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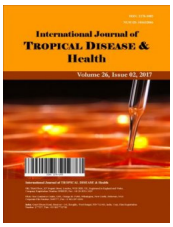

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Human Immunodeficiency Virus and Hepatitis B Virus Co-infection: A Cross-sectional Household Survey in Kiruhura District, Southwestern, Uganda

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Authors' contributions

All authors read and approved the final manuscript. Author ROA participated in conception, design, data collection, analysis and drafting and approval of the manuscript. Author FB participated in the conception, design, data collection, analysis and drafting and approval of the manuscript. Author FDB participated in the conception, drafting and approval of the manuscript. Author IIYB participated in the conception, drafting and approval of the manuscript.

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ABSTRACT

The aim of this study was set to determine the prevalence of HIV/HBV co-infections and the associated risk factors in the general population in the district of Kiruhura-Uganda. A cross-sectional household survey was conducted from April 2014 to November 2014 and 1874 people were recruited on to the study. Blood samples collected from research subjects were analyzed for HIV

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antibodies, HBsAg and HBcAb antibodies. Social-demographic data were captured using a questionnaire. Chi-square tests and bivariate logistic regression were used to determine the association between predictor variables. *P*-values at 95% confidence interval were considered significant if < 0.05. The overall viral monoinfections in the study population for HIV, HBsAg and HBcAb were 6.6% (CI; 5.5-7.8), 4.1% (CI; 3.3-5.1); and 32.8% (CI; 29.7-33.9%) respectively. Meanwhile, the prevalence of current HBV (HIV/HBsAg) and lifelong HBV (HIV/ HBcAb) coinfection was 0.6% and 2.4% respectively in the whole study population with children 5years and below having a prevalence of 0% for both co-infections. Prevalence of both HIV/HBsAg and HIV/HBcAb coinfection was higher among male gender and age group 26-45years. HIV/HBsAg coinfection was associated with being male OR = 5.5 (95% C I: 1.2 – 25.5), *p*-value= 0.03 and belonging to Bahima tribe OR=3.9, (95%CI: 1.1-13.5), p-value=0.032. HIV/HBcAb co-infection was associated with having high education level OR=2.1 (95% CI: 1.1 - 3.9) *p*-value = 0.02 and belonging to Banyoro/Batoro tribe OR=6.1, (95%CI: 1.3-28.3), *p*-value=0.02. Although the prevalence of acute and chronic HBV (HIV/HBV) coinfection among the study population in Kiruhura district Uganda was low, the prevalence is still substantial enough to cause a high burden of morbidity and mortality among the study population.

Keywords: Associated factors; Coinfection; HBcAb; HBsAg; HIV; prevalence; Uganda.

ABBREVIATIONS

AIDs : Acquired immunodeficiency syndrome
ALT : Alanine transaminase
Anti-HBc : Antibody to hepatitis "c" core antigen
ARV : Antiretro viral therapy
AST : Aspartate aminotransferase
CI : Confidence interval
FB : Fred Bagenda
FDB : Frederick Byarugaba
FRC : Faculty of Medicine Research Ethics Committee
HAART : Highly Active Antiretroviral Therapy
HBcAb : Antibody to hepatitis B core antigen
HBsAg : Hepatitis B surface antigen
HBV : Hepatitis B virus
HIV : Human immunodeficiency virus
MUST : Mbarara University of Science and Technology
OR : Odd ratio
REC : Research Ethics Committee
ROA : Richard Onyuthi Apecu
UNCST : Uganda National Council of Science and Technology
YBII : Yap Boum II

1. INTRODUCTION

Human Immunodeficiency Virus (HIV) infections and Hepatitis B virus (HBV) infections are both transmitted by unprotected sexual contact, blood transfusion, re-use of contaminated needles and syringes and vertical transmission from mothers to child during child birth, this makes health workers at high risk for infection[1-3]. Co-infection with HIV and HBV are common globally and are among the top ten causes of infectious diseases and death worldwide [3-5]. The global HIV/HBV co-infected population is estimated at 2-4 million.

Worldwide about 40 million people have been infected with HIV in what is so far the largest pandemic ever [6]. Most of the HIV infected persons are in sub-Saharan Africa and in Uganda the prevalence of HIV is 7.3% according to the Uganda AIDS Indicator Survey of 2011 [7] which shows a rise from the prevalence of 6.3% in 2006. Knowledge of HIV prevention is generally high in the Ugandan community although the risk behaviour may not exactly correlate with the levels of knowledge [8].

