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Sero-prevalence of Hepatitis B virus and plasmodium co-infection profile among patients in Wukari and Environs, North East Nigeria

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Abstract

Hepatitis B virus and plasmodium co-infection is of an increase in developing countries as a result of lack of proper diagnosis leading to increased morbidity. This study was to determine the sero-prevalence of *Hepatitis B Virus* and *Plasmodium* co-infection profile among patients in Wukari and environs. Seventy (70) subjects' with the age range of between 0 to 80 years participated and standard microbiological techniques were observed in this study. The results obtained showed 34 (48.6%) were males and 36 (51.4%) were females. Four (5.7%) participants were sero-positive for HBsAg, HBsAb, HBeAg and HBeAb while 66 were not detected positive. The Male with 5.9% participants were sero-positive while 5.6% of the female participants were sero-positive. 20 (28.6%) of the participants were sero-positive for malaria. This comprises of 7 males and 13 females. 20.6% of the males were sero-positive while 36.1% of the females were sero-positive. The distribution of parasitaemia by gender across the participants showed that 24 (34.3%) had plasmodium parasitaemia, out of which 9 were males and 15 were females. 26.5% of the males and 41.7% of the females had plasmodium parasitaemia. There was no co-infection of Hepatitis B virus and malaria, despite both having prevalence of 5.7% and 34.3% respectively. The research on its own has shown that in order to reduce HBV and plasmodium co-infection, mass immunization of adults and antiviral drugs should be provided for those that are infected, while HBV and plasmodium co-infections screening programs should be instituted in all levels of institutions in the country to reduce the prevalence rate and level of transmission of the hepatitis virus. This study also has added to the puddle of knowledge already available in this area of research.

Keywords: Hepatitis B Virus; Patients; Plasmodium; Wukari, Sero-prevalence

1. Introduction

The oldest evidence of hepatitis B infection dates to Bronze Age [1]. The evidence was obtained from 4,500-year-old human remains by shotgun sequencing of the viral genomes [1]. [1], has described it as the oldest ever recovered from vertebrate samples. The divergence of orthohepadnavirus and avihepadnavirus occurred about 125,000 years ago and both the Avihepadnavirus and Orthohepadna viruses began to diversify about 25,000 years ago [2]. The branching at this time led to the emergence of the Orthohepadna genotypes A–H. Human strains have a most recent common ancestor dating back to 7,000 to 10,000 years ago. A second estimate of the origin of this virus suggests a most recent common ancestor of the human strains evolved around 1500 years ago [3]. The most recent common ancestor of the avian strains was placed at 6000 years ago. The mutation rate was estimated to be approximately 10^{-6} substitutions/site/year. Another analysis with a larger data set suggests that Hepatitis B infected humans 33,600 years ago [4]. Examination of sequences in the zebra finch have pushed the origin of this genus back at least to 40 million

