Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and Hepatitis C Virus (HCV) Co-Infections among Patients attending General Hospital, Wukari, Taraba State, North East, Nigeria

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Abstract

Human Immunodeficiency virus (HIV), Hepatitis B virus (HBV), and Hepatitis C virus (HCV) are all potent viral pathogens of public health significance. However, there is limited data regarding co-infection of HIV, HBV, and HCV in developing countries, especially Nigeria. Hence this study was carried out to determine the prevalence of HBV, HCV and HIV co-infections among patients in Wukari, Taraba State. One hundred (100) blood samples of patients attending Hospital in Wukari, Taraba state were collected and screened for Hepatitis B surface antigen, anti – HCV antigen and HIV antigen were included in this study. The venous blood samples were collected and screened for Hepatitis-B surface antigen (HBsAg), Anti-HCV antibodies and HIV antibodies using HBV Combo Rapid Test Cassette; TELL Rapid diagnostic strip as well as Determine and StakPat test strips using standard serological techniques. The results indicates prevalence rate of HBV was 15.0%, 20.0% males and 13.8% females, HCV was 5.0, with 3.3% males and with 6.2% females and HIV was 8%, 10.0% males and 7.1% females. The prevalence rates of HBV/HIV, HCV/HIV and HBV/HCV/HIV co-infections were 7.0%, 3.0% and 2.0% respectively. The prevalence of HBV/HCV/HIV and HBV/HCV/HIV infection was more among subjects within age range of 21-30 years (11.5%, 3.8% and 3.8%) and lowest within the age range of 11-20 years (4.5%, 0% and 0%). This study further reaffirms the need for routine baseline screening for this serological marker, as it is a major consideration in the initiation and choice of highly active Anti-Retroviral Therapy. Hence, the results obtained from this researched implies that patients should be encouraged to go for screening and know their status for proper management to avoid cirrhosis and liver cancer and take steps to avoid infecting other individuals. Also, for those that are seropositive, early diagnosis, treatment and vaccination are the recommended preventive measures. There is need for vigorous awareness campaigns on the routes of transmission of these infections and to educate people living in developing regions as to the deadly effect of these infections.

Keywords: Co-infection, Hepatitis B Virus, Hepatitis C Virus, Human Immunodeficiency Virus, Patients, General Hospital, Wukari

1. Introduction

Co-infection is the infection of a host by numerous pathogenic organisms at the same time, which may or may not co-exist. Because pathogen species can interact within the host, co-infection is of particular importance to human health. Co-infection is regarded to have a bad overall effect on human health (Imarenezor *et al.*, 2016) [10]. Hepatitis is a condition in which the liver tissue becomes inflamed (Imarenezor *et al.*, 2017) [9]. Hepatitis involves such signs such as yellow staining of the skin and whites of the eyes (jaundice), poor appetite, vomiting, weariness, abdominal pain, and diarrhea in some individuals (WHO, 2016). Hepatitis is classified as acute if it clears up in six months or chronic if it lasts longer than that (Bello *et al.*, 2013) [2]. Hepatitis B is a viral infection that causes damages to the liver and is caused by the hepatitis B virus (Imarenezor *et al.*, 2021) [8].