Hepatitis B Virus (HBV) infection is endemic in Southeast Asia, sub-Saharan Africa and Uganda [9]. At least 8%, 18.5% and 52.3% of people having chronic infections are found worldwide, Africa and Uganda respectively [9,10]. In Uganda the national prevalence of hepatitis B virus infection was estimated at 10.3% and 52.3% for HBsAg and HBcAb respectively nested in a national HIV seroprevalence survey of 2005 and 17.6% for HBsAg in a survey carried out in 2013 in Gulu municipality in northern Uganda where endemicity is among the highest in the country [9, 10].

HIV infection increases the probability of having HBV infection by up to five times [11]. Also, children with HIV were more likely to show evidence of HBV infection than children without HIV infection and HBV prevalence is higher among children with HIV infection [12]. HIV modifies the natural history of HBV infection by increasing rates of chronicity, prolonging HBV

viraemia, moderately elevating the liver transaminases (AST/ALT) levels, increasing the progression to advanced liver disease and reactivation of quiescent hepatitis B infection [4, 13-18]. HIV infection is associated with rapid progression of liver disease in persons who are coinfected with HBV. This situation has led to liver disease becoming one of the most important causes of early death among HIV infected individuals in the Western world [4,17,19]. In areas most affected by HBV and HIV infections, high coinfection rates worsen the prognosis in dully infected individuals. Rates of hepatitis B serological conversion and viral clearance have been shown to be slow in patients coinfected with HIV, leading to accelerated rates of progression to cirrhosis. The impact of HBV on HIV natural history is less certain [4,20]. HIV and HBV coinfection is associated with a lower cluster of differentiation (CD4) count compared to individuals with HIV infection alone [21,22]. Due to improved access to and earlier initiation of antiretro virals (ARV's) in Uganda, there is need to document and inform policy on the importance of knowing the HBV co-infection among HIV adults and children in the general population as most of the available information is from HIV clinics and blood donors and this may also have implications for treatment protocol. Patients with co-infection require closer monitoring of liver transaminases due to the potential for hepatic toxicities, increased liver and AIDS-related mortality, resistance to some of the drugs in the regimens and they may need highly active antiretroviral therapy (HAART) regimens that will target both viruses [13,23,24]. There is a paucity of information on HIV and HBV co-infection and its associated factors in Uganda and most of the available information is from studies done on blood donors and HIV clinic's in hospitals [22]. Information on HIV and HBV co-infection in the general population is even more limited in Uganda and hence the importance to document it. This study, therefore, was set out to establish the prevalence of current HIV/HBsAg and chronic HIV/HBcAb coinfection and to determine the demographic, social and behavioural characteristics associated with the co-infection in the general population of Kiruhura district in southwestern Uganda.

2. MATERIALS AND METHODS

2.1 Study Design and Site

This was a cross-sectional household survey that was conducted in Kiruhura district in southwestern Uganda from April 2014 to November 2014. Kiruhura district is located in southwestern Uganda. It is approximately 265 Km, by road, south west of Kampala the capital city of Uganda. The district has an area of 4,608sq.kms. The district is composed of 2 counties namely Nyabushozi and Kazuo counties. The counties are subdivided into 15 sub-counties, 96 parishes and 506 villages [25]. The total population in Kiruhura District is 328,077 [8] with 57.6% of the population engaged in livestock farming and 42.4% is engaged in agricultural production [25]. The study population was composed of children below 5 years and adults (male and female) aged 15-59 years who were permanent residents of the sampled households. All women and men who consented were interviewed and asked to voluntarily give a blood sample for testing. Children aged below 5 years were assented to by parents or guardians for the collection of blood samples for testing. A total of 1868 people were surveyed and these included 212 children aged five years and below.

2.2 Sampling Method

The sample was drawn using a multi (six) stage sampling design with the household as the final sampling unit from which a participant was chosen. Kiruhura district is divided up into 2 counties; the first stage of the sampling involved randomly selecting from a list of sub-counties in each of the 2 counties. The next level of sampling was a selection of parishes randomly from the sub-counties and finally, villages were randomly selected from each of the selected parishes. At the village, all the households were enlisted and starting at a random household every third house hold was selected using systematic sampling and one member was randomly selected based on the inclusion criteria. This was done using labelled papers the person who picked a paper with yes was selected. The number of individuals selected from each village was estimated proportional to the population size (PPS) of the village. We also did stratification for urban and rural areas with 20% of the areas being urban and 80% being rural. Twenty percent of the total sample size were children < 5years and the rest adults 15 to 59 years of age.