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years ago and possibly to 80 million years ago [5]. Chimpanzee, gorilla, orangutan, and gibbon's species cluster with human isolates. Non primate species included the woodchuck hepatitis virus, the ground squirrel hepatitis virus and arctic squirrel hepatitis virus. A number of bat infecting species have also been described. It has been proposed that a New World bat species may be the origin of the primate species [6]. A study of isolates from the circumpolar Arctic human population has proposed that the ancestor of the sub genotype B5 (the endemic type found in this population) that the ancestral virus originated in Asia about 2000 years ago (95% HPD 900 BC - 830 AD) [7]. Coalescence occurred about 1000 AD. This sub genotype spread from Asia initially to Greenland and then spread westward within the last 400 years. It was also found that some ancient hepatitis viral strains still infect humans, while other became extinct [1]. This disproved the belief that hepatitis B originated in the New World and spread to Europe around 16th century [1]. Hepatitis B Virus (HBV) is a DNA virus of the family hepadnaviridae and causes diseases resulting in liver conditions that could be of immense danger to human health [8]. It is a major cause of liver disease morbidity and mortality worldwide. There is a 15–25% risk of dying prematurely in adulthood from HBV-related cirrhosis and hepatocellular carcinoma, while a small proportion of those with acute infections may also succumb to fulminant liver failure [9]. Malaria is a mosquito borne disease in humans caused by parasitic protozoans of the genus *Plasmodium* [10]. Human malaria is caused by five different species of *Plasmodium* namely, *Plasmodium falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, and *P. knowlesi* [11]. *falciparum* and *P. vivax* are the most lethal [8]. An obligate intracellular parasite, *Plasmodium* requires two hosts to complete its life cycle, that is, an arthropod vector for sexual life cycle and human host for asexual life cycle. The mosquitoes which act as vector for this disease are female *Anopheles funestus*, *Anopheles moucheti*, *Anopheles gambiae*, *Anopheles arabiensis* [12]. The symptoms of malaria include abdominal discomfort, headache, joint aches, muscle aches, abdominal discomfort, vomiting, lethargy, anorexia [13]. The severe form of malaria often occurs in individuals not previously exposed to malaria such as young children and travelers from non-endemic areas, and often present clinically as cerebral malaria, pulmonary edema, acute kidney injury, hypoglycemia, lactic acidosis, anemia, and liver involvement [14]. Both Malaria and HBV infections can present with febrile illness associated with generalized body ache, weakness, headache and yellowish sclera as their first symptoms [15]. It has been estimated that about 2 billion people have been infected with HBV and more than 300 million people worldwide suffer from persistent infection [16]. Out of this, about 600,000 people die every year due to the acute or chronic consequences of the disease [17]. The prevalence rate of HBV infection is highest in the Sub-Saharan Africa and Eastern parts of Asia with 44% of cirrhotic liver disease and 47% of hepatocellular carcinoma cases in Sub-Saharan Africa attributed to HBV [18]. The infection is largely acquired during childhood with 5-10% of the adults developing a chronic disease [15], and HBV accounts for over 360 million cases of chronic hepatitis and 620,000 deaths annually [8]. Despite being vaccine preventable, HBV infection remains a global health problem. Similarly, malaria remains a burden globally particularly in Sub-Saharan Africa and a major health threat worldwide [19]. It is one of the most widespread infectious diseases in the world [20]. According to a World health organization [8], there were 214 million new cases of malaria and 438,000 deaths worldwide, and over 41% of world's population remain exposed to this disease [8]. Over the last few years, the incidence of malaria has reduced considerably, raising the possibility that eradication might be possible in the future [11]. The estimated global incidence rate of malaria decreased by 21% between 2010 and 2015 and 41% between 2000 and 2015 [21]. Also, the proportion of the population at risk in sub-Saharan Africa infected with malaria parasites is estimated to have declined from 22% in 2005 to 17% in 2010, and to 13% in 2015 [21; 22]. Due to the coincidence in the endemicity of HBV and *Plasmodium* infections, co-infection of HBV with *Plasmodium* may occur [23]. These two infections live some of their developmental stages within the liver, and hepatocyte damage in HBV infection may cause poor liver handling of malaria parasites [24] thus culminating in increased morbidity. In line with this, co-infection with *Plasmodium* parasite and HBV virus in individual may possibly influence progression of both agents and associated severity. It is on this background that this work determines the sero-prevalence of *Hepatitis B Virus* profile and *Plasmodium* co-infection among patients attending hospitals in Wukari environs. Due to low vaccination rates and the fact that about 75% of the Nigerian population will be exposed to HBV [18], the risk of contracting HBV is quite significant. In a previous study conducted in a University located in Wukari, a Hepatitis B Surface Antigen (HBsAg) seroprevalence rate of 6.0% was observed [25]; which raises some level of concern. On the other hand, Nigeria is known for having the world's greatest malaria burden, recording approximately 51 million cases and 207,000 deaths annually, while 97 % of the total population is at risk of infection [26]. Worthy of mention is the fact that malaria accounts for 60% of outpatient visits to hospitals [26]. Malaria and HBV infection are co-endemic throughout much of the tropical and Sub-Saharan Africa and they both present major threat to public health [27]. These facts are quite worrisome and even more alarming when HBV infection occurs concurrently with malaria. In 2010, the World Health Assembly resolved to recognize viral hepatitis as a global health problem [28]. There remains a scarcity of research on people's knowledge, attitudes, and practices towards malaria in the majority of the federation, particularly in Northern Nigeria [29]. Also, not much study has been carried out on HBV in most parts of the country and much is not known about its epidemiology [25]. This study therefore became necessary, in that, it will describe the epidemiology of HBV and highlight the burden of the HBV and malaria co-infection in Wukari environs, identify gaps and make recommendations for improvements on surveillance and control of both infections. This study is therefore necessary to determine the sero-prevalence of *Hepatitis B Virus* and *Plasmodium* co-infection profile among patients in Wukari and environs.