It's capable of both acute and chronic infection (WHO, 2014) [19]. Many people are asymptomatic during the early stages of the infection (WHO, 2014) [19]. During acute infection, symptoms may occur such as vomiting, yellowish skin, fatigue, black urine, and abdominal pain that usually persist for few weeks but arerarelyfatal (WHO, 2014) [19]. Symptoms can take anywhere from 30 to 180 days to appear (WHO, 2014). In those infected around the time of birth, 90% acquire chronic hepatitis B while in those infected after the age of five, only 10% get chronic hepatitis B (Imarenezor *et al*., 2016) [10]. The virus is spread through contact with infectious blood or bodily fluids (WHO, 2014) [19]. In locations where the disease is widespread, infection occurs around the time of birth or as a result of contact with other people's blood during childhood (WHO, 2014) [19]. Intravenous drug use and sexual intercourse are the most common sources of transmission in areas where the disease is uncommon (WHO, 2014) [19]. Hepatitis C is a type of viral hepatitis caused by the hepatitis C virus (HCV), which primarily affects the liver (Imarenezor *et al*., 2016) [10]. During the initial infection, people often have mild or no symptoms (CDC, 2020). Occasionally, a fever, dark urine, abdominal pain, and yellow tinged skin occur (CDC, 2019). The virus persists in the liver in about 75 percent to 85 percent of those initially infected. HCV is transmitted mostly by blood-to-blood contact, which is related with injectable drug use, improperly cleaned medical equipment, needle injuries in healthcare, and transfusions (Imarenezor *et al*., 2016) [10]. It can also be passed from a woman to her infant during birth (WHO, 2016) []. Hepatitis C has no vaccine (CDC, 2020). Prevention includes harm reduction efforts among people who inject drugs, testing donated blood, and treatment of people with chronic infection (WHO, 2016). Hepatitis B virus (HBV) is a member of the hepadnavirus family. The virus particle (virion) consists of an outer lipid envelope and an icosahedral nucleocapsid core composed of core protein. These virions are 30–42 nm in diameter. The virus is one of the smallest enveloped animal viruses. The 42 nm virions, which are capable of infecting liver cells known as hepatocytes, are referred to as "Dane particles". In addition to the Dane particles, filamentous and spherical bodies lacking a core can be found in the serum of infected individuals. These particles are not infectious and are composed of the lipid and protein that forms part of the surface of the virion, which is called the surface antigens (HBsAg), and is produced in excess during the life cycle of the virus. Transmission of hepatitis B virus results from exposure to infectious blood or body fluids containing blood. It is 50 to 100 times more infectious than human immunodeficiency virus (Imarenezor *et al*., 2016) [10]. Possible forms of transmission include sexual contact (F0lade-Nulia *et al*., 2012), blood transfusions and transfusion with other human blood products (re-use of contaminated needles and syringes, and vertical transmission from mother to child (MTCT) during childbirth. Without intervention, a mother who is positive for HBsAg has a 20% risk of passing the infection to her offspring at the time of birth. This risk is as high as 90% if the mother is also positive for HBeAg. HBV can be transmitted between family members within households, possibly by contact of non-intact skin or mucous membrane with secretions or saliva containing HBV. Hepatitis C infection rates increased substantially in the 20th century due to a combination of intravenous drug abuse and the reuse of poorly sterilized medical equipment (WHO, 2015) [20]. However, advancements in treatment have led to notable declines in chronic infections and deaths from the virus. As a result, the number of chronic patients receiving treatment worldwide has grown from about 950,000 in 2015 to 9.4 million in 2019 (Imarenezor *et al*., 2016) [10]. During the same period, hepatitis C deaths declined from about 400,000 to 290,000 (WHO, 2021). Previously, a study conducted in 2013 found high infection rates greater than 3.5% population infected in Central and East Asia, North Africa and the Middle East, intermediate infection rates (1.5–3.5%) in South and Southeast Asia, sub-Saharan Africa, Andean, Central and Southern Latin America, Caribbean, Oceania, Australasia and Central, Eastern and Western Europe; and low infection rates (less than 1.5%) in Asia-Pacific, Tropical Latin America and North America (Mohd *et al*., 2013) [12]. In the United States, about 2% of people have chronic hepatitis C (Weitzel *et al*., 2020). Human Immunodeficiency Virus (HIV) and Hepatitis C Virus (HCV) co-infection is a multi-faceted, chronic condition that significantly impacts public health. According to the WHO in 2019, 2 to 15% of those infected with HIV are also affected by HCV, increasing their risk of morbidity and mortality due to accelerated liver disease. The burden of co-infection is especially high in certain high-risk groups, such as intravenous drug users and men who have sex with men (WHO, 2020). It is estimated that 6.2% of people living with HIV also show signs of past or present hepatitis C infection. This equates to 2.3 million people living with HIV, over half of whom (1.36 million) are people who inject drugs (WHO, 2017) Injection drug use accounts for 23% of new hepatitis C infections while 8% of people living with chronic hepatitis C currently inject drugs (WHO,2017). This study was therefore carried out with the aim to determine the prevalence of hepatitis B, C and HIV-1, HIV-2 co-infection among individuals living in Wukari, North east, Nigeria.

