Acta Scientific Microbiology (ISSN: 2581-3226)

Volume 7 Issue 2 February 2024

Review Article

# Prevalence of Hepatitis B Among Pregnant Women Attending Ante-Natal Clinic in Federal Medical Centre Keffi, Nasarawa State, Nigeria

**Ajobiewe JO[1]*, Adetuyi Bisayo[3], Ajobiewe HF[2], Akinloye Oyetunde[7], Patrick Pillah[1], Victoria Pillah[4], Alau Kenneth[5], Aisha Salami[6] and Yashim AN[7]**

*[1]Veritas University, Bwari Abuja, Nigeria*

*[2]Bingham University, Karu Nasarawa State of Nigeria, Nigeria*

*[3]National Open University, Dutze Study Center, Abuja, Nigeria*

*[4]Nigerian National University Commission 'NUC', Nigeria*

*[5]Health System Consults Limited (HSCL), Abuja, Nigeria*

*[6]United State Department of Defense, Walter Reed Program, Nigeria US Embassy Nig., Nigeria*

*[7]Baze University, Abuja, Nigeria*

***Corresponding Author:** Ajobiewe JO, Veritas University, Bwari Abuja, Nigeria.

**DOI:** 10.31080/ASMI.2024.07.1350

**Received:** March 03, 2023

**Published:** January 26, 2024

© All rights are reserved by **Ajobiewe JO., *et al.***

## Abstract

Hepatitis B virus (HBV) infections is one of the most common cause of maternal morbidity and mortality. Studies on seroprevalence of HBV among pregnant women attending antenatal clinic at Federal Medical Centre, Keffi, Nasarawa state, Nigeria was carried out. A total of 106 serum samples of pregnant women attending the antenatal clinic were obtained and HBV was detected using HBV test kits. Out of 106 serum samples of pregnant women attending the antenatal clinic, the prevalence of HBV infection was 28(26.4%). The prevalence of HBV among the pregnant women was highest among those within the age group 21-25yrs (57.9%) The prevalence of HBV was also high among pregnant women with informal education (37.0%) and farmers (31.6%) as well as the single (51.4%) and those with history of blood transfusion (32.2%) and first trimester of pregnancy (34.4%) respectively. The prevalence of HBV among the pregnant women in relation to socio-demographic factors of the pregnant women were statistically significant ($P < 0.05$) in agreement with World Health Organization (WHO) findings.

**Keywords:** World Health Organization (WHO); Prevalence; Pregnant; Women; Hepatitis B virus (HBV) Federal Medical Centre; Keffi; Nasarawa state; Nigeria; Infection

## Study-Background

Viral hepatitis is an inflammation of the liver caused by one of the five hepatitis viruses, referred to as types A, B, C, D and E. While all of these viruses cause liver disease, they vary significantly in terms of epidemiology, natural history, prevention, diagnosis and treatment. Hepatitis is an inflammation of the liver characterized by the presence of inflammatory cells in the tissue of the organ [1,24]. It may occur with limited or no symptoms, but often leads to jaundice, anorexia (poor appetite) and malaise. Hepatitis virus infection is acute when it lasts less than six months and chronic when it persists longer. It is commonly the result of a viral infection, other possible causes of hepatitis include autoimmune hepatitis which is hepatitis that occur as a secondary result of medications, drugs, toxins and alcohol. Autoimmune hepatitis is a disease that occurs when your body makes antibodies against your liver tissue. Hepatitis B is a major disease of global public health threat worldwide with high prevalence in low and middle income countries [2]. It is preventable with safe and effective vaccines that have been available since 1982. Of the 2 billion people who have been infected with the hepatitis B virus (HBV) globally, more than 350 million have chronic (lifelong) infections with high prevalence in sub-Sahara Africa and other part of Asia countries most especially in adult women population [22,23]. Over 20 million people are infected annually with this virus. It is a disease caused by hepatotropic DNA virus and is more potent in individuals compare to human immunodeficiency virus. Hepatitis B is a leading cause of chronic

hepatitis, liver cirrhosis, and hepatocellular carcinoma worldwide. The hepatitis B virus is spread between people through contact with the blood or other body fluids, while the hepatitis C virus is spread through direct contact with infected blood. Very rarely it can also be passed on through other body fluids [1,21]. Many people infected with hepatitis B or C rarely displays any symptom, although they can still transmit the virus to others.

The transmission of hepatitis B virus from mother to child (vertical transmission) occurs during pregnancy, child delivery, and after delivery through breast milk (when nipples are cracked) [18] During the first year of life of infants, about 80 – 90% are infected with HBV which may developed into chronic infection at about 6 years of their life time. Also, about 15-20% of adults becomes chronically infected with the virus during childhood that may developed to hepatitis B related cancer or cirrhosis [16]. The chronic hepatitis B viral infection is much more expected among individuals infected during infancy and early year of life time compared to individuals infected during the adult stage of life [11,17].

The vertical transmission of this virus (i.e. transmission from mother to child) remains the most common route of the transmission of the virus especially in endemic area where about 20% of women of child bearing stage may have HBV and about one-third of this infection are responsible for chronic disease associated with death [9]. Other mode of transmission of the virus include exposure to contaminated blood or body fluids (i.e. semen, vaginal fluid and saliva) of an infected person, unprotected sex with infected person, blood transfusions and blood products where there is improper screening for blood-borne viruses, medical or dental interventions in countries where equipment is not adequately sterilized, sharing equipment for injecting drugs, sharing straws (rolled up bank notes for snorting cocaine which is alkaline and corrosive), sharing razors, toothbrushes or other household articles, tattooing and body piercing if done using unsterilized equipment [1,8].

Viral hepatitis during pregnancy is associated with high risk of maternal complications. There is a high rate of vertical transmission causing fetal and neonatal hepatitis which can have serious effects on the neonate, leading to impaired mental and physical health later in life. A leading cause in maternal mortality is also said to be the most familiar cause of jaundice in pregnancy. Peri-natal transmission of this disease occurs if the mother has had acute Hepatitis B infection during late pregnancy, in the first postpartum or if the mother is a chronic HBsAg carrier. Hepatitis C transmission occurs predominantly around time of delivery and pregnancy. Using this background information, the epidemiology of viral hepatitis during pregnancy is essential for health planners and program managers.

## Statement of the Problem

Hepatitis B Viral infection is a serious public health concern globally with an estimated cases of over 350million and Africa has about 50 million cases with mortality rate of about 25% in Sub-Sahara Africa [1,3]. Nigeria is classified among the group of countries endemic for HBV infection. Currently about 18 million Nigerians are infected. Many of these people may not be aware of the infection and hence innocently or undeliberately fail to seek appropriate medical attention before it could progress to chronic liver disease, cirrhosis and hepatocellular carcinoma. Similarly, when pregnant women are involved, they constitute a serious health risk not only to their unborn children but also to the society at large) and has become a leading cause of fetal death [6]. The symptoms of the disease cause by this HBV varies from sub-clinical to icteric, hyper acute and sub-acute hepatitis and from asymptomatic carrier stage to chronic hepatic cirrhosis.