2. Material and methods

2.1. Study area and population

This study was carried out in the Department of Microbiology, Federal University Wukari, Taraba State, Nigeria. Wukari metropolis is a large town which is the Headquarter of Wukari Local Government Area of Taraba State. Geographically, Wukari lies between latitude 7°55'42" North and longitude 9°47'59" East. It has an area of 4,308 km². Wukari is home to Federal University Wukari, National Open University of Nigeria study center and Kwara University. It is an important town in Taraba state, characterized with agricultural activities among other activities. The average annual temperature in Wukari is 26.8°C, with March being the hottest month with an average temperature of 29.8°C and August has the lowest average temperature with 25.4°C. The average precipitation is 1205mm. The major languages spoken are Jukun, Kutep, Tiv, Hausa and Fulani [25].

2.2. Ethical approval

A letter of introduction was obtained from the Department of Microbiology, Federal University Wukari, and ethical approval was obtained from the hospital management. The purpose and procedure of the study was explained to the volunteers, parents or caregivers and their consent was obtained for samples collection.

2.3. Study design

The study design is a community, hospital-based cross-sectional and experimental study. The essence of the research was explained to the target population and their consents were obtained after which blood samples were collected.

2.4. Sample collection

All materials (sterile tubes, syringes and needles, tourniquet, cotton swab) required for the collection of venous blood were assembled and labeling of the sterile plain containers with the subjects' identification numbers were done. About 5ml of blood samples were collected from seventy (70) participants aseptically by venipuncture and dispensed into sterile labeled tubes with anticoagulants. Thick smears of the blood samples were made at the spot on clean and grease-free slides. The blood samples were transported in an ice box to the laboratory. The whole blood was stored at 4-8°C in the refrigerator for up to 24 hours, but was not allowed to freeze.

2.5. Analysis of samples for *Plasmodium spp*

Analysis was performed using microscopic examination of thick smears and parasitemia (parasites/mL of blood) was calculated in positive cases. Malaria Rapid Diagnostic Test (RDT) was performed using whole plasma samples from all individuals to confirm diagnoses, using a test kit from Standard Diagnostics, Inc.

2.5.1. Procedure for Thick film

The procedure for staining and viewing thick film to establish malaria parasitaemia was done according to the method described by [30].

2.5.2. Rapid Diagnostic Test Procedure

The procedure was carried out based on the manufacturer's instruction. All the kit components and specimens were brought to room temperature prior to testing. The test device was removed from the foil pouch and placed on a flat, dry surface. It was labelled with subject's ID number. About 5µL of the blood sample was dispensed into the round specimen well. Four drops of assay diluent were placed into the assay diluent well. After a range of 15 to 30 minutes, the results were read.

2.5.3. Interpretation of Result

Negative: One line "C" in the result window indicates that no Malaria *P. falciparum* antigen is present. Positive: Two lines "C" and "P" in the result window indicates *P. falciparum* positive. Invalid: No "C" line in the result window

2.6. Analysis Of Samples for Hepatitis B Virus

Serum samples were analyzed for the presence of HBV Surface Antigen (HBsAg), Surface Antibody (HBsAb), Core Antibody (HBcAb), Envelope Antigen (HBeAg) and Envelope Antibody (HBeAb) using HBV Combo Rapid Test Cassette by Acro Biotech, Inc.