2. Materials and Method

2.1 Study Area

Wukari metropolis 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 Kwararafa 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℃, with March being the hottest month with an average temperature of 29.8℃ and August has the lowest average temperature with 25.4℃. The average precipitation is 1205mm. The major languages spoken are Jukun, Kutep, Tiv, Hausa and Fulani (Imarenezor *et al*., 2016) [10].

2.2 Study design and sampling

The study is a hospital-based prospective study. A community health center within Wukari metropolis was considered as sample collection center. A total of 100 patients from the age of 18 years old that voluntarily walked into the health facilities was counseled and tested for HIV, HBV and HCV. All the subjects 'consents were obtained after which blood samples were collected.

2.3 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 and

Taraba State Ministry of Health. The purpose and procedure of the study was explained to the volunteers, parents or caregivers and their consent was obtained for samples collection. Written consent has been collected and preserved by the author(s).

2.4 Materials
Sterile tubes (EDTA and plain tubes), hand gloves, syringes and needles, tourniquet, cotton swab, Centrifuge, refrigerator and RDT Kits.

2.5 Sample Collection
The tourniquet was tied to the upper arm before locating a prominent vein. The skin covering the vein was then cleansed with methylated spirit. About 5mL of blood sample were collected from each outpatient aseptically by venipuncture. The sample was then transferred into EDTA. The blood samples were transported in an ice box to the laboratory.

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 Gemc Technology Group Ltd. The analysis was done using TELL Rapid diagnostic strip, a commercially available test kits for the detection of anti – HCV antibody from each patient's serum. The HCV Rapid Test strip is a qualitative, membrane based immunoassay for the detection of antibody to HCV in serum or plasma. Serum samples were analyzed for the presence HIV-1 and HIV-2 antibodies using the Determine (Abbot laboratories, U.S.A) and StatPak test kits were used for confirmation of the result and a result is recorded as positive for HIV only if both Determine and StatPak showed positive reaction, it was recorded as negative if only one test kit or both shoed negative.

2.6.1 Interpretation of Results for hepatitis B virus
For HBsAg, HBsAb, HBeAg
Negative: One red/pink line appears in the control line (C) and no visible colored line appears in the test region (T). Positive: Two red/pink lines appear, one at the control region (C), the other at the test region (T). Invalid: Control line fails to appear or no line appears at all.
For HBeAb, HBcAb,
Negative: Two red/pink lines appear, one at the control region (C), the other at the test region (T). Positive: a red/pink line appears in the control region (C) and no visible colored line appears in the test region (T). Invalid: Control line fails to appear or no line appears at all.

2.6.2 Interpretation of Results for Hepatitis C virus
Negative: A red/pink line appears in the control line (C) and no apparent colored line appears in the test region (T). Positive: Two red/pink lines appear, one at the control region (C), the other at the test region (T). Invalid: Control line fails to appear or no line appears at all.

2.6.3 Interpretation of Results for HIV-1 AND HIV-2
Negative: A red/pink line appears in the control line (C) and no apparent colored line appears in the test region (T). Positive: Two red/pink lines appear, one at the control region (C), the other at the test region (T). Invalid: Control line fails to appear or no line appears at all.