The prevalence of hepatitis B virus in pregnant women is a public health threat because the chances of the transmission of the virus to the fetus is high [10] and the fetus have about 90% risk of the chronic liver disease. Implication of HBV in pregnant women include; threatened preterm labor, antepartum hemorrhage as well as gestational diabetes mellitus [4,5].

The vertical transmission of hepatitis B virus from mother to child is responsible for chronic liver disease in infants with prevalence ranges from 6-25% in Nigeria [12] Also, many authors reported on the prevalence of the HBV virus among women in Nigeria with prevalence rate that varies irrespective of the population [5,6,12].

However, there is a limited reliable data on the prevalence of HBV among the pregnant women attending ante-natal clinic and especially in the study centre, considering the fact that Nigeria ranked as the most common endemic area for HBV. Hence this study investigates the prevalence of HBV among the pregnant women attending ante-natal clinic in Federal Medical Centre, Keffi, and Nasarawa state.

The subject for the samples of the study was picked randomly.

## Hypotheses

### Hypothesis 1

- **$H_0$:** Socio-demographic factors does not predispose pregnant women to HBV infection
- **Ha:** Socio-demographic factors predisposes pregnant women to HBV infection.

### Hypothesis 2

- **Ho:** Medical history does not predispose pregnant women to HBV infection
- **Ha:** Medical history predisposes pregnant women to HBV infection

## Literature Review

### Structure of hepatitis B

The hepatitis B virus (HBV) is a small DNA virus with unusual features similar to retroviruses. It is a prototype virus of the Hepadnaviridae family causing Hepatitis B in humans, it is a viral infection that attacks the liver and can cause both acute and chronic disease.

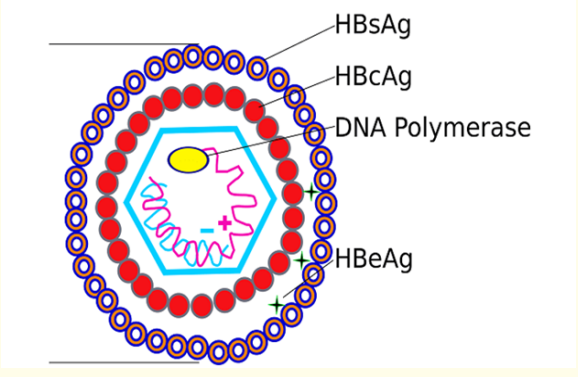


**Figure 1:** Structures of Hepatitis B Virus.

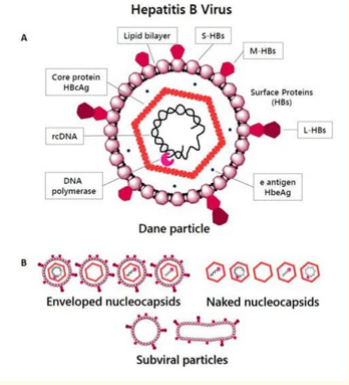


**Figure 2:** Structures of Hepatitis B Virus.

There are three types of viral particles that are visualized in infectious serum by electron microscopy.

- 42 nm in diameter (Dane particle- Virion)
- 20 nm in diameter (Spherical Structures)
- 22 nm in diameter (Filamentous Particles)

The hepatitis B virus which is 42nm particle comprises an electron dense nucleocapsid or core, 27nm in diameter surrounded by an outer envelope of the surface protein (HBsAg – Otherwise called the Australian Antigen) embedded in membranous lipoprotein derived from the host cell (the Australian antigen), that is the surface antigen and is produced in excess by the infected hepatocytes, and is secrete in the form of 22 nm particles and tubular structures with the same diameter. In other words, serum from individuals infected with hepatitis B contains three distinct antigenic particles: a spherical 22nm particle, a 42nm spherical particle (containing DNA and DNA polymerase) called the DANE Particle, and tubular or filamentous particles of the same diameter with the spherical particles (22nm). The small spherical and tubular particles are the unassembled components of the Dane particles the infective form of the virus. The unassembled particles contain hepatitis B surface antigen (HBsAg) the Australian antigen. The surface of the virion has a similar composition but also contains the large surface proteins. These large surface proteins are not found in the 22nm spherical particles (but maybe present in the tubular forms in highly viremic individual) and their detection in serum correlate nucleocapsid with viraemia. There is an outer shell (or envelope) composed of lipid and protein that is termed "surface antigen" or "HBsAg" [21].

Inner protein shell that is referred to as the core particle or "HBcAg", contains the viral DNA and enzymes used in viral replication (called "DNA polymerase").

HBeAg (hepatitis B e antigen) is the antigenic determinant that is closely associated with the nucleocapsid of HBV. It also circulates as a soluble protein in serum.

The carboxyl terminus of the core protein is anginine rise and this highly basic domains is believe to interact with the genome [15,16].

### Taxonomy of the Hepatitis B Virus

- Capsid symmetry: Icosahedral
- Enveloped or naked: Enveloped
- General: Orthohepadavirus
- Size of capsid assembly: Cytoplasm
- Stranded Ness: Double

- Size (NM): 40 TO 48NM (42NM)
- Virus family: Hepadnaviridae
- (HOST; DISEASE): Man; HBV of human which is strongly of associated with liver cancer.

## Reproduction (Replication) of hepatitis b virus

Hepadnaviruses, including human hepatitis B virus (HBV), replicate through reverse transcription of an RNA intermediate, the pregenomic RNA (pgRNA). Despite this kinship to retroviruses, there are fundamental differences beyond the fact that Hepadnaviruses contain DNA instead of RNA. Most peculiar is the initiation of reverse transcription: it occurs by protein-priming, is strictly committed to using an RNA hairpin on the pgRNA, ε, as template, and depends on cellular chaperones; moreover, proper replication can apparently occur only in the specialized environment [7].

**Keywords:** Chaperone-mediated reverse transcription, HBV ccDNA, Hepadnaviruses, P protein, Pregenomic RNA, Protein-priming, reverse transcriptase Replication of the hepadnaviral genome can broadly be divided into three;

- Infectious virions contain in their inner icosahedral core the genome as a partially double-stranded, circular but not covalently closed DNA of about 3.2 kb in length (relaxed circular, or RC-DNA);
- Upon infection, the RC-DNA is converted, inside the host cell nucleus, into a plasmid-like covalently closed circular DNA (cccDNA);
- From the cccDNA, several genomic and sub genomic RNAs are transcribed by cellular RNA polymerase II; of these, the pregenomic RNA (pgRNA) is selectively packaged into progeny capsids and is reverse transcribed by the co-packaged P protein into new RC-DNA genomes. Matured RC-DNA containing-but not immature RNA containing-nucleocapsids can be used for intracellular cccDNA amplification, or be enveloped and released from the cell as progeny virions. Below we discuss these genome conversions, with emphasis on the reverse transcription step, and particularly its unique initiation mechanism [4].

## Historical background of HBV

The hepatitis B virus was discovered in 1965 by Dr. Baruch Blumberg who won the Nobel prize for his discovery. Originally, the virus was called "Australia Antigen" because it was named after an Australian aborigine's blood sample that reacted with an antibody in the serum of an American hemophilia patient. And the Dane particle (complete hepatitis B virion) was identified in 1970.

