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Human Immunodeficiency and Hepatitis B Viral Co-infection in Women Attending Antenatal Care Clinic in a Tertiary Health Institution in Nigeria

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ABSTRACT

Background: *Human immunodeficiency virus (HIV) and Hepatitis B virus (HBV) infections are major global health problems with common modes of transmission.* ***Objective:*** *To determine the prevalence, demographic characteristics, risk factors and liver dysfunction among antenatal women with HIV and HBV co-infection.* ***Methodology:*** *A cross-sectional study of 586 pregnant women. Socio-demographic data were collected and blood samples were collected and tested for HBsAg and HIV infection. The liver function test was conducted on those who tested positive to HBV alone and have HIV/HBV co-infection. Data were analyzed using SPSS version 18 statistical program.* ***Result:*** *The prevalence of patients with HIV and HBV co-infection was 0.3%. They are single and in the age group of 21-24. The mean value of total bilirubin and unconjugated bilirubin of the patients with HBV/HIV co-infection were significantly higher (p=0.037) than in those with hepatitis B virus infection alone.* ***Conclusion:*** *The study showed low HIV/HBV co-infection amongst antenatal women and confirmed the assertion that co-infection leads to significant impaired liver function. This should be kept very low or eradicated to reduce devastating complications of HIV/HBV co-infection.*

Keywords: HIV, Hepatitis B, HIV-HBV co-infection, Antenatal, Liver function test

INTRODUCTION

A person who is infected with both the hepatitis B and Human immunodeficiency viruses is said to have HBV/HIV co-infection. It has been observed that this condition leads to increased morbidity and mortality as compared to HIV or HBV mono-infections [1]. HBV and HIV have similar characteristics such as transmission modes; using a reverse transcriptase enzyme in replication and the tendency to develop chronic infections, which are often difficult to treat. Both virus, have an immense capacity of mutation in their genome, causing rapid emergence of mutant strains, some of which are resistant to widely used anti-viral agents [1]. They are transmitted by exposure to infected blood or body fluid, unprotected sexual contacts, blood transfusion and vertically from mother to child [2].

HBV infection can induce a wide spectrum of clinical features, ranging from an inactive carrier state to fulminant hepatitis, cirrhosis and hepatocellular carcinoma [3,4]. Studies showed an increase in the incidence of prematurity, low Apgar scores, higher risk of intra-ventricular hemorrhage among newborns of HBsAg carrier [3,4]. Also, intrapartum and post-partum hemorrhage is higher due to coagulation failure from lack of production of vitamin k-dependent clotting factors, especially if the prothrombin time is prolonged as in hepatic failure from chronic hepatitis B viral infection [4]. Health care workers are also at risk of infection [3]. Complications of HIV in pregnancy include higher rates of spontaneous abortions, low birth weight, poor Apgar scores and intrauterine growth restriction [5]. Others are malaria, abruptio placentae, bacterial pneumonia, urinary tract infection, vertical transmission of HIV/AIDS, premature delivery and other opportunistic infections [6].

Among HIV-infected adults, HBV infection prevalence of up to ten times higher than in the general population has been reported in western countries [6]. Across Europe, approximately 9% of HIV-positive patients are co-infected with HBV [6]. Data from sub-Saharan Africa are limited, primarily due to a lack of routine screening. Although, very few co-infection studies have been carried out in Africa and since Sub-Saharan Africa is a home of about 29.4 million HIV infected people, high HIV/HBV co-infection is expected. Several sero-prevalence studies conducted in various HIV-positive populations using various screening and confirmatory modalities have reported a co-infection prevalence of 2% to 10% in Africa [7].