2.7 Data/Statistical Analysis
The data obtained from the results were analyzed using descriptive statistics.

3. Results
Table 1 shows the distribution of the subjects based on gender and age. One hundred subjects participated in this study. The ages of the outpatients were inclusive of both children and adults across; Thirty (30%) were males and Seventy (70%) were females. Table 2 shows the prevalence of Hepatitis B, Hepatitis C and HIV among the outpatients. HBV prevalence was 15%, HCV was 5% while HIV prevalence was 8%. Of the 15 HBV-positive patients, 6(20.0%) were males while 9(13.8%) were females. Of 5 HCV-positive patients, 1(3.3%) were males while 4(6.2%) were females. Of 15 HIV-positive patients, three (10.0%) were males and five (7.1%) were females. Table 3 shows the coinfection of HBV/HIV, HCV/HIV, HBV/HCV and HBV/HCV/HIV among outpatients based on gender Table 4 shows the coinfection of HBV/HIV, HCV/HIV, HBV/HCV and HBV/HCV/HIV among outpatients based on age group. Figure 1 shows Pie chart showing the overall prevalence of HBV among study participants. Figure 2a shows Pie charts showing the prevalence of HBV among the male participants. Figure 2b shows Pie charts showing the prevalence of HBV among the female participants. Figure 3 illustrations Pie chart showing prevalence of HCV among study participants. Figure 4a indications Pie charts showing the prevalence of HCV among the male participants. Figure 4b indications Pie charts showing the prevalence of HCV among the female participants. Figure 5 shows Pie chart showing prevalence of HIV among study participants. Figure 6a shows Pie charts showing prevalence of HIV among Male participants. Figure 6b indications Pie charts showing prevalence of HIV among female participants. Figure 7 indications Pie chart showing prevalence of the Coinfection among study participants. Figure 8a illustrations Pie charts showing the prevalence of the Coinfection among Male Participants. Figure 8b indications Pie charts showing the prevalence of the Coinfection among female Participants.

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

Age (years)	Male(n=30)	Female (n=70)	Total (n=100)
11-20	10	12	22(22)
21-30	12	40	52(52)
31-40	4	14	18(18)
41-50	0	2	2(2)
51-60	4	0	4(4)
61-70	0	2	2(2)
Total	30(30%)	70(70%)	100(100)

Table 2: Prevalence of Hepatitis B, Hepatitis C and HIV

Gender	Number examined (n=100)	HBV n (%)	HCV n (%)	HIV n (%)
Male	30	6(20.0)	1(3.3)	3(10.0)
Female	70	9(13.8)	4(6.2)	5(7.1)
Total	100	15(15)	5(5)	8(8)

Table 3: Coinfection of HBV, HCV and HIV among study participants based on gender

Gender	Number examined	HBV/HIV n (%)	HCV/HIV n (%)	HBV/HCV/HIV n (%)
Male	30	3(10.0)	1(3.3)	1(3.3)
Female	70	4(5.7)	2(2.9)	1(1.4)
Total	100	7(7)	3(3)	2(2)

Table 4: Coinfection of HBV, HCV and HIV among study participants based by age

Age	Number examined	HBV/HIV n (%)	HCV/HIV n (%)	HBV/HCV/HIV n (%)
11-20	12	1(4.5)	0(0.0)	0(0.0)
21-30	52	6(11.5)	2(3.8)	2(3.8)
31-40	18	0(0.0)	1(5.6)	0(0.0)
41-50	2	0(0.0)	0(0.0)	0(0.0)
51-60	4	0(0.0)	0(0.0)	0(0.0)
61-70	2	0(0.0)	0(0.0)	0(0.0)