2.3 Sample Collection and Serological Analysis

After obtaining consent/assent from the research subjects, a venous blood sample was drawn

using standard operating procedure and transferred into a plain 7.0 ml tube. Blood samples were allowed to separate naturally and then most of the sera were transferred into micro-vials (3ml), stored at 4^0C in cold ice packs and later transported to Mbarara University of Science (MUST) Clinical Research Laboratory where the samples were finally stored in deep freezers at -80^0C for further analysis. The remaining serum was used to test for both HBV and HIV using the immunochromatographic assay in the field following manufacturer's instruction.

2.4 Laboratory Tests for HBsAg and Anti-HBcAb

Specimens were tested in the field for hepatitis B surface antigen (HBsAg) in human sera using.

One Step HBsAg Test kit (Cypress Diagnostic One Step HBsAg Test, Langdorpsesteenweg 160.3201-Belgium) following the manufacture instructions. In the MUST Clinical Research Laboratory, after thawing, the sera were retested for HBsAg and anti-HBcAb antigens using VIDAS immunoassay system [26]. Evidence of current HBV infection was defined by a positive test for HBsAg, which could be due to chronic carrier state or acute infection. Evidence of lifetime (past or current) HBV infection was defined by a positive test for anti-HBc antibodies, indicating previous exposure to hepatitis B virus. For quality control, 5% of HBsAg positive and 5% HBsAg-negative sera (randomly selected) were retested at EBENER Clinical Laboratory in Kampala. Likewise, 5% of HBcAb-positive and 5% HBcAb-negative samples (randomly selected) were retested at EBENEZER Clinical Laboratories using the same test kits and VIDAS immunoassay machine. A discordance of less than 10% of the EBENEZER Clinical Laboratory (quality control laboratory) and the original test results from MUST Clinical Research Laboratory was deemed acceptable. The laboratory test results for individuals were linked to individual and household questionnaire information through their unique identifiers.

2.5 HBSAG Testing

VIDAS HBsAg Ultra (BIOMERIEUX, SA France) was used for qualitative detection of HBsAg in the serum. VIDAS HBsAg is an automated qualitative test for use on the VIDAS family instruments for the detection of hepatitis B surface antigen (HBsAg) in human serum or plasma, by the use of Enzyme Linked Fluorescent Assay (ELFA) technique. The solid phase receptacle (SPR) serves as the solid phase as well as the pipetting device for the assay. Reagents for the assay are ready to use and pre-dispensed in the sealed reagent strips. All the assay steps are performed automatically by the instrument. The reaction medium is cycled in and out of the SPR several times. After a preliminary washing step, the antigen present in the sample will bind simultaneously to the monoclonal antibody coating the interior of the SPR and to the antibody conjugated with biotin. Unbounded sample components are washed away. The antigen bound to the solid phase and to the biotinylated antibody is in contact with streptavidin conjugated with alkaline phosphatase which will bind with biotin. Another wash step follows which and removes unbound components. During the final detection step, the substrate (4-methyl-umbelliferyl phosphate) is cycled in and out of the SPR. The conjugate enzyme catalyzes the hydrolysis of this substrate into fluorescent products (4-methyl-umbelliferone), the fluorescence of which is measured at 450nm. The intensity of the fluorescence is proportional to the concentration of antigen present in the sample. At the end of the assay, results are analyzed automatically by the instrument and are expressed as an index calculated using a standard.

2.6 Anti-HBc Testing

VIDAS Anti-HBc Total II assay was used for qualitative detection of anti-HBc antibodies in the samples. VIDAS Anti-HBc Total II assay is an enzyme-linked fluorescent immunoassay (ELFA) based on an inhibition principle. The solid phase receptacle (SPR) serves as the solid phase as well as the pipetting device for the assay. Reagents for the assay are ready to use and pre-dispensed in the sealed reagent strips. All of the assay steps are performed automatically by the instrument. The reaction medium is cycled in and out of the SPR several times. After dilution, the sample is incubated in the SPR. The anti-HBc antibodies (IgM and IgG) present in the sample binds to recombinant HBc antigen coating the interior of the SPR. Unbound sample components are eliminated during the washing step The solid phase is then incubated with the conjugate alkaline phosphatase-labelled monoclonal anti-HBc antibody. This conjugate binds to the solid phase HBc antigen sites that have not bound to serum antibodies. Unbound conjugate is removed by washing. During the