The ever increasing burden of these infections has become a growing global concern [2]. Studies showed that HIV co-infection with HBV adversely impacts on the natural history of HBV, by accelerating progression to chronic liver disease due to drug-related hepatotoxicity and hepatitis reactivation [1,2]. At this stage, most patients are likely to die due to liver-related diseases compared to those without HIV infection. The impact of co-infection is especially apparent with the use of highly active antiretroviral therapy (HAART) due to reports of complex interactions with antiretroviral therapy (ART) including reactivation of "silent" HBV infection and immune reconstitution syndromes [8]. As HAART are used in areas of Africa and Asia that have high HBV endemicity, liver disease from chronic hepatitis B will likely emerge as an even greater problem. Thus, it is important to understand HIV/HBV co-infection in regions with high chronic hepatitis B endemicity and expanding antiretroviral programs, especially because of the implications of using HAART agents that also possess anti-HBV activity [9].

The study of HIV/HBV co-infection is critical in our environment. There has not been such study in Calabar, Nigeria which is noted to have very high HIV and HBV infection rates, with many global partners assisting with free HAART regimen [10,11]. The study among pregnant women is vital because spread in this group could take a rapid pattern in the community as they are in active sexual and reproductive group. Vertical transmission to the baby is eminent without intervention and spread to their single or multiple sexual partners are almost inevitable. Besides, the control of diseases could be more effective if the preventive measures are instituted among pregnant women during the antenatal period [12].

This study determines the magnitude of HBV/HIV co-infection among antenatal women in this centre. This will improve care, survival, quality of life and ultimately contribute to the reduction of AIDS and Hepatitis B related end-stage liver diseases.

METHODOLOGY

This prospective cross-sectional study was carried out at the antenatal clinic of the Department of Obstetrics and Gynaecology, UCTH, Calabar, The study received approval by the Regional Ethics Committee of the institution, and informed consent was obtained from the participants before being enrolled in the study. The subjects included were pregnant women at booking for antenatal care.

Forty participants were recruited weekly to generate a sample size of 586 for the study over a four-month period from 1st March to 30th June 2016. A systematic sampling technique was applied and every 2nd patient who gave informed consent was included in the study. The process was continued until the sample size of 586 was reached. However, the first subject was selected by simple random sampling technique by balloting. The exclusion criterion was a refusal to participate in the study.

Information on age, parity, last menstrual period, gestational age, occupation, marital and educational status was obtained from participants and entered into a data form specifically designed for the study. The interviewer-administered questionnaire was used to complete the data on risk factors for hepatitis B infection and HIV. The data was obtained by the researcher (s) and also by trained resident doctors.

About 4ml of venous blood was collected from each woman with a 5ml syringe after the application of a tourniquet. The blood was collected into ethylene di-amine tetra-acetic acid (EDTA) containing tube and transferred to the hospital laboratory for analysis. The samples were centrifuged at 2000 rpm for 10 min. to separate the plasma from blood cells. Parallel testing for HBsAg was used for the testing. Parallel testing involves the use of two rapid Enzyme-Linked Immune-Sorbent Assay (ELISA) test kits simultaneously. The HBsAg screening was done by applying the plasma onto the kits and observed after 15 minutes. Collected sample of blood was concurrently tested for HIV using rapid

diagnostics kit method. All seropositive samples had a confirmation using the rapid diagnostic strip test. The screening tests were performed by a laboratory scientist in the University of Calabar Teaching hospital laboratory using the standard procedure recommended by the manufacturers of the test kit. All participants who tested positive to HBV and HIV had liver function test performed.

The data was analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Statistical comparison was done using Chi-square (X^2) test and T-test at 95% confidence interval and level of significance less than 0.05.

RESULTS

A total of 586 pregnant women participated in the study during the four month period. Of these, 16 tested positive to HBsAg, 20 participants tested positive to HIV with while 2 tested positive to both HIV and HBV (Figure 1). The mean age of participants was 29.80 ± 4.74; mean parity 2.57 ± 1.50, while the mean gestational age at booking was 25.95 ± 7.79.