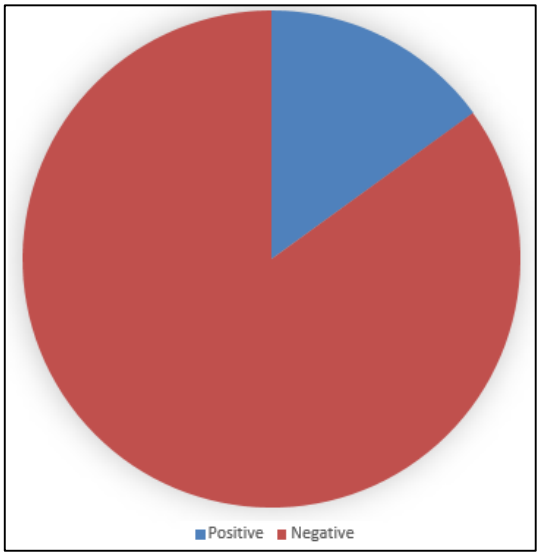

Fig 1: Pie chart showing the overall prevalence of HBV among study participants

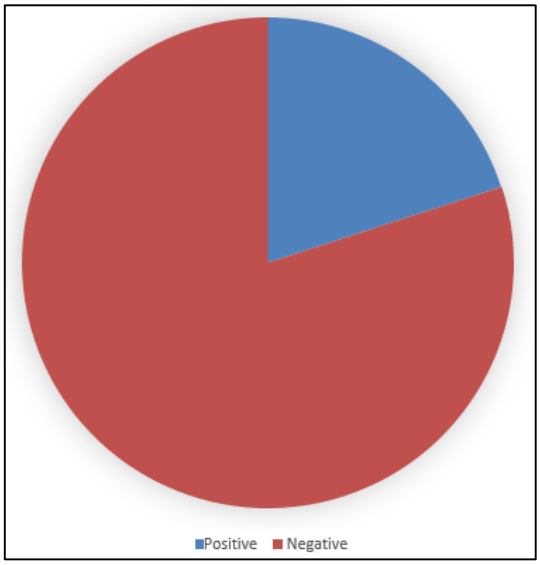

Fig 2: Pie charts showing the prevalence of HBV among the male participants

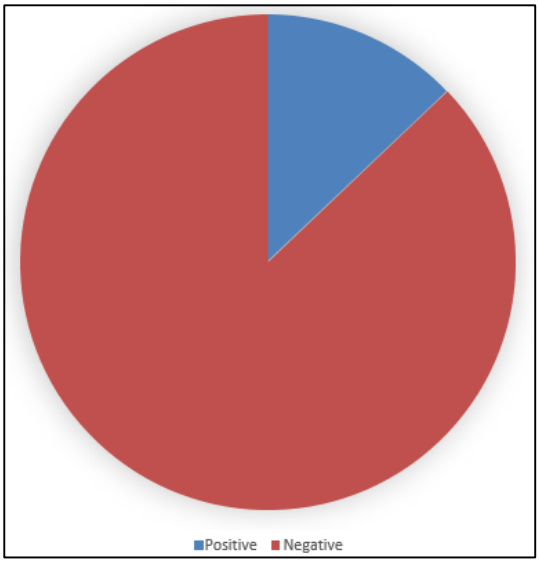

Fig 3: Pie charts showing the prevalence of HBV among the female participants

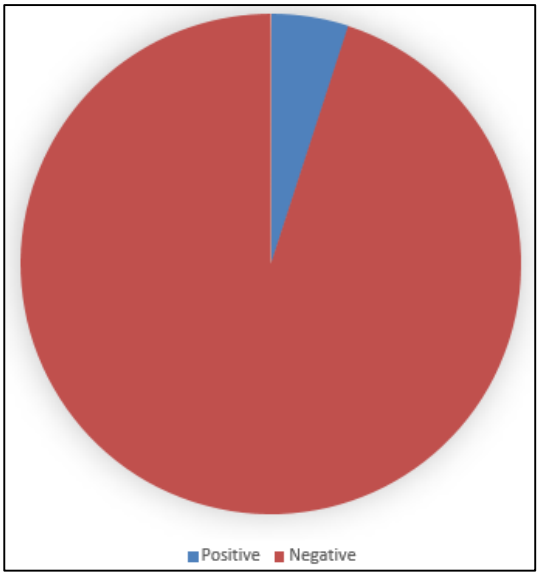