final detection step, the substrate (4-methyl-umbelliferyl phosphate) is cycled in and out of the SPR. The conjugate enzyme catalyzes the hydrolysis of this substrate into fluorescent products (4-methyl-umbelliferone), the fluorescence of which is measured at 450nm. The intensity of the fluorescence is inversely proportional to the quantity of anti-HBc antibodies present in the sample. Results are analyzed automatically by the instrument and are expressed as an index calculated using a standard.

2.7 Laboratory Tests for HIV 1 and 2

Sera were tested for HIV ½ antibodies in the field using rapid diagnostic test kits following the Ministry of Health Algorithm (Serial testing). The first test kit used was Determine HIV ½ (Abbott, Japan), Second test kit was HIV ½ STAT-PACK DIPSTICK (Chembio Diagnostic System, USA) and the third test kit also used as a tiebreaker was Uni-Gold Recombigen HIV ½ test kit (Trinity Biotech). Sera stored in a deep freezer at MUST Clinical Research Laboratory were later thawed and further screened for the presence of HIV-1 and HIV-2 antibodies using Enzyme Immunoassay (EIA) tests using Murex 1.20.(Abbott Laboratories, Japan) and Vironostika HIV Uni-Form II Ag/Ab (Biomerieux, Boxtel, The Netherland) following the manufacturer's instructions. For purpose of quality control, all positive samples and 5% of the negative samples were retested using the same protocol. Any discordance of up to 10% was accepted. The laboratory test results for individuals were linked to individual and household questionnaire information through their unique identifiers.

2.8 Data Analysis

Data was entered into Epi-data software (The EpiData Association, Odense, Denmark) [27], edited, cleaned and validated. It was then exported and analyzed using the STATA version 13 (STATA Corp LP, College Station, Texas, USA)[28]. Demographic data was described as proportions with 95% confidence interval and median was used for continuous variables, chi-square tests and bivariate logistic regression were used for association of predictor variables (sex, age group, literacy level, educational level, rural or urban setting, religion, relative wealth status, ever married or not and ethnicity) with the outcome variable being prevalence of HBV/HIV coinfection. P-values were calculated at the 95% confidence interval and were considered significant if < 0.05. For the significant predictor's variables in the bivariate analysis, a multivariate logistic regression model was constructed to analyze for confounding, forward and backward regression produced the same model.

3. RESULTS

3.1 Prevalence of Monoinfections of HIV, HBsAg and Anti-HBc among the Study Population

Out of 1874 blood samples analyzed the prevalence of HIV was 6.6% (CI: 5.5-7.8), HBsAg was 4.1% (CI: 3.3-5.1) and anti-HBc was 31.8% (CI; 29.7-33.9) respectively among the study population.

3.2 Demographic Characteristics of the Study Population

Out of 1874 participants sampled, 55.1% (n=1029, 95% CI 52.8 – 57.3) were females, males were 44.9% (n=845, CI; 42.7-47.2) and children up to 5 years of age were 11.4% (n=212, 95% CI: 10.0 – 12.9). Median age was 30 (IQR 23.40), age groups were 0-5 years, 15-25 years, 26-45 years and 46-59 years with the largest age group of 26-45 years was 55.1% (n=1042, 95% CI: 53.3 – 57.8). Most 70.6% (n=1323, 95% CI: 68.6 – 72.7) were from the rural setting, with 79.1% (n=1273, 95% CI: 77.2 – 81.1) in the lower wealth status. Most 62.0% (n=1,003, 95% CI: 59.6 – 64.3) had secondary school education or lower but with a high literacy level of about 64.9% (n=1054, 95% 62.5 – 67.2) and 83.9% (n=1,359, 95 CI 82-85.6) were currently unemployed. They consisted of seven different tribes with Banyankole/Bakiga being the largest at 75.8% (n=1232, 95% CI: 73.7 – 77.8) and 21.2% (n=344, 95% CI: 19.3 -23.2) of them had never been married. The median duration of stay in the area was 12yrs (IQR= 17). (Table 1).