Hepatitis B infection was common among the age group of 25-30 years (50.0%), nulliparous women (43.8%) and married women (81.2%). HIV infection was highest among the age groups of 25-30 years and 31-35 year, para 3-4 (35.0%), civil servants (40.0%) and married women (75.0%). The 2 (0.3%) women with HIV/HBV co-infection belong to the age group of 21-24 years, students, single mothers with secondary education. There were no statistically significant relationships between socio-demographic characteristics and HBV and/or HIV infection (Table 1).

There was a statistically significant relationship between hepatitis B virus infection and tattoos/tribal marks, and the sharing of sharp/needles. This relationship was statistically significant (p=0.000) (Table 2).

There was a statistically significant relationship between HIV infection and previous dental manipulation (p=0.007). There was no statistically significant relationship between HIV infection and previous multiple sexual partners, tattoos/tribal and sharing of sharps/needles (Table 3).

The mean value of total bilirubin of HBV/HIV co-infection group (39.60 ± 1.05mg/dl) was significantly higher (p=0.037) than the mean value of total bilirubin of participants with hepatitis virus infection alone. The same is seen with a mean of unconjugated bilirubin (p=0.007). Other parameters of liver function tests did not show a statistically significant difference (Table 4).

Table 1 The socio-demographic characteristics of the study participants

Socio-demographic	HBV			HIV			HIV/HBV co-infection
Variables	**+Ve (%) 16 (2.7%)**	**-Ve (%) 570 (9.3%)**	**X^2 (p-value)**	**+Ve (%) 20 (3.4%)**	**-Ve (%) 566 (96.6%)**	**X^2 (p-value)**	**N (%) 2 (0.3%)**
Age (years)							
<21	1 (6.3%)	7 (1.2%)	6.89 (0.229)	1 (5.0%)	7 (1.2%)	6.67 (0.246%)	0 (0.0%)
21-24	2 (12.5%)	70 (12.3%)		2 (10.0%)	70 (12.4%)		2 (100.0%)
25-30	8 (50.0%)	260 (45.6%)		6 (30.0%)	262 (46.3%)		0 (0.0%)
31-35	2 (12.5%)	166 (29.1%)		6 (30.0%)	162 (28.6%)		0 (0.0%)
36-40	2 (12.5%)	59 (10.4%)		4 (20.0%)	57 (10.1%)		0 (0.0%)
>40	1 (6.3%)	8 (1.4%)		1 (5.0%)	8 (1.4%)		0 (0.0%)
Parity							
0	7 (43.8%)	166 (29.1%)	2.94 (0.401)	5 (25.0%)	168 (29.7%)	5.72 (0.126%)	2 (100.0%)
1-2	2 (12.5%)	156 (27.4%)		2 (10.0%)	156 (27.5%)		0 (0.0%)
3-4	2 (12.5%)	105 (18.4%)		7 (35.0%)	100 (17.7%)		0 (0.0%)
≥ 5	5 (31.2%)	143 (25.1%)		6 (30.0%)	142 (25.1%)		0 (0.0%)
Occupation							

Govt-employed	2 (12.5%)	148 (26.0%)	7.26 (0.202)	8 (40.0%)	142 (25.1%)	5.79 (0.327%)	0 (0.0%)
Self-employed	5 (31.5%)	237 (41.6%)		4 (20.0%)	238 (42.0%)		0 (0.0%)
Private-employed	1 (6.3%)	10 (1.7%)		1 (5.0%)	10 (1.8%)		0 (0.0%)
Student	4 (25.0%)	72 (12.6%)		2 (10.0%)	74 (13.1%)		2 (100.0%)
Applicant	2 (12.5%)	78 (13.7%)		4 (20.0%)	76 (13.4%)		0 (0.0%)
Others*	2 (12.5%)	25 (4.4%)		1 (5.0%)	26 (4.6%)		0 (0.0%)
Educational Status							
Not literate	1 (6.3%)	5 (0.9%)	7.11 (0.068)	1 (5.0%)	5 (0.9%)	6.94 (0.074%)	0 (0.0%)
Primary level	1 (6.3%)	9 (1.6%)		1 (5.0%)	9 (1.6%)		0 (0.0%)
Secondary	6 (37.5%)	182 (31.9%)		9 (45.0%)	178 (31.4%)		2 (100.0%)
Tertiary	8 (50.0%)	374 (65.6%)		9 (45.0%)	374 (66.1%)		0 (0.0%)
Marital Status							
Single/co-habiting	3 (18.8%)	96 (16.8%)	-	5 (25.0%)	94 (16.6%)	-	2 (100.0%)
Married	13 (81.2%)	471 (82.6%)		15 (75.0%)	469 (82.9%)		0 (0.0%)
Divorced/Separated/ Widowed	0 (0.0)	3 (0.5%)		0 (0.0%)	3 (0.5%)		0 (0.0%)
Others* include Full-time housewife, food vendor							