2.7. Procedure for Hepatitis B profile test

The test was carried out using the procedure outlined by the manufacturer of the kit used. All the kit components and specimens were brought to room temperature prior to testing. Clear plasma was separated from the blood which showed no sign of haemolysis. The test cassette was removed from the foil pouch and placed on a clean and level surface. It was labeled with subject's ID number. Holding the dropper vertically, 3 drops of the plasma sample were dispensed into each sample well of the test cassette respectively, without trapping air bubbles. The results were read within 15 to 20 minutes, but not later than 20 minutes.

2.8. Interpretation of Results

2.8.1. For HBsAg, HBsAb, HBeAg

Negative: One coloured line appears in the control line (C) and no apparent coloured line appears in the test region (T). Positive: Two distinct coloured lines appear, one at the control region (C), the other at the test region (T). Invalid: Control line fails to appear.

For HBeAb, HBcAb,

Negative: Two distinct coloured lines appear, one at the control region (C), the other at the test region (T). Positive: One coloured line appears in the control region (C) and no apparent coloured line appears in the test region (T). Invalid: Control line fails to appear.

2.9. Data/Statistical Analysis

The sero-prevalence of HBV and HCV infection was calculated by using participants with positive sample as numerator and the total number of participant as denominator. The data obtained from this study were presented using descriptive statistics.

3. Results

The distribution of the subjects based on gender and age is presented in Table 1 below. Seventy subjects participated in this study. The age range of the participants tested across Hospitals in Wukari and environs was between 0 to 80 years; 34 (48.6%) were males and 36 (51.4%) were females.

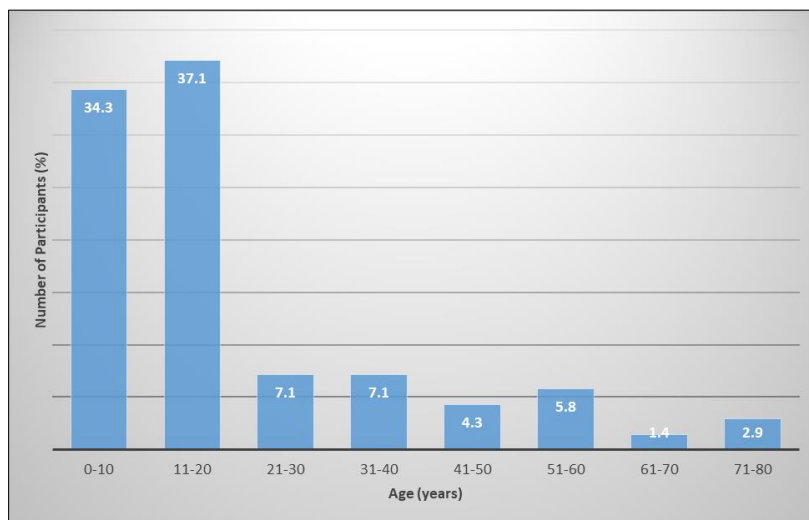


Figure 1 Bar Chart showing the percentage distribution of participants across various age group

Figure 1: Bar Chart showing the percentage distribution of participants across various age groups. Table 2 shows that 4 (5.7%) persons out of 70 study participants were sero-positive for HBsAg. Other biomarkers were not detected. Equal sero-positivity rate was observed among the males with 2 sero-positives and females with 2 sero-positives. 5.9% of the Male participants were sero-positive while 5.6% of the female participants were sero-positive. Figure 2: Pie chart showing the overall Sero-prevalence of HBV among the study participants. Figure 3: Pie charts showing the Sero-

prevalence of HBV among the male (A) and female (B) participants. Table 3 shows that 20 (28.6%) of the participants were sero-positive for malaria. This comprises of 7 males and 13 females. 20.6% of the males were sero-positive while 36.1% of the females were sero-positive. Table 4 shows the distribution of parasitaemia by gender across the participants. 24 (34.3%) had plasmodium parasitaemia, out of which 9 were males and 15 were females. 26.5% of the males and 41.7% of the females had plasmodium parasitaemia. In table 5, it was shown that there was no co-infection of Hepatitis B virus and malaria, despite both having prevalence of 5.7% and 34.3% respectively.