Fig 4: Pie chart showing prevalence of HCV among study participants

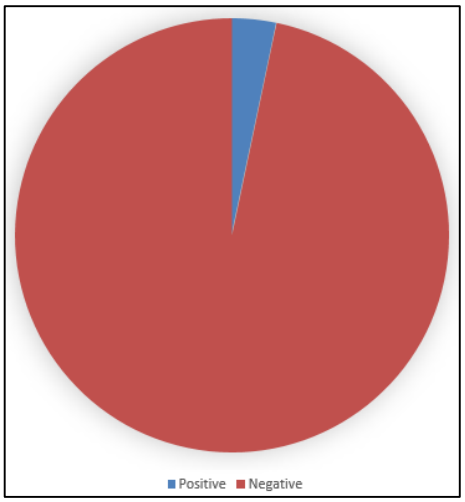

Fig 5: Pie charts showing the prevalence of HCV among the male participants

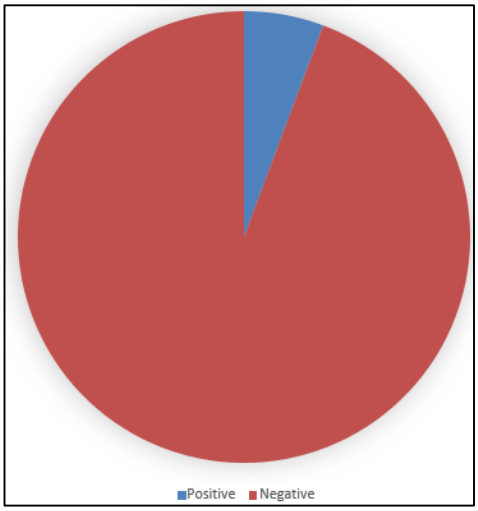

Fig 6: Pie charts showing the prevalence of HCV among the female participants

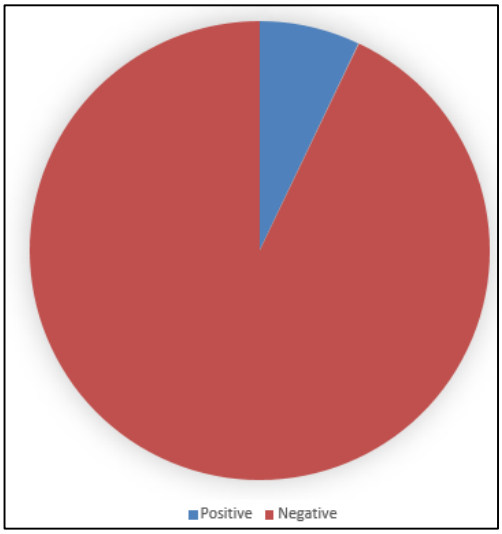

Fig 9: Pie charts showing prevalence of HIV among female participants

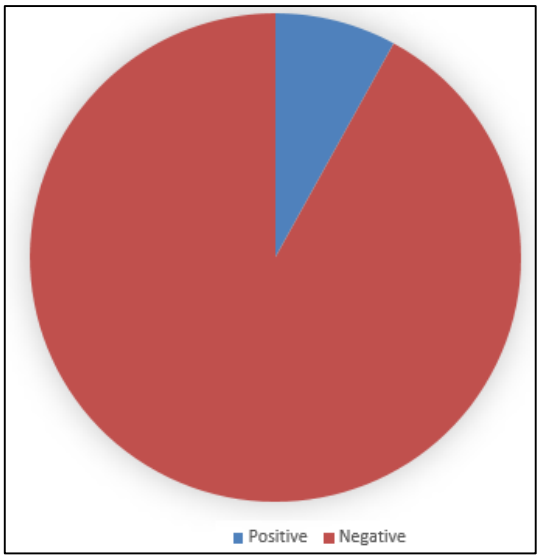