Table 2 The risk factors for hepatitis B virus infection among pregnant women attending antenatal care

Variables	HBsAg Status		Total (%)	Fisher Exact (p-value)
	+ve (%) 16 (2.7%)	-ve (%) 570 (97.3%)	586 (100.0%)	
PreviousBlood Transfusion				
Yes	2 (12.5%)	32 (5.6%)	34 (5.8%)	0.236
No	14 (87.5%)	538 (94.4%)	552 (94.2%)	
Previous Multiple Sexual Partner				
Yes	2 (12.5%)	106 (18.6%)	108 (18.4%)	0.748
No	14 (87.5%)	464 (81.4%)	478 (81.6%)	
Tattoos/Tribal Marks				
Yes	12 (75.0%)	48 (8.4%)	60 (10.2%)	0.000*
No	4 (25.0%)	522 (91.6%)	526 (81.6%)	
Previous Surgery				
Yes	3 (18.8%)	134 (23.5%)	137 (23.4%)	1
No	13 (81.2%)	436 (76.5%)	449 (76.6%)	
Previous Dental Manipulation				
Yes	1 (6.3%)	55 (9.6%)	56 (9.6%)	0.934
No	15 (93.7%)	515 (90.4)	530 (90.4%)	
Sharing of Sharps/Needles				
Yes	8 (50.0%)	108 (18.9%)	116 (19.8%)	0.005*
No	8 (50.0%)	462 (81.1%)	470 (80.2%)	
Female Circumcision				
Yes	4 (25.0%)	88 (15.4%)	92 (15.7%)	0.295
No	12 (75.0%)	482 (84.6%)	494 (84.3%)	
History of Intravenous Drug use				
Yes	2 (12.5%)	119 (20.9%)	121 (20.6%)	0.544
No	14 (87.5%)	451 (79.1%)	465 (79.4%)	
Previous Delivery with TBA				
Yes	1 (6.3%)	36 (6.3%)	37 (6.3%)	0.992
No	15 (93.7%)	534 (93.7%)	549 (93.7%)	

Polygamous Marriage				
Yes	1 (6.3%)	12 (2.1%)	13 (2.2%)	0.305
No	15 (93.7%)	558 (97.9%)	573 (97.8%)	
Previous Abortion				
Yes	3 (18.8%)	111 (19.5%)	114 (19.5%)	0.998
No	13 (81.2%)	459 (80.5%)	472 (80.5%)	
*Statistically Significant; TBA: Traditional Birth Attendant				

Table 3 The risk factors for HIV infection among pregnant women attending antenatal care