3.3 Prevalence of HIV/HBsAg and HIV/HBcAb Co-infection by Socio-demographic Characteristics

The prevalence of HIV/HBsAg and HIV/HBcAb co-infection was 0.6% (n=11, 95% CI: 0.3 – 1.1) and 2.4% (n=45, 95% CI: 1.7 – 3.2) respectively in the whole study group. Children 1-5yrs had a prevalence of 0% for both HIV/HBsAg and HIV/HBcAb co-infection. Prevalence of HIV/HBsAg was higher among males 1.1% (n=9, 95% CI: 0.6 – 2.1), people aged 26-45years

Table 1. Socio-demographic characteristics of the study population

Variables	n (%)	95%CI
Age : (n=1874)		
1 – 5	212 (11.4)	10.0 – 12.9
15 – 25	426 (22.7)	20.9 – 24.7
26 – 45	1,042 (55.5)	53.3 – 57.8
46 – 59	194(10.3)	9.0 – 11.8
Sex: (n=1874)		
Male	845 (44.9)	42.7 –47.2
Female	1,029 (55.1)	52.8 – 57.3
Education level: (n=1618)		
No education	67 (4.1)	3.3 – 5.2
Primary	296 (18.3)	16.5 – 20.3
Secondary	1,003 (62.0)	59.6 – 64.3
Tertiary	252 (15.6)	13.9 – 17.4
Settings (n=1874).		
Urban	551 (29.4)	27.4 - 31.5
Rural	1,323 (70.6)	68.6 – 72.7
Relative wealth status (n=1610)		
High	337 (20.9)	18.8 – 22.7
Low	1,273 (79.1)	77.2 – 81.1
Currently working/employed (n=1620)		
Yes	1,359 (83.9)	82. – 85.6
No	261 (16.1)	14.4 – 18.0
Ethnicity (1625)		
Banyankole/Bakiga	1,232 (75.8)	73.7 – 77.8
Baganda	39 (2.4)	1.8 – 3.3
Bahima	196 (12.1)	10.6 – 13.7
Banyarwanda	75 (4.6)	3.7 - 5.8
Banyoro/Batoro	14 (0.9)	0.5 - 1.5
Non bantu	4 (0.3)	0.09 - 0.6
Bafumbira	65 (4)	3.1 – 5.1
Literary Level (1624)		
Can't read & write	570 (35.1)	32.8 – 37.5
Can Read & write	1,054 (64.9)	62.5 – 67.2
Marital status (1624)		
Never married	344 (21.2)	19.3 -23.2
Currently married	1,152 (71)	68.7 – 73.1
Ever married	128 (7.8)	6.7 – 9.1
Religion (n=1626)		
Catholic	427 (26.3)	24.2 - 28.5
Protestant	911 (56.0)	53.6 - 58.4
Moslem	58 (3.6)	2.8 -4.6
SDA	87 (5.6)	4.3 -6.5
Pentecostal	143 (8.8)	7.4 – 10.2

Age: median = 30years, IQR =17, duration of continuous stay (years): median=12yrs IQR= 17.

0.8% (n=8, 95% CI: 0.4 – 1.5), high education level 1.4% (n=5, 95% CI: 0.5 – 3.3), the more urban population 1.9% (n=6, 95% CI: 0.5 – 2.4), high relative wealth status 0.9% (n=3, 95% CI:

0.3 – 2.7), people with high literacy level 0.9% (n= 9, 95% CI: 0.4 – 1.6), the Pentecostal religion 1.4% (n=2, 95% CI: 0.3 - 5.4), the Bahima tribe 2%, (n=4, 95%CI: 0. 8 – 5.3), the never married 0.9%, (n=3, 95% CI:0,3 - 2.7) and those currently working 0.8% (n11, 95% CI:0.4 – 1.5).

Prevalence of HIV/HBcAb was higher among males 3.1%, (n=26, 95% CI: 2.1 – 4.5), people aged 26-45yrs 3.3% (n=34, 95% CI: 2.6 – 4.6), high education level 4.7% (n=18, 95% CI: 2.9 – 7.4), urban population 3.6% (n=20, 95%CI:2.4 – 5.6), high relative wealth status 3.6% (n=13, 95% CI:2.0 – 6.2), people with high literacy level 2.8% (n=30, 95%CI: 2 – 4), the SDA religion 4.6% (n=4, 95% CI:1.7 – 11.7), the Banyoro/Batoro tribe 14.3% (n=2, 95% CI:3.4 - 44) and the ever married 2.8% (n=36, 95% CI: 2 – 3.9) (Table 2).