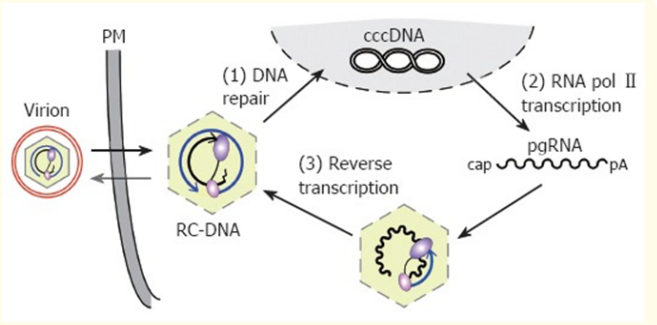


**Figure 3:** Replication cycle of the hepadnaviral genome. Enveloped virions infect the cell, releasing RC-DNA containing nucleocapsids into the cytoplasm. RC-DNA is transported to the nucleus, and repaired to form cccDNA (1). Transcription of cccDNA by RNA polymerase II (2) produces, amongst other transcripts (not shown), pgRNA. pgRNA is encapsulated, together with P protein, and reverse transcribed inside the nucleocapsid (3). (+)-DNA synthesis from the (-)-DNA template generates new RC-DNA. New cycles lead to intracellular cccDNA amplification; alternatively, the RC-DNA containing nucleocapsids are enveloped and released as virions PM, plasma Persistent viral infections require that the viral genome be present in the infected cell in a stable form that is not lost during cell division, and which therefore can be used for the continuous production of progeny genomes.

Identification of serologic markers for HBV infection followed and helped to clarify the natural history of the disease. Ultimately, HBsAg, the surface protein of HBV was manufactured in quantity and now comprises the immunogenic in highly effective vaccines for prevention of HBV infection. A plasma- derived Hepatitis B vaccine was first licensed for use in the United State in 1981 and replaced in 1986 with recombinant hepatitis B vaccine. In recent times, the rapid and continuous discoveries of the viral disease around the whole world have improved our understanding of the complexity of this unusual virus. Although there has not been any substantial decrease in the overall prevalence of HBV, there is the hope that the next generation will see a decline in both the worldwide carrier rate and the incidence of new HBV infections if current HBV vaccinations are intensified [7].

## Mode of Transmission of Hepatitis B

Hepatitis B is parentally transmitted unknowingly in several ways:

Contact with infected blood and bodily fluids such as saliva and menstrual fluid, vaginal and seminal fluids Saliva with blood, urine, and tears [3].

Contact with infected household members, may spread the hepatitis B virus. While the exact mode of transmission is not always clear, it appears that contaminated objects in the environment may indirectly transfer the virus to a person who has the potential for infection. Pregnant women who have the hepatitis B virus can pass it to their babies usually during the birth process [13].

Hepatitis B is most commonly spread from mother to child at birth (perinatal transmission) or through horizontal transmission (exposure to infected blood), especially from an infected child to an uninfected child during the first 5 years of life. The development of chronic infection is common in infants infected from their mothers or before the age of 5 years [3].

Hepatitis B is also spread by needle stick injury, tattooing, and piercing. Transmission of the virus may also occur through the reuse of contaminated needles and syringes or sharp objects either in health care settings, in the community or among persons who inject drugs. Sexual transmission is more prevalent in unvaccinated persons with multiple sexual partners.

Hepatitis B infection acquired in adulthood leads to chronic hepatitis in less than 5% of cases, whereas infection in infancy and early childhood leads to chronic hepatitis in about 95% of cases. This is the basis for strengthening and prioritizing infant and childhood vaccination.

The hepatitis B virus can survive outside the body for at least 7 days. During this time, the virus can still cause infection if it enters the body of a person who is not protected by the vaccine. The incubation period of the hepatitis B virus ranges from 30 to 180 days. The virus may be detected within 30 to 60 days after infection and can persist and develop into chronic hepatitis B, especially when transmitted in infancy or childhood [6].

## Theoretical framework

- The Health Belief Model is the observation that health behavior affects one's beliefs and perceptions about the disease as well as the available measures to decrease its occurrence.
- HBM guides health promotion and disease prevention program which makes it suitable for this study, in which I investigated the prevalence of Hepatitis B among pregnant women in the study area.
- HBM can be applied for the follow up of the pregnant women who are positive of the said disease to make sure the foetus is vaccinated after delivery and the mother is been managed of the virus
- HBM is used to explain and predict individual changes in health behaviors. As it is, it can be applied to the adult victims of the said virus, in the sense that, there will be monitor of the patient's reactions to the drugs given.

## Symptoms of hepatitis B

Hepatitis B is called a "silent infection" because most people do not have any symptoms when they are first infected. Thus, they can unknowingly pass the virus to others and continue the silent spread of hepatitis B. Testing is the only way to know for sure if you are infected.

- Most healthy adults do not experience any symptoms when they are first infected with the hepatitis B virus
- Some people who are infected will have symptoms and seek medical attention, but many will think they just have the flu and ignore the symptoms
- About 1 percent of those infected will develop a life-threatening condition called "fulminant hepatitis," which can be fatal and result in liver failure and death. Although this response is rare, fulminant hepatitis develops suddenly and requires immediate medical attention [23].

## Common symptoms of hepatitis B infection

- Fever, fatigue, muscle or joint pain
- Loss of appetite
- Mild nausea and vomiting
- Stomach pain
- Pale or light-colored stools
- Dark, tea colored urine

## Serious symptoms that require immediate medical attention

- Severe nausea and vomiting
- *v* eyes and skin (called «jaundice»)
- Bloated or swollen stomach [7]

## Stages of hepatitis B virus infection

### Acute Hepatitis Infection

Acute HBV infection is the initial stage of the infection and every HBV- infected patient goes through this, even though not all patients transit beyond this stage. Early phases of this stage of the infection are characterized serologically by the presence of HBsAg,

high serum HBV DNA, HBeAg, and normal level of serum aminotransferase level (ALT), and minimal or insignificant inflammation on liver biopsy [2]. A later phase, also called immunity phase, is marked by increased serum titres of anti-HBsAg IgG (HBsAb), anti-HBcAg IgG, lowered or disappearance of HBsAg and HBV DNA, normal liver histology. This is true for those who recover fully from the infection after attaining full and permanent immunity through exposure. The duration of either phase differs among patients but generally lasts between 5-8 months [7]. However, those patients who fail to mobilize adequate immune response factors to combat the infection end up with the fate of living with the disease in their entire lifetime. In this case, it is said the disease has become chronic. The physical signs and symptoms, such as jaundice, fever, dark-urine formation, nausea, among others, would occur, even though they will last shortly after which they get resolved following recovery. Generally, transition from the acute stage to the chronic stage depends on several factors including age, gender, viral genotype, and host immune competence.