Table 1 Distribution of study participants based on gender and age group

| Age (Years) | Male | Female | Total (%) |
|-------------|------------|------------|-----------|
| 0-10 | 10 | 14 | 24 (34.3) |
| 11-20 | 15 | 11 | 26 (37.1) |
| 21-30 | 4 | 1 | 5 (7.1) |
| 31-40 | 2 | 3 | 5 (7.1) |
| 41-50 | 2 | 1 | 3 (4.3) |
| 51-60 | 1 | 3 | 4 (5.8) |
| 61-70 | 0 | 1 | 1 (1.4) |
| 71-80 | 0 | 2 | 2 (2.9) |
| Total | 34 (48.6%) | 36 (51.4%) | 70 (100) |

Table 2 Sero-prevalence of HBV by gender among the study participants

| Biomaker | Male (%) n = 34 | Female (%) n = 36 | Frequency (%) n = 70 |
|----------|--------------------|----------------------|-------------------------|
| HBsAg | 2 (5.9) | 2 (5.6) | 4 (5.7) |
| HBsAb | 0 | 0 | 0 |
| HBcAb | 0 | 0 | 0 |
| HBeAg | 0 | 0 | 0 |
| HBeAb | 0 | 0 | 0 |
| Total | 2 (5.9) | 2 (5.6) | 4 (5.7) |

Table 3 Sero-prevalence of *Plasmodium falciparum* antigen by gender among the study participants

| Sex | No. of positive (%) | No. of Negative (%) |
|-----------------|---------------------|---------------------|
| Male (n = 34) | 7 (20.6) | 27 (79.4) |
| Female (n = 36) | 13 (36.1) | 23 (63.9) |
| Total (n = 70) | 20 (28.6) | 50 (71.4) |

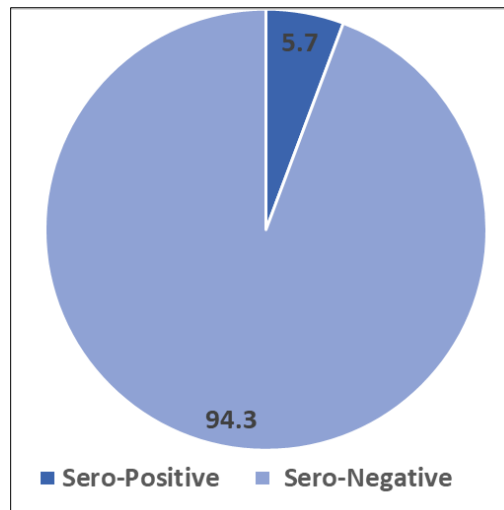


Figure 2 Pie chart showing the overall Sero-prevalence of HBV among the study participants