Variables	HIV status		Total (%)	Fisher Exact (p-value)
	+ve (%) 20 (3.1%)	-ve (%) 566 (96.9%)	586 (100.0%)	
Previous Blood Transfusion				
Yes	1 (5.0%)	33 (5.8%)	34 (5.8%)	1
No	19 (95.0%)	533 (94.2%)	552 (94.2%)	
Previous Multiple Sexual Partner				
Yes	6 (30.0%)	102 (18.0%)	108 (18.4%)	0.234
No	14 (70.0%)	464 (82.0%)	478 (81.6%)	
Tattoos/Tribal Marks				
Yes	2 (10.0%)	58 (10.2%)	60 (10.2%)	0.946
No	18 (90.0%)	508 (89.8%)	526 (89.8%)	
Previous Surgery				
Yes	4 (20.0%)	133 (23.5%)	137 (23.4%)	1
No	16 (80.0%)	433 (76.5%)	449 (76.6%)	
Previous Dental Manipulation				
Yes	6 (30.0%)	50 (8.8%)	56 (9.6%)	0.007*
No	14 (70.0%)	516 (91.2%)	530 (90.4%)	
Sharing of Sharps/Needles				
Yes	5 (25.0%)	111 (19.6%)	116 (19.8%)	0.568
No	15 (75.0%)	455 (80.4%)	470 (80.2%)	
Female Circumcision				
Yes	4 (20.0%)	88 (15.5%)	92 (15.7%)	0.537
No	16 (80.0%)	478 (84.5%)	494 (84.3%)	
History of Intravenous Drug use				
Yes	7 (35.0%)	114 (20.1%)	121 (20.6%)	0.154
No	13 (65.0%)	452 (79.9%)	465 (79.4%)	
Previous Delivery with TBA				
Yes	2 (10.0%)	35 (6.2%)	37 (6.3%)	0.364
No	18 (90.0%)	531 (93.8%)	549 (93.7%)	
Polygamous Marriage				
Yes	2 (10.0%)	11 (1.9%)	13 (2.2%)	0.069
No	18 (90.0%)	555 (98.1%)	573 (97.8%)	
Previous Abortion				

Yes	5 (25.0%)	109 (19.3%)	114 (19.5%)	0.564
No	15 (75.0%)	457 (80.7%)	472 (80.5%)	
*Statistically Significant; TBA: Traditional Birth Attendant				

Table 4 Co-infection status and mean values of different parameters of liver function tests

Variables	HBV alone (n=14)	HBV/HIV co-infection (n=2)	t-test	p-value
	Mean ± SD	Mean ± SD		
Total protein (g/l)	72.75 ± 5.98	85.40 ± 1.02	2.044	0.062
Albumin (g/l)	42.66 ± 8.27	56.70 ± 0.71	1.64	0.125
Alanine transaminase (ALT)	9.29 ± 5.39	5.01 ± 1.40	1.304	0.215
Aspartate transaminase (AST)	19.38 ± 4.52	14.03 ± 1.90	1.149	0.271
Alkaline phosphatase (ALP)	166.14 ± 86.17	116.80 ± 6.01	1.562	0.154
Y-glutamyltransferase (GGT)	34.41 ± 24.31	27.00 ± 3.80	0.692	0.501
Total bilirubin	29.46 ± 4.32	39.60 ± 1.05	2.317	0.037*
Conjugated bilirubin	26.11 ± 4.66	31.50 ± 200	1.118	0.284
Unconjugated bilirubin	3.35 ± 1.44	8.10 ± 1.82	3.182	0.007*
*Statistically significant				