Table 2. Prevalence of HIV/HBsAg and HIV/HBcAb co-infection by socio-demographic characteristics

Variables	HIV/HBsAg		HIV/HBcAb	
	n (%)	95% CI	n (%)	95% CI
Study population (n=1868)	**11 (0.6)**	**0.3 – 1.1**	**45 (2.4)**	**1.7 – 3.2**
Age (n=1,868)				
1 – 5	0 (0)	–	0 (0)	–
15 – 25	3 (0.7)	0.2 – 2.2	7 (1.7)	0.8 – 3.4
26 – 45	8(0.8)	0.4 – 1.5	34 (3.3)	2.6 – 4.6
46 – 59	0 (0)	-	4 (2.1)	0.8 – 5.4
Sex (n=1868)				
Male	9 (1.1)	0.6 - 2.1	26 (3.1)	2.1 – 4.5
Female	2 (0.2)	0.05 – 0.8	19 (1.8)	1.2 – 2.9
Education level (n=1,618)				
High	5 (1.4)	0.5 – 3.3	18 (4.7)	2.9 – 7.4
Low	6 (0.5)	0.2 - 1.1	27 (2.2)	1.5 - 3.1
Settings (n=1868)				
Rural	5 (0.4)	0.2 - 0.9	25 (1.9)	1.3- 2.8
Urban	6 (1.9)	0.5 – 2.4	20 (3.6)	2.4 – 5.6
Currently working/employed (n=1620)				
Yes	11 (0.8)	0.4 – 1.5	37 (2.7)	2.0 – 3.7
No	0 (0)	--	8 (2.7)	1.3 – 5.5
Relative wealth status (n=1610)				
High	3 (0.9)	0.3 – 2.7	13 (3.6)	2.0 – 6.2
Low	8 (0.6)	0.3 – 1.6	32 (2.5)	1.8 – 3.5
Ethnicity (n=1625)				
Banyankole/Bakiga	6 (0.5)	0.2 – 1.1	33 (2.7)	1.9 - 3.7
Baganda	0 (0)	–	0 (0)	--
Bahima	4 (2.0)	0. 8 – 5.3	8 (4.1)	2.0 – 8.0
Banyarwanda	1 (1.3)	0.2 – 8.9	1 (1.3)	0.2 - 9.0
Banyoro/Batoro	0 (0)	–	2 (14.3)	3.4 – 44
Non bantu	0 (0)	--	0 (0)	--
Bafumbira	0 (0)	–	1 (1.5)	0.2 - 10.3
Literary Level (n=1,624)				
Can't read & write	2 (0,4)	0.1 - 1.4	15 (2.6)	1.6 - 4.3
Can Read & write	9 (0.9)	0.4 – 1.6	30 (2.8)	2 – 4
Marital status (n=1624)				
Never married	3 (0.9)	0,3 - 2.7	9 (2.6)	1.4 - 4.9
Ever married	8 (0.6)	0.3 – 1.2	36 (2.8)	2 – 3.9
Religion (n=1533)				
Catholic	2 (0.5)	0.1 – 1.9	11 (2.8)	1.4 – 4.6
Protestant	7 (0.8)	0.4 – 1.6	25 (2.7)	1.9 - 4.0
Moslem	0 (0)	--	0 (0)	--
SDA	0 (0)	–	4 (4.6)	1.7 – 11.7
Pentecostal	2 (1.4)	0.3 - 5.4	5 (3.5)	1.5 – 8.2

3.4 Associated Predictors of HIV/HBsAg Prevalence

The factors that are associated with HIV/HBsAg co-infections were: sex (male) OR = 5.5 (C I; 1.2 – 25.5), *p*-value= 0.03 and Bahima tribe/ethnicity OR = 3.9 (CI: 1.2 – 13.5), *p*-value =0.032. There were associations between having HIV/HBsAg co-infection and high literacy level, high education level, being of the Pentecostal faith, ever married, ever having had a blood transfusion, ever having gotten drunk and having had sex with more than 2 partners in the last 12 months, but however these were not statistically significant. Staying in the rural area, having sex debut before 18 years and having a spouse was protective to with having HIV/HBsAg co-infection but they were also not statistically significant (Table 3).