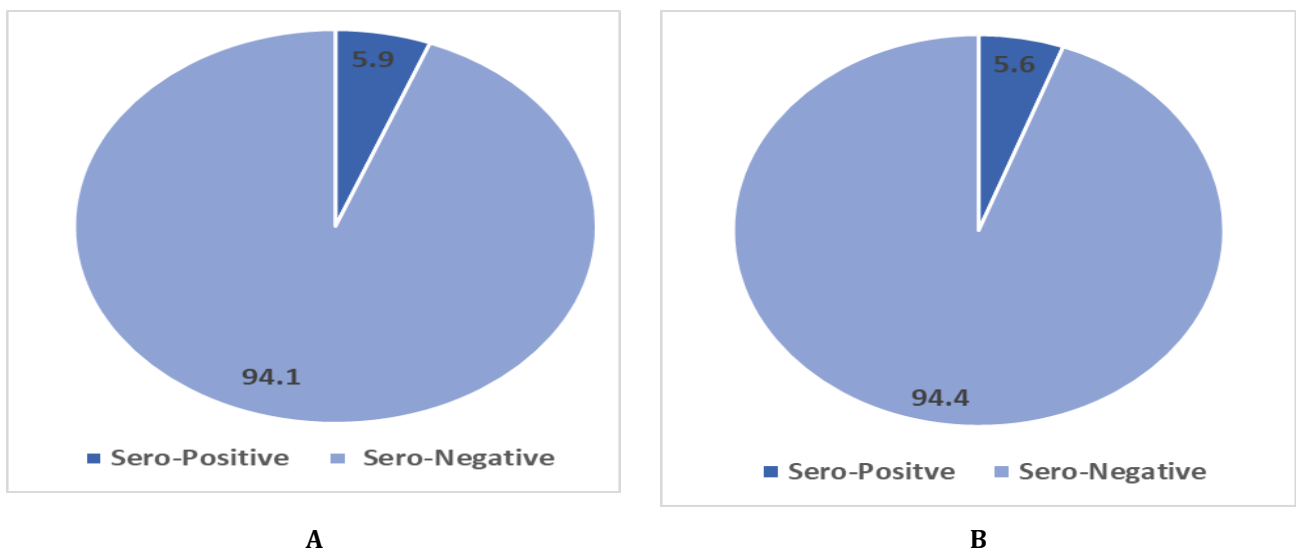


Figure 3 Pie charts showing the Sero-prevalence of HBV among the male (A) and female (B) participants

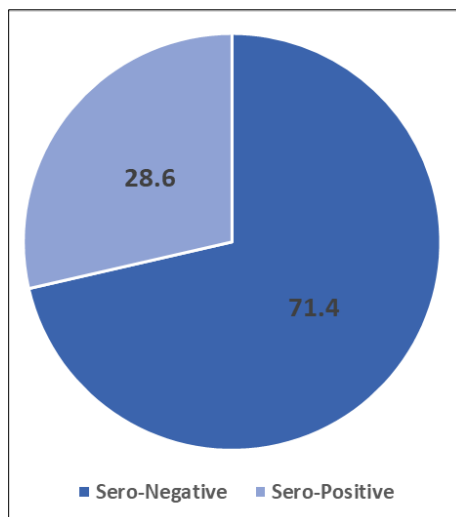


Figure 4 Sero-prevalence of *Plasmodium falciparum* antigen among the study participants