About 70% of adults with acute hepatitis B have few or no symptoms. The remaining 30% develop significant symptoms two to four months following exposure to the hepatitis B virus. This period of time between the exposure and the first symptoms is called the incubation period. The most common symptoms of acute hepatitis B are fatigue, loss of appetite, nausea, and abdominal pain over the region of the liver. Jaundice often accompanies these other symptoms, when this happens, the infection is commonly referred to as acute icteric (jaundice) hepatitis. Occasionally individual with acute hepatitis B develop prodromal symptoms (such as skin rash, joint pain and lower grade fever), these are symptoms that start just before the onset of the symptom of hepatitis described above. Sometimes, the prodromal symptoms resemble the symptoms of flu. Most adults, particular those with acute symptomatic hepatitis B (with jaundice will recover completely from the infection within two to three month and develop antibodies that give them a lifelong immunity [3,14].

## Chronic infection

Chronic hepatitis B infection is inflammation of the liver that lasts for six months or longer. It lingers because the patient's immune system cannot fight off the virus. Chronic hepatitis B infection may last a lifetime, possibly leading to serious illnesses such as cirrhosis and liver cancers. Age at the time of acute infection is the primary determinant of the risk for progression to chronic infection. More than 90% of infants who are infected in the perinatal period develop chronic HBV infection. Between 25% and 50% of children infected between 1 and 5years of age become chronically infected with HBV, whereas only 6% to 10% of acutely infected older children and adults develop chronic HBV infections. Patients who have acute HBV infection while immune suppressed or concurrently with an underlying chronic illness have a higher risk for development of chronic infection [19 23]. In this case the virus is almost always detectable and symptoms may be either mild or absent for a long period of time, blood tests show that no antibodies have developed. The condition is usually suspected when abnormal enzyme tests are found on routine blood test. There are rarely any symptoms in the early stages of chronic hepatitis B, Additional tests such as ultrasound are helpful to determine the condition of the liver. A liver biopsy is always performed to determine the degree of the inflammation. Patient with chronic hepatitis B should avoid alcohol because it can cause additional liver damage [22].

## Prevention and control

Hepatitis B infection can be prevented by getting vaccine and HBIG (immune globulin) soon after coming into contact with the virus, persons who have recently been exposed to HBV should get HBIG and vaccine as soon as possible and preferably within 24 hours but not more than 2 weeks after the exposure.

## Primary prevention

- Advocacy and raising awareness of all types of viral hepatitis infections help reduce transmission in the community.
- In order to prevent maternal-child transmission, WHO has recommended HBV vaccination at birth. Investigation shown that 27% of newborns globally received this vaccine [24].
- Screening for Hepatitis B virus infection in pregnant women at their first perinatal clinic visit should be ensured so as to reduce mother to child transmission [7].
- Implementation of blood safety strategies, including blood supplies based on voluntary non-remunerated blood donations, effective public education on blood donation, blood selection and quality-assured screening of all donated blood and blood components used for transfusion can prevent transmission of HBV and HCV.
- Infection control precautions in health care and community settings can prevent transmission of viral hepatitis as well as many other diseases.
- Safe injection practices can protect against HBV and HCV transmission.
- Safer sex practices, including minimizing the number of partners and using barrier protective measures (condoms), protect against HBV and possibly against HCV transmission.

Occupational safety measures prevent transmission of viral hepatitis to health care workers.

Given the differences in the geographic distribution, transmission, diagnosis and treatment of hepatitis A, B, C, D and E infections, tailored prevention and control strategies are required. A comprehensive approach to the prevention of viral hepatitis includes a number of strategies.

### Secondary and tertiary prevention

- Early diagnosis provides the best opportunity for effective medical support and prevention of further spread. It also allows the infected persons to take steps to prevent transmission of the disease to others.
- Early diagnosis of those with chronic infection also allows people to take precautions to protect the liver from additional harm, specifically by abstaining from alcohol and tobacco consumption and avoiding certain drugs that are known to be toxic to the liver.
- Both the introduction of confirmatory testing and the notification and counselling of blood donors who have reactive results detected during screening of donated blood provide unique opportunities for early diagnosis and medical support to asymptomatic individuals who come to donate blood [18].

The general measure for prevention and control of hepatitis B summarized in the following.

- Excluding contact with HBV infected blood and secretions and minimizing needle sticks by scrupulous techniques.
- Passive prophylaxis with intramuscular injection of hepatitis B immune globulin 2 days of exposure and not 7 days
- Vaccination with the recombinant vaccines, Engerix B or Recombivax HB or Heplisav-B of the people who are at high risk of contracting this virus [19,20].

### Site of injection for vaccination

Hepatitis B vaccination should be given in the upper arm or the anterolateral aspect of the thigh and not in the buttock. There are over 100 reports of unexpectedly low antibody seroconversion rates after hepatitis B vaccination using injection into the buttocks. Many studies have since shown that the antibody response rate was significantly higher in centers using the buttock. On the basic of antibody test after vaccination the advisory committee on immunization practices of the centers of disease control, USA recommended that the arm be used as the site for hepatitis B vaccination in adults, as has the department of health in the United Kingdom. A comprehensive study of hepatitis B in 1989 by (Shaw., *et al.*) Showed that participants who received the vaccine in the deltoid had antibody titers that were up to 17 times higher than those of subjects who received the injections in the buttock. A recent study has shown that obese adolescents who were immunized with a 1.5-inch needle achieved significantly higher antibody titers to HBsAg than those immunized using a 1-inch needle.

Furthermore, those who injected in the buttock were 2-4 times more likely to fail to reach a minimum antibody level of 10 IU/L after vaccination. The injection of vaccine into deep fat in the buttocks is likely with needles shorter than 5cm and there is a lack of phagocytic or antigen presenting cells in layers of fat. Another factor may be due to the rapidity of which antigen becomes available to the circulation from deposition in fat, leading to a decay in processing by macrophages and eventually presentation to T and B cells. An additional factor maybe denaturation by enzymes of antigen that has remained in fat for hours or days. In essence, vaccine should be given in to the deltoid muscle or the anterolateral aspect of the thigh, the only acceptable sites for hepatitis B immunization [18]. Persons with a history of serious adverse events (such as anaphylaxis) after receipt of hepatitis B vaccine should not receive additional doses. As with other vaccines, vaccination of persons with moderate or severe acute illness, with or without fever, should be deferred until the illness resolves.

Pregnancy is not a contraindication to vaccination. Limited data indicate no apparent risk of adverse events to developing fetuses when hepatitis B vaccine is administered to pregnant women. The vaccine contains noninfectious HBsAg particles and should cause no risk to the fetus, and HBV Infection in a pregnant woman can result in severe disease for the mother and chronic infection for the newborn [21].

### People at risk of contracting the virus

Persons most at risk for infection:

Every person may be at some risk for a hepatitis B infection during their lifetime, so all people should consider getting the hepatitis B vaccine. However, some groups are more likely to be exposed to the hepatitis B virus.