3.5 Associated Predictors of HIV&HBcAb Co-infection

The factors that are associated with high HIV/HBcAb co-infection are: high education level OR 2.1 (CI 1.1 - 3.9); *p*-value = 0.02 and Banyoro/Batoro tribe/ethnicity OR 6.1 (CI 1.3 - 28.3), *p*-value = 0.02. There was no statistically significant difference between having HIV/HBcAb co-infection and the different age groups. There was a positive association between having HIV/HBcAb co-infection and being male, staying in the urban setting, being of the SDA religion, sex debut before 18 years, ever having had a blood transfusion, ever taken alcohol or gotten drunk and having had sex with 4 or more partners in life, these were however not statistically significant. Age groups 15-25 and >=45, low relative wealth, never being married and having a circumcised spouse were negatively associated with having HIV/HBcAb co-infection but were not statistically significant (Table 4).

4. DISCUSSION

Due to the recent increase in the HIV prevalence in Uganda from 6.5% to 7.4% [7] and the scale-up and earlier initiation of lifelong ARV's, information on HBV co-infection is important to guide in the implementation of drug regimens and monitoring of patients liver function. In this cross-sectional household survey, we found current HBV (HIV/HBsAg) co-infection of 0.6%

Table 3. Associated predictors of HIV/HBsAg prevalence

Predictor	Unadjusted OR (95%CI)	*p*-value	adjusted OR (95%CI)	*p*-value
Socio-Demographic				
Male	5.7 (1.2 – 25.8)	**<0.028**	**5.5** (1.2 – 25.5)	0.03
Age 26-45yrs	Ref			
<5 years	1	--		
17-25	0.9 (0.2 -- 3.5)	0.88		
>=47	1	--		
High literacy level	2.4 (0.5 - 11.4)	0.25		
High education level	2.9 (0.9 - 9.6)	0.08		
Rural setting	0.3 (0.1 - 1.1)	0.08		
Ever married	1.4 (0.4 - 5.2)	0.63		
High relative wealth status	1.4 (0.4 – 5.4)	0.6		
Currently working/employed	1	-		
Bahima tribe/ethnicity	**4.2** (1.2 - 14.6)	**0.02**	**3.9** (1.1 – 3.5)	**0.032**
Pentecostal religion	2.3 (0.5 - 10.8)	0.28		
Behavioural				
First sex before 18yrs	0.8 (0.2 - 2.9)	0.68		
Ever had a blood transfusion	2.8 (1.04 - 4.2)	0.19		
Ever taken alcohol	1.4 (0.4 - 4.9)	0.57		
Ever gotten drunk from taking alcohol	2.9 (0.7 - 4.2)	0.35		
Sex with 2 or more people in last 12 months	1.7 (0.2 – 13.9)	0.61		
Had sex with less than 4 people in life	1.2 (0.3 – 4.0)	0.79		
Having a spouse (currently)	0.8 (0.2 - 2.9)	0.68		
Male spouse circumcised	1	-		

Table 4. Associated predictors of HIV & HBcAb co-infection

Predictor/Covariate	Unadjusted OR (95%CI)	*p*-value	adjusted OR (95%CI)	*p*-value
Socio-Demographic				
Male	1.7 (0.9 - 3.1)	0.082		
Age 26-45yrs	Ref			
<5 years	1	--		
15-25	0.5 (0.2 - 1.1)	0.09		
>=45	0.6 (0.2 - 1.8)	0.38		
High literacy level	1.1 (1.03 - 3.2)	0.80		
High education level	2.2 (1.2 - 4.1)	0.01	**2.1** (1.1 – 3.9)	0.02
Urban setting	1.9 (1.1 - 3.5)	0.03	1.5 (0.9 – 2.9)	0.14
Low relative wealth status	0.7 (0.4 - 1.4)	0.29		
Never married	0.9 (0.4 - 1.9)	0.84		
Currently working/employed	1 (0.4 - 2.3)	0.97		
Banyoro/Batoro tribe/ethnicity	6.1 (1.3 - 27.1)	0.02	**6.1** (1.3 - 28.3)	0.02
SDA religion	1.7 (0.6 - 5.0)	0.29		
Behavioural				
First sex before 18yrs	1.5 (0.8 - 2.7)	0.19		
Had blood transfusion last 12mon	1.6 (0.6 - 4.2)	0.32		
Ever taken alcohol	1.3 (0.7 - 2.4)	0.41		
Ever gotten drunk from taking alcohol	1.3 (0.4 - 3.8)	0.63		