Fig 7: Pie chart showing prevalence of HIV among study participants

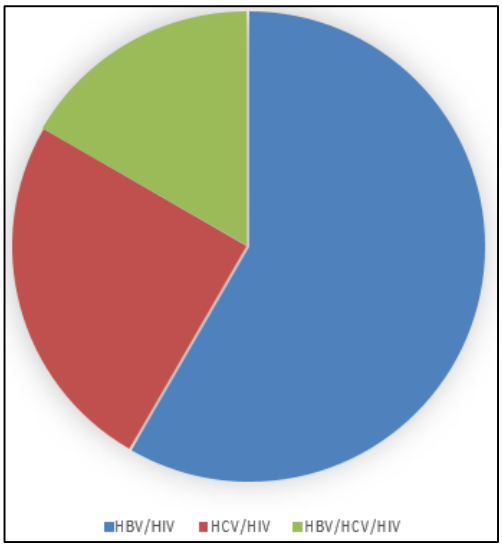

Fig 10: Pie chart showing prevalence of the Coinfection among study participants

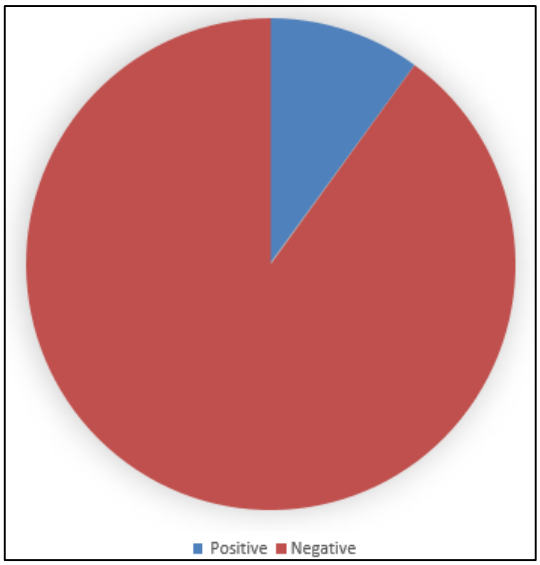

Fig 8: Pie charts showing prevalence of HIV among Male participants

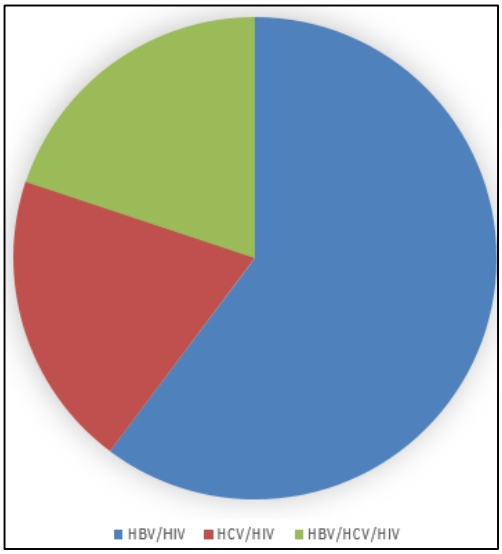

Fig 11: Pie charts showing the prevalence of the Coinfection among Male Participants