See below for the CDC's list of people at increased risk of infection

- All pregnant women
- Infants born to mothers who are living with hepatitis B
- Adoptive families of children from countries where hepatitis B is common
- All infants, beginning at birth
- Unvaccinated children aged <19
- Susceptible sexual partners of people with hepatitis B infection

- Sexually active persons who are not in a long-term, mutually monogamous relationship (e.g., more than one sex partner during the previous six months)
- Persons seeking evaluation or treatment for a sexually transmitted infection
- Men who have sex with men
- People with current or recent drug use
- Susceptible household contacts of people with hepatitis B infection
- Inmates and staff of a correctional facility
- Healthcare and public safety workers at risk for exposure to blood
- Persons with end-stage renal disease, including pre-dialysis, hemodialysis, peritoneal dialysis, and home dialysis patients
- Residents and staff of facilities for persons with developmental disabilities
- Travelers to and families adopting from countries where hepatitis B is common (e.g. Asia, Africa, South America, Pacific Islands, Eastern Europe, and the Middle East)
- Persons with chronic liver disease, other than hepatitis B (e.g. cirrhosis, fatty liver disease, etc.)
- Persons with hepatitis C infection
- Persons with HIV infection

## Methodology

### Study site

The study was conducted in Ante Natal Clinic of Obstetrics and Gynecology Department, Federal Medical Centre (FMC) Keffi, which is a tertiary health institution located in keffi, Nasarawa State of North Central Nigeria, approximately 68km from Abuja, Nigeria's federal capital territory and 128km from Lafia town , the state capital of Nasarawa State. Keffi is located between latitude $8^0$5N of the equator and longitude $7^0$8'E of the Greenwich meridian and is situated on an altitude of 850m above sea level. The hospital caters to keffi's populace of about 124,900 persons as well as patients referred from surrounding towns and states. The hospital have 36 departments and about 284 bed space. Obstetrics and gynecology department take care of pregnancy, childbirth, postpartum period, reproductive health and the functions and diseases specific to women and girls. The department comprises of sub clinics; ante natal clinic, lying-in-ward clinic, labour ward, postnatal, eclamptic, gynae emergency, gynae clinic and theatre, in which they operate four times in a week i.e., Monday to Thursday.

### Study population

These were pregnant women attending ante natal clinic at Federal Medical Centre, Keffi, Nasarawa state.


**Figure 4:** Map of Nasarawa state showing the study area highlighted in yellow.

### Sample size determination

The sample size was determined using the formula, Described by fisher (1996)

$$N = \frac{Z^2pq}{d^2}$$

N= sample size

Z=Confidence interval (normal standard deviate at 95% confident interval which is taken as 1.96)

P= Prevalence rate of HBV (=6.7% which is taken from a study by Mustapha., *et al.* 2020)

q= 1-prevalence rate of HBV

d=95% confidence interval (5% probability)

N=?

Z=1.96

P=6.7= 0.067

q=1-0.067=0.0933

d=0.05

$$N = \frac{(1.96)^2 \times 0.067 \times 0.933 \approx 96}{(0.05)^2}$$

$$= \frac{3.8416 \times 0.067 \times 0.933 \approx 96}{0.0025}$$

Actual sample size = calculated sample size + 10% attrition rate

Calculating for attrition which is 10% of sample size

=10/96 x100 = 10.4

Therefore, final sample size is 96+10 =106

### Study subjects and sampling procedure

In the normal maternal care procedure of the hospital, pregnant women were triaged and assigned to the clinic as a routine service delivery procedure in the antenatal care clinic of the hospital. They were then permitted to enter into the ANC room one by one for routine follow-up care. All pregnant women with confirmed preg-

nancy were eligible to be enrolled in this study; those who met the inclusion criteria were interviewed after i promptly explained the purpose of the study. Pregnant women who were critically sick and unable to respond to the interview and those who did not volunteer to participate in the study were excluded. Systematic random sampling method was used to select the eligible study participants. The determined number of pregnant women was recruited within six weeks' working days.

### Ethical approval

The study proposal was submitted to Health Research Ethics Committee (HREC) of federal medical Centre, Keffi. Then, the committee assessed the work, commented and approved it, by confirming the study does not have any ethical issue that may harm the study participants. Therefore, the study obtained an official ethical clearance from the committee. Moreover, all the study participants were informed about the study and assured about the confidentiality, protection and anonymity of data. Written consent was obtained from each study participant before the data collection and participation in the study.

### Inclusion criteria

All Pregnant women attending the antenatal clinic of Federal Medical Centre, Keffi during the time of the research work was included in the study**.**

### Exclusion criteria

Non- pregnant women and pregnant women with history of HBV vaccination was excluded in the study.

### Sample collection

A total of 106 whole blood sample(s) of the pregnant women attending the clinic were randomly collected using 2ml syringe and transfer into test tubes and transported to laboratory department, Federal Medical Centre, Keffi for analysis.

### Screening for hepatitis B virus

The HBV was screened from the serum obtained from the whole of the patients using HBV kits, 50 microliter of the serum was obtained and transferred into the absorbent part of the kit and allowed for 5 minutes, double line with the control and test panel of the kit was recorded as HBV positive while single line only at the control panel of the kit was recorded as HBV negative.

### Statistical Analysis

The descriptive data obtained from the study was analyzed using chi-square statistics. Chi square is calculated using the formula below:

$\chi^2 = \Sigma (O-E)^2/E$

where $\chi^2$ – Chi Square

$\Sigma$ – Summation

O – Observed Frequency

E – Expected Frequency

It simply means we find the difference between the observed frequency (O) and expected frequency (E) and square the result, then divide by the expected frequency. The results are then summed up to get the calculated chi square. This result is then compared with the critical values from chi square tables at specified p-values or level of significance. The significance was determined at 95% confidence interval (5% probability).

## Results

| Socio-demographic factors | No. of Samples | No. (%) HBV |
|---|---|---|
| Age (yrs) | | |
| 16-20 | 10 | 5 (50.0) |
| 21-25 | 19 | 11 (57.9) |
| 26-30 | 21 | 3 (14.3) |
| 31-35 | 32 | 5 (15.6) |
| 36-40 | 19 | 2 (10.5) |
| 41-45 | 4 | 2 (50.0) |
| >45 | 1 | 0 (0.0) |
| Total | 106 | 28 (26.4) |
| Level of Education | | |
| Primary | 25 | 5 (21.0) |
| Secondary | 34 | 11 (32.3) |
| Tertiary | 20 | 2 (10.0) |
| Non-formal Education | 27 | 10 (37.0) |
| Total | 106 | 28 (26.4) |
| Marital status | | |
| Single | 35 | 18 (51.4) |
| Married | 31 | 3 (9.7) |
| Divorced | 40 | 7 (17.5) |
| Total | 106 | 28 (26.4) |
| Occupation | | |
| Civil servant | 7 | 1 (14.3) |
| Artisans | 26 | 6 (23.1) |
| Business | 25 | 6 (24.0) |
| Farmers | 38 | 12 (31.6) |
| House Wife | 10 | 3 (30.0) |
| Total | 106 | 28 (26.4) |

**Table 1:** Prevalence of Hepatitis B virus among pregnant Women attending Antenatal Clinic, Federal Medical Centre, Keffi, Nigeria in relation to socio-demographic factors**.**

| Trimester of Pregnancy | No. of Samples | No. (%) HBV |
|---|---|---|
| 1st | 32 | 11 (34.4) |
| 2nd | 33 | 10 (30.3) |
| 3rd | 41 | 7 (17.1) |
| Total | 106 | 28 (26.4) |