which is similar to infection level in Southern Ethiopia 0.6% [29] in a rural hospital. This is however lower than nine other studies in Uganda and some sub-Saharan countries: Uganda 4.9%, 3.9%, [30,31], Kenya 56% [32], Nigeria 33%, 11.9% and 2.7% [33-35], Ghana 37% [21], Rwanda 2.4% [30], Zambia 9.9% [36], Ethiopia 19% [37], Gambia 12.2% [38] and South Africa 3.8% [39]. For lifelong HBV (HIV/anti-HBc) co-infection we had a prevalence of 2.4% in our study which again is also lower than other studies; Gambia 26.1% [38] and South Africa 10.6%[39]. Among children 1-5 years we found a prevalence of 0% which is also lower than in Tanzania 9.6% & 2.1% [12] and Ethiopia 7.5% [40]. The zero prevalence of HBV and HIV co-infection among the children group in our study is a clear manifestation of the successful campaign of HBV prevention in Uganda through the introduction of early infant vaccination programme launched in 2002. The finding show lower prevalence for both HIV/HBsAg and HIV/HBA and this may be most probably because all other studies cited were conducted at HIV clinics among HIV positive patients among antenatal mothers and in prisons who were already at high risk for the possible co-infection. However, the findings in our study shows that there is still active and chronic co-infection of HIV and hepatitis B virus in this area of Uganda with lower endemicity compared to the northern part of the country. This can actually imply that the rate could be higher elsewhere in the country and among high risk groups therefore it may be prudent to test for hepatitis B co-infection among patients for HAART initiation.

In this study HIV/HBsAg co-infection was found to be significantly higher among males (1.1%) than females (0.2%), *p*=0.03. This is similar to findings in Gambia [38] where male were at higher risk of co-infection compared to females. However in Kenya and South Africa [32,39], although males were more co-infected, the difference was not significant between them and their female counter parts. This observed difference in our study may be due to the fact that polygamy is common in Uganda and males may also be more likely to have multiple sex partners as compared to the females. HIV/HBV current co-infection was also found to be significantly higher among the Bahima ethnic group and this may be due to the sexual behaviour of this ethnic group who from anecdotal evidence practice wife sharing. In South, Africa race was not found to be significantly associated with the HIV/HBsAg co-infection [32,39].

For the lifelong HBV (HIV/HBcAb) co-infection was significantly higher among people with higher level of education p=0.02, but in Kenya [41] however education level did not show any significant association with having the co-infection. Despite the available literature on the effects of HIV/HBV co-infection on drug

resistance, HIV disease progression and effect of HIV coinfection on hepatitis disease progression, hepatitis B status testing has not been introduced in the routine assessment for initiation of HAART at the HIV [3,14,15]. In order to improve on care and outcome, this should be introduced because this study has shown that in the general population which is not at high risk you have about 2.4% lifelong HBV/HIV coinfection in a lower endemic area of the country.

5. CONCLUSION

The prevalence of current and lifelong HBV (HIV/HBV) co-infection was low among the population living in Kiruhura district southwestern Uganda. The low prevalence of HIV/HBV coinfection is still substantial to cause a high burden of morbidity and mortality among the population. In order to have an HIV and HBV free future community, there is need to strengthen HBV testing in the existing health systems such as testing among patients attending HIV clinics, antenatal clinics and to forge new testing strategy using community home-based approaches. There is also need to continue strengthening the routine immunization strategies and adapt treatment and prevention strategies that take into account the possibility of co-infection for the two conditions.

CONSENT

It is not applicable.

ETHICS APPROVAL AND CONSENT OF PARTICIPANTS

The research protocol was approved by Mbarara University Faculty of Medicine Research Committee (FRC), Mbarara University of Science and Technology Research Ethics Committee (REC) [Rec. No. 01/08-11] and Uganda National Council of Science and Technology (UNCST) [Ref. No. HS1126]. Informed consent and assent were obtained from each of the eligible participants once the study protocol was fully explained to them.

AVAILABILITY OF DATA AND MATERIALS

All data supporting our findings are contained in the paper. There are no restrictions to data sources, however, details of the full data may be accessed through Professor Richard Onyuthi Apecu (corresponding author), Department of Medical Laboratory Sciences, Mbarara University of Science and Technology, PO Box 1410, Mbarara, Uganda.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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