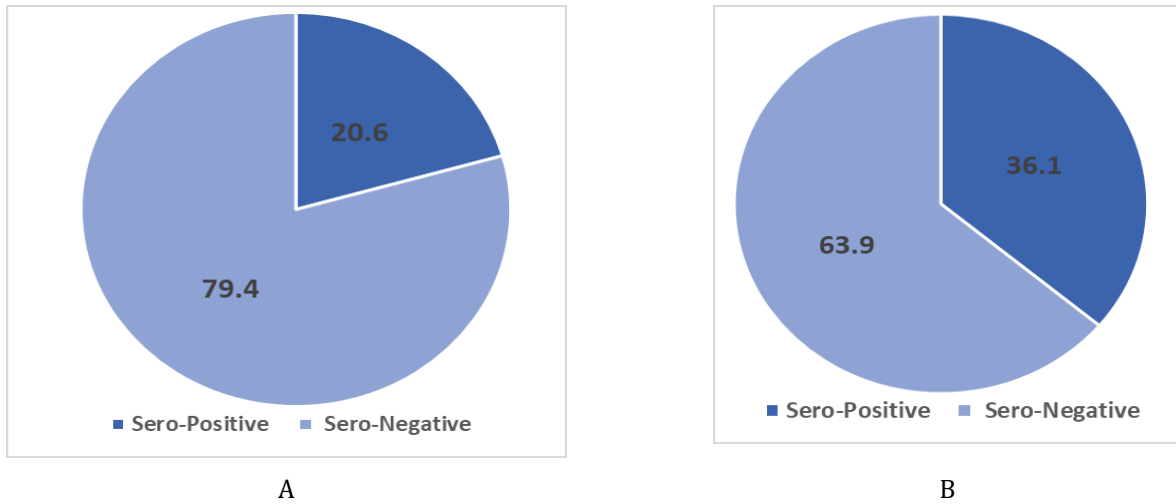


Figure 5 Pie charts showing sero-prevalence of *Plasmodium falciparum* antigen among the male (A) and female (B) participants.

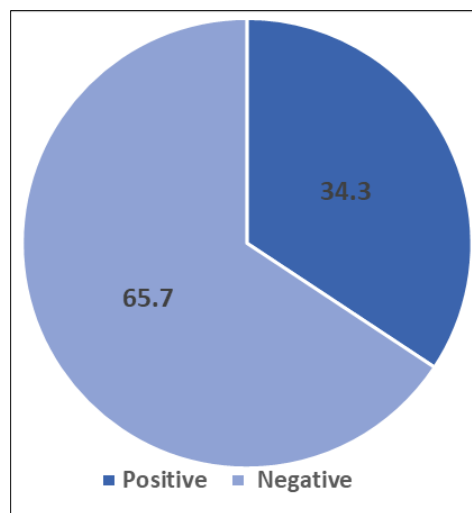


Figure 6 Prevalence of *Plasmodium* parasitaemia among the participants

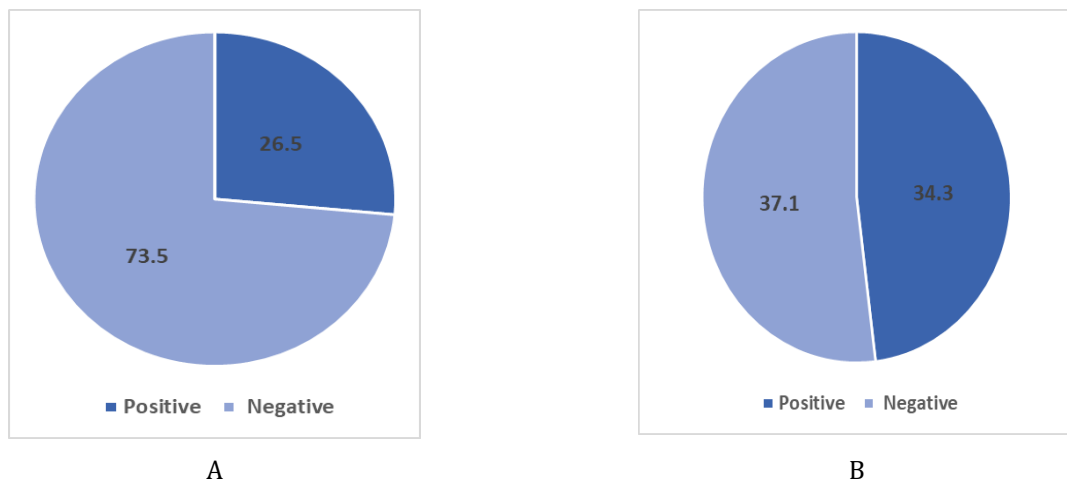


Figure 7 Pie chart showing the prevalence of *Plasmodium* parasitaemia among the male (A) and female (B) participants

Table 4 Distribution of parasitaemia by gender across the participants

| Sex | No. of positive (%) | No. of Negative (%) |
|-----------------|---------------------|---------------------|
| Male (n = 34) | 9 (26.5) | 25 (73.5) |
| Female (n = 36) | 15 (41.7) | 21 (58.3) |
| Total (n = 70) | 24 (34.3) | 46 (65.7) |