**Table 2:** Prevalence of Hepatitis B virus among pregnant Women attending Antenatal Clinic, Federal Medical Centre, Keffi, Nigeria in relation to factor related to pregnancy.

| Possible risk factors | No. of Samples | No. (%) HBV |
|---|---|---|
| History of Blood Transfusion | | |
| Yes | 59 | 19 (32.2) |
| No | 47 | 9 (19.1) |
| Total | 106 | 28 (26.4) |
| Multiple Sex Partners | | |
| Yes | 42 | 21 (50.0) |
| No | 64 | 7 (10.9) |
| Total | 106 | 28 (26.4) |

**Table 3:** Prevalence of Hepatitis B virus among pregnant Women attending Antenatal Clinic, Federal Medical Centre, Keffi, Nigeria in relation to possible risk factors**.**

## Prevalence of hepatitis B virus (HBV)

Out of 106 serum of pregnant women attending ante natal clinic, Federal Medical Centre, keffi, the seroprevalence of HBV was 28 (26.41%). The seroprevalence of HBV in relation to socio-demographic factors, possible risk factors and factors associated with pregnancy is as shown in Table 1, 2 and 3 respectively. The prevalence of HBV in relation to age shows that the prevalence was higher in 21- 25 years (57.9%) but low in 36-45yrs (10.5%). Also, the seroprevalence of HBV in relation to the level of education, marital status and occupation of the pregnant women was high among those who are uneducated (37.0%) and single (51.4%) but low among tertiary (10.0%) and those who are married (9.7%) respectively as shown in table 2.

The seroprevalence of HBV in relation to occupation of the pregnant women attending the clinic in the study centre was high among the farmers (31.6%) but low among the civil servants (14.3%).

The prevalence of HBV among the pregnant women in relation to socio-demographic factors of the pregnant women were statistically significant ($P < 0.05$).

The prevalence of HBV among the pregnant women with history of blood transfusion was high (32.2%) and also among women in their first trimester of gestational age (34.4 %) but low among those without history of blood transfusion (19.1%) and pregnant women in their 3rd trimester of gestational age (17.1%). For multiple sex partners, the prevalence was also high among those patients with multiple sex partners (50.0%) and low among patients without multiple sex partners (10.9%). The Seroprevalence of the HBV among the pregnant women in relation to possible risk factors such as history of blood transfusion and multiple sex partners were statistically significant ($P > 0.05$).

## Analysis of data

This section will analyze data obtained in relation to the hypothesis earlier stated.

Hypothesis 1: Socio-demographic factors does not predispose the pregnant women from been infected by HBV.

The socio-demographic factors for which data was obtained include age, level of education, marital status and occupation. Each table below shows the chi square statistics for each factor compared with the critical value to reach a statistical conclusion.

Each table has attached null hypothesis.

## Hypothesis for age

- $H_0$: Age does not predispose pregnant women to being infected by HBV
- $H_a$ Age predisposes pregnant women to HBV infection

| Age in Years | No. of Sample | Observed positive (O) | Expected positive (E) | O-E | $(O-E)^2$ | $(O-E)^2/E$ |
|---|---|---|---|---|---|---|
| 16 – 20 | 10 | 5 | 7.57 | -2.57 | 6.6049 | 0.87 |
| 21- 25 | 19 | 11 | 7.57 | 3.43 | 11.7649 | 1.55 |
| 26 – 30 | 21 | 3 | 7.57 | -4.57 | 20.8849 | 2.76 |
| 31- 35 | 32 | 5 | 7.57 | -2.57 | 6.6049 | 0.87 |
| 36- 40 | 19 | 2 | 7.57 | -5.57 | 31.0249 | 5.00 |
| 41- 4/5 | 4 | 2 | 7.57 | -5.57 | 31.0249 | 5.00 |
| >45 | 1 | 0 | 7.57 | -7.57 | 57.3049 | 7.57 |
| | 106 | 28 | | | | 23.62 |

**Table 4**

Df = N-1 = 7 – 1 = 6 where df is degree of freedom within the categories and p-value (α) = 0.05.

Hence; $\chi^2 = \Sigma (O-E)^2/E$ where

$\chi^2$ – Chi Square

Σ – Summation

O – Observed Frequency

E – Expected Frequency

$\chi^2 = 23.62$

Using df = 6 and α = 0.05

Critical value from chi square tables = 12.59

$\chi^2$ > critical value, hence we reject $H_o$ and accept $H_1$:

$\chi^2_{Cal} = 23.62$

df = 6 , α= 0.05

$\chi^2_{crit} = 12.59$

$\chi^2_{cal} > \chi^2$ crit reject $H_{0,,}$ accept $H_a$ the alternative hypothesis.

## Hypothesis for level of education

- $H_0$: Level of education does not predispose pregnant women to being infected by HBV
- $H_a$: Level of education can predispose pregnant women to HBV infection.

| Level of Education | No. of sample | Observed-positive (O) | Expected positive (E) | O-E | $(O-E)^2$ | $(O-E)^2/E$ |
|---|---|---|---|---|---|---|
| Primary | 25 | 5 | 13.25 | -8.25 | 68.0625 | 5.14 |
| Secondary | 34 | 11 | 13.25 | -2.25 | 5.0625 | 0.38 |
| Tertiary | 20 | 2 | 13.25 | -11.25 | 126.5625 | 9.55 |
| Non-formal Education | 27 | 10 | 13.25 | -3.25 | 10.5625 | 0.80 |
| | 106 | | 53 | | | 15.87 |

**Table 5**

$\chi^2 = 15.87$

df = 4-1 =3

α= 0.05

crit =7.815

$\chi^2$ > crit at α = 0.05

reject $H_{0,}$ Accept $H_a$.

## Hypothesis for marital status

- $H_0$: Marital status does not predispose pregnant women to being infected by HBV
- $H_a$: Marital status predisposes pregnant women to HBV infection.

| Marital status | No of sample | Observed positive | Expected positive | 0-E | $(O-E)^2$ | $(O-E)^2/E$ |
|---|---|---|---|---|---|---|
| Single | 35 | 18 | 17.67 | 0.33 | 0.1089 | 0.01 |
| Married | 31 | 3 | 17.67 | -14.67 | 215.2089 | 12.18 |
| Divorced | 40 | 7 | 17.67 | -10.67 | 113.8489 | 6.44 |
| | | | 53 | | | 18.63 |

**Table 6**

$\chi^2 = 18.63$

df= 3-1 =2

α=0.05

crit = 5.991

$\chi^2$ > crit at 0.05

reject $H_{0,}$ accept Hi

## Hypothesis for occupation

- $H_0$: Occupation does not predispose pregnant women to being infected by HBV
- $H_a$: Occupation predisposes pregnant women to HBV infection.

| Occupation | No of sample | Observed positive | Expected positive | 0-E | $(O-E)^2$ | $(O-E)^2/E$ |
|---|---|---|---|---|---|---|
| Civil servant | 7 | 1 | 10.6 | -9.6 | 92.16 | 8.69 |
| Artisans | 26 | 6 | 10.6 | -4.6 | 21.16 | 2.00 |
| Business | 25 | 6 | | -4.6 | 21.16 | 2.00 |
| Farmers | 38 | 12 | 10.6 | 1.4 | 1.96 | 0.18 |
| House wife | 10 | 3 | 10.6 | -7.6 | 57.76 | 5.45 |
| | 106 | | 53 | | | 18.32 |

**Table 7**

$\chi^2 = 18.32$

df =5-1=4 , α= 0.05

Crit = 9.488

$\chi^2$ > crit at 0.05

Reject $H_{0,}$ accept $H_1$.