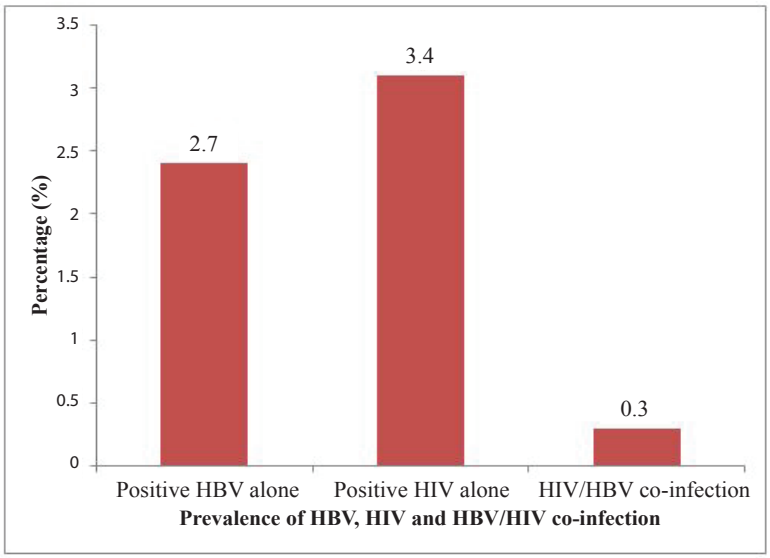

Figure 1 Prevalence of HBV, HIV and HBV/HIV co-infection among study participants

DISCUSSION

Hepatitis B/HIV co-infection in women of reproductive age is of clinical and public health importance because these women constitute a significant reservoir for horizontal and perinatal HBV and HIV transmission [13]. In our study, the prevalence of HIV/HBV co-infection among pregnant women attending antenatal care was 0.3%. This is similar to HIV and HBV co-infection prevalence rate of 0.24% [14] and 0.7% reported in tertiary hospitals within the same Eastern part of Nigeria [15], but higher than 0.004% reported in Ijebu-Ode, Western Nigeria [16]. A higher prevalence of 7.1% was reported in Federal Capital Territory (FCT), Abuja, in the north-central part of the country [17]. These differences in different geographical regions of Nigeria may be due to differences in culture, religion, educational and socioeconomic status which influence the age of marriage, sexual behavior, antenatal attendance, screening coverage and utilization of health-care facilities. In HBV/HIV co-infection, the progression to advanced liver disease, such as cirrhosis and hepatocellular carcinoma is more rapid and liver-related mortality is higher. Since the introduction of

highly active antiretroviral therapy (HAART), liver-related morbidity and mortality have assumed an increasing burden on the health of people with HIV infection [2].

The study showed that the prevalence of hepatitis B infection was 2.7%. The finding is similar to 2.2% in southeast Nigeria [18] and 2.4% reported in Asia [19], however, it was lower than 9.3% reported in another Nigerian study [15]. The lower prevalence found in this study compared with previous studies may be accounted for by several interventions put in place to control HIV infections and transmission [10]. In this study, HBsAg was highest among the 25-30 years age group. This finding is similar to the study in Kano, Nigeria [20], where the majority of those that tested positive to HBsAg were in a similar age group.

In this study, the prevalence of HIV amongst the participants was 3.4%. The prevalence of HIV patients in Calabar as of 2010 was 6.5%, which was higher than our finding [21]. Again, the increased knowledge and prevention modalities may have been responsible for the steady decrease in the prevalence. In another study in Benin City, Nigeria, the prevalence of HIV amongst asymptomatic pregnant women was 8.3% which was almost three times higher than our findings [22]. Higher prevalence was documented in the age group of 25-35 years. This was closely similar to a higher prevalence observed in 25-29 years old age group in Ethiopia [23]. In a Canadian study, all HIV positive women in the study were 15-29 years of age, which was similar to sero-prevalence survey of HIV infection in British Colombia [24]. HIV infection was also highest among para 3-4, civil servants, women with secondary education and married women in this study which are also similar to some studies [23,25].