Table 5 Sero-prevalence of coinfections among participants (n = 70)

| Infection | No. of Positive (%) | No. of Negative (%) |
|-------------|---------------------|---------------------|
| Malaria | 24 (34.3) | 46 (65.7) |
| Hepatitis B | 4 (5.7) | 66 (94.3) |
| Coinfection | 0 (0.0) | 70 (100.0) |

4. Discussion

Hepatitis B Virus and plasmodium co- infections are both reportedly common in several tropical areas, and the endemicity of these infections often overlaps. The presence of malaria and HBV co-infection has been known to influence the progression of either malaria, hepatitis, or both diseases [31]. From the result generated in this study, there was an overall sero-prevalence rate of 5.7% for HBsAg and prevalence rate of 34.3% was recorded for malaria parasitaemia. No case of co-infection was observed. The prevalence rate (5.7%) obtained in this study is close to 6.0% reported by [25] from Wukari and 6.5% reported by [15] from Kano. The figure from this study is however; lower than 11% reported by [32] from Kogi state, 11.5% reported by [33] from Ekiti State and 12.3% reported by [34]. [9] noted that there has been a downward trend in the prevalence of chronic HBV infection mainly due to immunization against HBV and improved health-care practices, for example, screening of blood and blood products, injection safety, and infection control policies and practices. The 34.3% prevalence rate of malaria infection presented by this study is close to 30.59% reported by [35] and 25.5% reported by [15] both from Kano. It differed by a wide margin from 77.6% presented by [36] from Enugu. In this present study, females (34.3%) had greater malaria burden than men (26.5%). A similar observation was made by [15] who reported a prevalence rate of 18.0% in female than males with 7.5%. This is also consistent with the findings by [35], who reported a prevalence rate of 61.0% in female than their male counterparts with 38.0%. The 0% prevalence rate recorded in this study varied from most other studies where various rates of prevalence were reported. [37] recorded 5.5% prevalence rate of HBV and malaria co-infection. [38] recorded a co-infection prevalence rate of 7.8% among a group of pregnant Nigerian women. [15] recorded 4.5% in febrile patients in Kano. The difference could likely be related to the number of participants (70) recruited for this present study which is low compared to other related studies. On the other hand, it could be a proof that, there is decrease in the trend of malaria and HBV infections and that the effort at prevention and control of these two infections is reaching the target as noted by [15]. Numerous studies have been carried out on the prevalence of malaria infection, HBV infection and the coincidence of both infections.

5. Conclusion

Although much is known about the epidemiology of HBV and plasmodium infections in Nigeria, limited investigations have been carried out on HBV and plasmodium co-infections in some parts of the country. Studies carried out by various authors have shown that HBV and plasmodium co-infections are highly prevalent among Nigerians. The result of this study which shows that the prevalence of HBC (5.7%) and plasmodium infections (34.3%) which is high when compared with the study population shows that many of these patients do not know much about hepatitis viral infection, mode of transmission, vaccination, treatment, prevention and control hence the high prevalence rate recorded in this study population. As a result of this, there is need for adequate screening programme to reduce the transmission of infection. Public awareness programme to educate the populaces on modes of transmission should be put in place for HBV vaccination because many of the patients are not aware of the infection and its mode of transmission, some are afraid of taking vaccine for various reasons such as religion which in this part most people still believe that the use of drugs is against their religion. Therefore, in order to reduce HBV and plasmodium co-infection, mass immunization of adults and antiviral drugs should be provided for those that are infected, while HBV and plasmodium co-infections screening programs should be instituted in all levels of institutions in the country to reduce the prevalence rate and level of

transmission of the hepatitis virus. This study has therefore, added to the pool of knowledge already available in this area of research. The result of this study showed that the prevalence rate of HBV and malaria infections are 5.7% and 34.3% respectively with no co-infection. This could be a pointer to the increasing awareness of people towards prevention of HBV and malaria infections. The data from this study can be relied upon and as well, further consolidated by subsequent studies.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest reported. Authors unanimously agree with the publication of this scientific work.

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