## Hypothesis 2

Medical history does not predispose pregnant women to be infected with HBV.

Medical history that was captured include trimester of pregnancy, history of blood transfusion and multiple sex partner.

Each table below shows the chi square statistics for each factor compared with the critical value to reach a statistical conclusion.

Each table has attached null hypothesis

- $H_0$: Gestational age does not predispose pregnant women to being infected by HBV
- $H_a$: Gestational age predisposes pregnant women to HBV infection.

| Trimester of pregnancy | No of sample | Observed positive | Expected positive | 0-E | $(O-E)^2$ | $(O-E)^2/E$ |
|---|---|---|---|---|---|---|
| 1st | 32 | 11 | 17.67 | -6.67 | 44.4889 | 2.52 |
| 2nd | 33 | 10 | 17.67 | -7.67 | 58.8789 | 3.33 |
| 3rd | 41 | 7 | 17.67 | -10.67 | 113.8489 | 6.44 |
| | | | 53 | | | 12.29 |

**Table 8**

$\chi^2 = 12.29$
df =3-1=2, α= 0.05
Crit = 5.991
$\chi^2$ > crit at 0.05
Reject $H_0$, accept $H_1$.

## Hypothesis for history of blood transfusion

- $H_0$: History of blood transfusion does not predispose pregnant women to being infected by HBV
- $H_a$: History of blood transfusion predisposes pregnant women to HBV infection.

| History of blood transfusion | No of sample | Observed positive | Expected positive | 0-E | (O-E)2 | $(O-E)^2/E$ |
|---|---|---|---|---|---|---|
| YES | 59 | 19 | 26.5 | -7.5 | 56.25 | 2.12 |
| NO | 47 | 9 | 26.5 | -17.6 | 309.76 | 11.69 |
| | 106 | 28 | 53 | | | 13.81 |

**Table 9**

$\chi^2 = 13.81$
df =2-1=1, α= 0.05
Crit = 3.841
$\chi^2$ > crit at 0.05
Reject $H_0$, accept $H_a$.

## Hypothesis for history of multiple sex partner

- $H_0$: The History of having multiple sex partner does not predispose pregnant women to being infected by HBV
- $H_a$: The history of having multiple sex partner predisposes pregnant women to HBV infection.

| Multiple sex partner | No of sample | Observed positive | Expected positive | 0-E | (O-E)2 | (O-E)2/E |
|---|---|---|---|---|---|---|
| YES | 42 | 21 | 26.5 | -5.5 | 30.25 | 1.14 |
| NO | 64 | 7 | 26.5 | -19.5 | 380.25 | 14.35 |
| | 106 | 28 | 53 | | | 15.49 |

**Table 10**

$\chi^2 = 15.49$
df =3-1=2 , α= 0.05
Crit = 3.841
$\chi^2$ > crit at 0.05
Reject $H_0$, accept $H_a$

## Discussion of results

This section will elaborate on the analysis done in section 4,2 above, it will also lead to the response to the research hypotheses in the study.

## Research hypothesis 1 ($H_0$)

Socio-demographic factors does not predispose the pregnant women from been infected by HBV.

The table below shows the summary of results for each socio-demographic factor and the statistical conclusion reached at α = 0.05.

| S/N | Socio-demographic Factor | $\chi^2$ Calculated | Critical Value | Conclusion | Inference |
|---|---|---|---|---|---|
| 1. | Age | 21.94 | 12.59 | Reject $H_0$ | Accept $H_1$ |
| 2. | Level of Education | 15.87 | 7.815 | Reject $H_0$ | Accept $H_1$ |
| 3. | Marital Status | 18.63 | 5.991 | Reject $H_0$ | Accept $H_1$ |
| 4. | Occupation | 18.32 | 9.488 | Reject $H_0$ | Accept $H_1$ |

**Table 11**

From table above the null hypothesis ($H_0$) for each of the contributing socio-demographic factors (age, level of education, marital status and occupation) were rejected at a significant level of α = 0.05, and the alternative hypothesis ($H_1$) accepted. Hence it is safe to infer that sociodemographic factors could predispose or contribute to the exposure and subsequent infection of pregnant women with HBV. Thus the results obtained above suggest that there is a strong relationship between the sociodemographic factors and being infected with HBV.

So we can conclude that there exist a strong evidence to reject the null hypothesis a above.

| S/N | Medical history | $\chi^2$ Calculated | Critical Value | Conclusion | Inference |
|---|---|---|---|---|---|
| 1. | Gestational age | 12.29 | 5.991 | Reject $H_0$ | Accept $H_a$ |
| 2. | History of blood transfusion | 13.81 | 3.841 | Reject $H_0$ | Accept $H_a$ |
| 3. | Multiple sex partners | 15.49 | 3.841 | Reject $H_0$ | Accept $H_a$ |

**Table 12**

### Research hypothesis 2 ($H_a$)

Medical history does not predispose pregnant women to be infected with HBV. Hence, Medical history that was captured include gestational age (trimester of pregnancy), history of blood transfusion and multiple sex partner.

The table below shows the summary of results for each medical history and the statistical conclusion reached at α = 0.05.

From the table above, the null hypothesis ($H_0$) for each of factors related to pregnancy and possible risk factors i.e. (gestational age, history of blood transfusion and multiple sex partners) were rejected at a significant level of α = 0.05, and the alternative hypothesis ($H_1$) accepted. Hence it is safe to infer that medical history could predispose or contribute to the exposure and subsequent infection of pregnant women with HBV. Thus the results obtained above suggest that there is a strong relationship between medical history and being infected with HBV.

So we can conclude that there exist a strong evidence to reject the null hypothesis 2 above and accept the alternative hypothesis which states that medical history of pregnant women could be the source of cause of hepatitis B virus.

## Summary, Conclusion and Recommendations

### Summary

The prevalence of HBV among the pregnant women in the study was relatively high and this however agree with the report by Cetin., *et al*. (2018) WHO classified Nigeria as the most endemic area of HBV infection. The high prevalence of HBV in our study may posed high risk of maternal morbidity, mortality and chronic disease both in pregnant women and their new born babies and also increase the burden of the disease due to vertical transmission from mother to child which may likely spread (Mustapha *et al.*, 2020). The prevalence of HBV infection in our study was higher than 7.9%, 19.8% and 6.7% reported by Yakasai., *et al*. (2017), Mac *et al*. (2019) and Mustapha., *et al*. (2020) in the Northern part of Nigeria, more so the prevalence was also higher than 16.5% and 12.5% reported by Dahie,H.A., *et al*. (2017) in the Southern part of Nigeria. The differences in the prevalence of HBV among the pregnant women in our study in comparison with other studies both in the Northern and Southern part of Nigeria may be due to the fact that the prevalence of HBV may varies irrespective of the geographical location and the subpopulations of the pregnant women recruited for the studies.