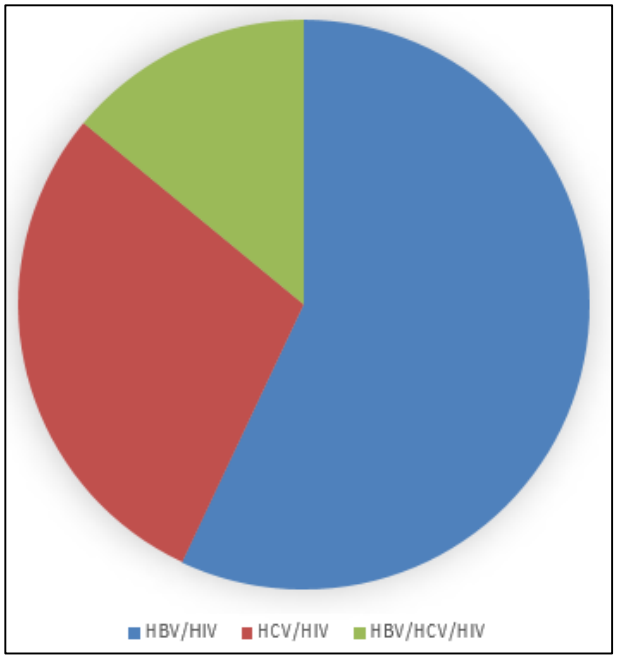

Fig 12: Pie charts showing the prevalence of the Coinfection among female Participants

4. Discussion

This research work assayed the prevalence of HBV, HCV and HIV among patients living within Wukari metropolis, Wukari LGA in Taraba state. From this study, Hepatitis B prevalence was 15%. This prevalence is higher than 6% which was reported by Imarenezor *et al.*, 2016 [10] among undergraduate students of Federal University Wukari and 6.67%, 6.7% (Nwolisa *et al.*, 2013; Okoroiwu *et al.*, 2018) [13, 16] reported in Port Harcourt. The prevalence rate is however comparable with 12% reported in Kaduna (Edia *et al.*, 2015) [6]. The 100 subjects examined, Hepatitis C was prevalence was 5%. This prevalence is higher than 0.7% (Odjimogho *et al.*, 2018) [14] reported in undergraduate students of Babcock university in Ogun state, the prevalence rate is however comparable with 6.0% reported in Wukari, Taraba state (Imarenezor *et al.*, 2016) [10]. This study revealed a prevalence of 7.0% for HBV/HIV co-infection. This prevalence contradicts 11.9% (Otegbayo *et al.*, 2010) [17] reported in Ibadan, 28.4% in Lagos (Balogun *et al.*, 2012) [3] and 15.4% in Sokoto among HIV patients (Alo *et al.*, 2013) [1] but is comparable with 5.8% reported in Nnewi, Anambra state (Okeke *et al.*, 2017). The prevalence rates of HCV/HIV co-infection in this study was 3.0%. It is comparable to 2.8% reported in Rivers state (Erasmus *et al.*, 2021) but contradicts 7.0% reported in Benin-city (Ojide *et al.*, 2015) [15]. The prevalence rates of HBV/HCV co-infection in this study was 3.0% which contradicts the prevalence rate of 0.0% reported among undergraduate students of Federal University in Wukari (Imarenezor *et al.*, 2016) [10], 14.5% reported in Iran after a survey on both HBV and HCV among HIV positive patients (Mohammadi *et al.*, 2010) [11].

5. Conclusion

In conclusion**, t**his study found a high prevalence of HBV, HCV and HIV at 15.0%, 5% and 8% respectively. An overall prevalence of 7.0% for HBV/HIV, 3.0% for HCV/HIV and 2.0% for HBV/HCV/HIV has been established in this study. From this study also, it was observed that males have higher prevalence of both Hepatitis viruses (10.0% for HBV and 3.3% for HCV) than female (5.7% for HBV and 2.9% for HCV) among HIV-positive patients. Having known the complication that accompanies these co-infections, it important that every HIV positive patient should undergo screening for HBV and HCV. This research work showed that coinfection with Hepatitis B and C is common among HIV-infected patients and further reaffirms the need for routine baseline screening for this serological marker, as it is a major consideration in the initiation and choice of highly active ART. Furthermore, those found negative should be immunized with HBV vaccine to improve the prognosis of their HIV status. Therefore, it is recommended that **t**here is need for vigorous awareness campaigns on the routes of transmission of these infections and to educate people living in developing regions such as Wukari on the potential transmission and also enlighten young adults on safe sex practices to minimize the spread of the infections as well as preventive strategies been developed and implemented.

6. Competing Interests

Authors have declared that no competing interests exist.

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