Hepatitis B virus and HIV have common modes of transmission. Both viruses are transmitted majorly through unprotected sexual intercourse, intravenous routes such as transfusion of infected blood or blood products, use of contaminated body piercing instruments like injection needles, tattooists, acupuncturists or manicure/pedicure instruments, surgery, contact with the blood or other body fluids of an infected person, or vertically from mother to child during delivery [17]. This study revealed that tattoos/tribal marks and sharing of sharps/needles were significantly associated with hepatitis B virus infection. This finding is consistent with a study that documented that history of surgery and tribal marks/tattooing were significantly associated with HIV/HBV co-infection [17]. About 18.8% of patients with hepatitis B virus infection had the previous history of abortion while 81.2% with the infection had no previous history of abortion. However, this relationship was not statistically significant. This finding differs from the findings in Ethiopia [26] and Kano [20] where abortion was reported as a significant risk factor for hepatitis B infection among pregnant women. It was stated that abortion is related to unprotected sexual intercourse which results in unplanned pregnancies and also increases the risk of HBV infection if such partners are infected. Also, instrumentation during an abortion and related activities may serve as sources of exposure since most terminations are done by unskilled personnel using contaminated instruments and surfaces. These observations in risk factors indicate the inconsistency of these risk factors and as such, screening pregnant women based on risk factors may be of little help in the detection of hepatitis B infection and prevention of neonatal transmission; hence the need for routine screening of all pregnant women.

There was a statistically significant relationship between HIV infection and previous dental manipulation ($p=0.007$). This was similar to other previous studies [2,16]. There was no statistically significant relationship between HIV infection and previous blood transfusion, previous multiple sexual partners, tattoos/tribal marks, sharing of sharps/needles and polygamous marriage. Although some of these risk factors were not significant, they confirmed previously established studies [2,16].

Studies have shown that co-infection of HIV and HBV leads to faster progression of HBV infection to hepatocellular carcinoma and cirrhosis [27,28]. This study indicates a statistically significant difference between the mean value of total bilirubin (29.46 ± 4.32 mg/dl) of participants with hepatitis B virus infection alone and the mean total bilirubin (39.60 ± 1.05 mg/dl) of the participant with HBV/HIV co-infection ($p=0.037$). Also, the mean value of unconjugated bilirubin (3.35 ± 1.44 mg/dl) of participants with hepatitis B virus infection alone is significantly lower than the mean value of unconjugated bilirubin (8.10 ± 1.82mg/dl) of the participant with HBV/HIV co-infection ($p=0.007$). Other parameters of liver function tests did not show a statistically significant difference. Although the mean ALT values in our study did not show any significance, studies have shown that in HBV/HIV co-infection, the progression to advanced liver diseases, such as cirrhosis and hepatocellular carcinoma is more rapid and liver-related mortality is higher [29]. Also, another study documented a predominantly cholestatic liver enzyme abnormality in HIV/HBV co-infected patients [29]. It was found that HIV/HBV co-infected patients predominantly had a cholestatic liver injury, followed

by hepatocellular injury and mixed pattern. This is congruent to the finding of a study by Olawumi where the mean serum ALT and ALP were significantly higher in the co-infected patients [30]. Baseke, et al. also documented elevated ALT, indicative of liver cell injury [31]. Similarly, Mugomeri, et al., in their study found that increased levels of ALT and AST is significantly associated with HBV/HIV co-infection status [32]. Although this study supports the findings of reduced liver function test among HIV/HBV co-infection, the difference in the finding from other studies may be due to low prevalence of HIV/HBV co-infection observed in this study as the liver function test result was based on the only two participants who had HIV/HBV co-infection.

This study is hospital-based and of short duration; consequently, it may not reflect a true representation of the actual prevalence of these conditions in the region, therefore the need for regional multi-center studies.

CONCLUSION

This study indicates that the HIV/HBV co-infection rate was low, 0.3%. The prevalence of HBsAg alone was 2.7% and HIV alone was 3.4%. This study also, agrees that HIV/HBV co-infection leads to impaired liver function. Therefore pregnant women with HIV/HBV co-infection are possibly at greater risk of end-stage liver disease or liver carcinoma. There is a need to intensify on the intervention strategies by government and non-governmental organizations in the fight against the spread of HIV/AIDS and the Hepatitis B virus in endemic populations. Future research work should be directed at the progression of the liver condition to cirrhosis or carcinoma among HBV/HIV co-infected persons.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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