The prevalence of HBV in relation to age in our study was highest in 21-25 yrs (57.9%) and this findings is slightly similar with the study earlier reported by Yakasai., *et al*. (2017) who reported high prevalence of HBV among pregnant women of age group 25-29 yrs (70.5%). The prevalence of HBV among the pregnant women in relation to the level of education and occupation was observed to be highest among those with informal education and farmers and this also justify that fact that the high prevalence of the virus may be due to lack of awareness among those with informal education and some farmers which may also lack awareness on the transmission of the HBV. The high prevalence of HVB among pregnant women with informal education in our study contradict with the findings of Yakasai., *et al*. (2017) who reported high prevalence of HBV among pregnant women with secondary level of education (11.3%). The prevalence of HBV among the pregnant women in relation to factors such as age, level of education and occupation were statistically significant and this implies that the socio-demographic factors mentioned may necessarily be factor for prevalence of HBV infections.

The high prevalence of HBV among the pregnant women who are single (51.4%) and with multiple sex partners in our study justify the fact the single women and those with multiple sex partners may likely be a predisposing factor of high prevalence of HBV due

to their active sexual activities. Previous studies also shows that acquisition of HBV infection is significantly higher among pregnant women involve in multiple sexual activities [12] and this is because multiple sexual activities and unprotected sexual intercourse is closely related to sexual transmitted infections which can easily exposed an individual to HBV considering the fact that HBV can transmitted via body fluid through sexual intercourse [12]. In another development also, the prevalence of HBV among the pregnant women with history of blood transfusion was also high and this may be due to lack of proper screening of blood before transfusion.

## Conclusion

The prevalence of HBV infection among the pregnant women in the study centre was high in accordance with WHO. The prevalence of HBV was highest among pregnant women who are farmers, single, informal education and with history of multiple sex partners and blood transfusion respectively. The prevalence of HBV in relation to the socio-demographic factors, factors related to pregnancy and possible risk factors were statistically significant. Therefore, it is hereby concluded that the infection, Hepatitis B virus is prevalent among patients in the said hospital; undoubtedly as the data speaks for itself.

## Recommendations

- Reduction of High prevalence of HBV through administration of vaccine and awareness should be ensured
- Enlightenment on the dangers of multiple sex partners as a possible predisposing factors of HBV infection among general population should be ensured
- Proper screening of blood before transfusion should be ensure to curtail the prevalence of HBV infections
- Testing of HBV among pregnant women attending antenatal clinics at their first prenatal clinic should be ensure to reduce the risk of maternal mortality and transmission from mother to child.
- Mass immunization of the children and adults at risk should be ensured
- Antiviral drugs and immunostimulatory therapy should be provided for those already infected.

## Bibliography

1. Adabara NU., *et al*. "Prevalence of Hepatitis B Virus among Women Attending Antenatal Clinic in the General Hospital, Minna, Niger State". (2012).
2. Altiparmak E., *et al*. "Seroprevalence of hepatitis B e antigen (HBe antigen) and B core antibodies (IgG anti-HBcore and IgM anti-HBcore) among hepatitis B". *BMC Research Notes* (2012).
3. American Academy of Family Physicians (AAFP). "Clinical preventive service recommendation: hepatitis". AAFP website (2019).
4. Aseb Arba Kinfe. "Co-contributor of prevalence hepatitis B viruses and associated factors among pregnant women attending ante natal clinic public hospitals of wolaita zone, South Ethiopia". (2020).
5. Bancha B., *et al*. "Contributor to prevalence hepatitis B viruses and associated factors among pregnant women attending ante natal clinic public hospital, South Ethiopia". (2021).
6. Berinyuy B Eustace., *et al*. "Prevalence of Hepatitis B Virus in Nigeria". Journal of Public Health and Epidemiology (2019).
7. Centers for Disease Control and Prevention (CDC). Hepatitis B information. CDC website (2019).
8. DahieHA and Heyle AA. "Prevalence of Hepatitis B and its associated factors among pregnant women in Mogadishu, Somalia". *Archives of Business Research* 5.11 (2017).
9. IM Ifeorah., *et al*. "Seroprevalence of hepatitis B and delta viruses among HIV-infected population attending anti-retroviral clinic in selected health facilities in Abuja, Nigeria". Jo*urnal of Immunoassay and Immunochemistry* 38.6 (2017): 608-619.
10. Ibrahim Adamu Yakasai., *et al*. Department of obstertrics and Gynaecology, Bayero University / Aminu Kano Teaching Hospital, Kano, Nigeria (2017).
11. Kebede KM., *et al*. "Hepatitis B virus infection among pregnant women in Ethiopia: a systematic review and meta-analysis of prevalence studies". *British Medical journal of Infectious* Disease 18.1 (2018): 322.
12. Mustapha G U., *et al*. "Seroprevalence of hepatitis B virus among antenatal clinic attendees in Gamawa Local Government Area, Bauchi State, Nigeria". *BMC Infectious Diseases* 20.1 (2020).
13. Henderson J T., *et al*. "Screening for hepatitis B infection in pregnant women: updated evidence report and systematic review for the US Preventive Services Task Force". *JAMA* (2020).

14. Henderson JT., *et al*. "Screening for hepatitis B virus infection in pregnant women: an updated systematic review for the U.S. preventive services task force". Evidence Synthesis No. 179. AHRQ Publication No. 19-05248-EF-1, Agency for Healthcare Research and Quality, Rockville, MD, (2019).

15. Hadden J., *et al*. "All-atom molecular dynamics of the HBV capsid reveals insights into biological function and cryo-EM resolution limits". *Elife* (2018).

16. Mckenzie Samuel. "Hepatitis B Structure: Capsid Flexibility and Function". *News-Medical* (2019).

17. National Institute of Diabetes and Digestive and Kidney Diseases. Autoimmune Hepatitis (2018).

18. Cetin S., *et al*. "Seroprevalence of hepatitis B surface antigen and associated risk factors among pregnant women". *Journal of Infection in Developing Countries* 12.10 (2018): 904–909.

19. USPSTF (US Preventive Services Task Force). USPSTF A and B Recommendations (2018).

20. WHO Executive Board. Viral hepatitis. Report by the Secretariat. EB126/15, 12 November (2009).

21. WHO Global Hepatitis Report 2017. World Health Organization. Guidelines (2019).

22. WHO. "Guidelines for the Prevention, Care and Treatment of Persons with Chronic Hepatitis B Infection". Geneva (2015).

23. WHO. "Hepatitis B and breastfeeding" (1996).

24. WHO. World Hepatitis Summit 2022. Global Hepatitis programme. WHO@ world hepatitis summit (2022).