination should be compulsory					
25	I need vaccination at my age					
26	I am always careful, so I don't need vaccination					
27	I am not at risk, therefore don't need vaccination					
28	I am scared of vaccination					
29	I don't trust the vaccine					
30	I will continue friendship with a person who has Hepatitis B					
31	HBV positive students should be allowed in school					
32	I am willing to be tested for HBV infection					

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33.Do you consider hepatitis B vaccine safe? Yes [ ] No[ ] Don't Know[ ]

34. What are the benefits of receiving the Hepatitis B vaccine?

35. Will you recommend hepatitis B vaccine to others? Yes [ ]NO[ ]

37. If no, why?.

Section D: Utilisation of Hepatitis B Vaccine

38. Has any of your close family received hepatitis B vaccine? Yes [ ] No [ ]

39. How many doses did he/she receive? (a) 1 (b) 2 (c) 3 (d) 4

40. Where did he/she receive it? (a) School (b) Home (c) Hospital (d) Religious center

(c) Others, specily.

41. Have you ever received hepatitis B vaccine? Yes [ ] No [ ]

42. If yes, at what age?

a As a child Yes [ ] No [ ]

b. As an adult Yes [ ]No [ ]

c. As a pregnant woman Yes [ ]No[ ]

d. As a traveler Yes [ ] No [ ]

43. How many doses have you received? (a) 1 (b) 2 (c) 3 (d) 4

44. Where did you receive it? (a) School (b) Home (c) Hospital (d) Religious center

(e) Others, specify.................. .

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Bio-data

Ogunwumiju Mayokun Emmanuel

Personal Information

Date of birth: 25 august 1995
Current address: 2, idi osan 2, Muslim, Ibadan.
Mobile: +2349050314226
E-mail: ogunwumijumayokun@gmail.com
Nationality: Nigerian
Marital status: single

Education

Masters of Public Health

Lead City University, Ibadan Oyo state
September 2020 to December 2022

BSc in Health Information Management (First class honour)
Lead City University, Ibadan Oyo state
September 2018 to July 2020

Higher National Diploma in Health Information Management
Obafemi Awolowo University Teaching Hospital, Ile Ife, Osun State.
September 2015 to August 2017

National Diploma in Health Information Management
Obafemi Awolowo University Teaching Hospital, Ile Ife, Osun State.
September 2012 to 2014

Secondary School Certificate Examination
Liberty Commercial Secondary School, Ibadan, Oyo State
2005 to 2012

Primary School Leaving Certificate
Saint David's Primary School, Ibadan, Oyo State
1999 to 2005

Work Experience

Lead City University, Ibadan, Oyo State
Health information manager at the university hospital and the head of the health records unit.
2019 - 2022

Dalhatu Araf Specialist Hospital, Lafia, Nasarawa State
Health records officer as a National youth corper {NYSC}
2017 - 2018

Federal Medical Centre Owo, Ondo State
Industrial training
2014 – 2015

Other Certification

Project Management Certification
NEW Horizon computer learning centers (2019)

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Introduction to Go.Data – field data collection, chains of transmission and contact follow-up
World Health Organisation Health Emergencies Programme (2021)

Jobberman Soft Skills Training Certificate
Jobberman (2021)

Software

SPSS
EXCEL
MS WORD
POWERPOINT
MS ACCESS
PHOTOSHOP

Leadership Position

Head of department
Health records department, lead city university hospital, Ibadan, Oyo state

Public Relation Officer and Head of media committee
Medical and community health service (NYSC CDS) 2018

General Secretary
National Association of Health Information Management Students, OAUTHC chapter 2016/2017

Public relation officer
National Association of Health Information Management Students, OAUTHC chapter 2013/2014

References

Available on request.

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University Compliance Certification

This is to certify that this this thesis by Mayokun Emmanuel OGUNWUMIJU with Matric No. LCU/PG/002097 in the Department of Public Health, Faculty of Basic Medical and Applied Sciences, Lead City University, Ibadan is in full compliance with the approved university format.

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_______________________ _______________________

Signature Date

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