2024-04-30

Seroprevalence of Hepatitis B Infection Among Blood Donors in the Western Zone of Tanzania

Marira, Gadiel

preprint

https://doi.org/10.21203/rs.3.rs-3825799/v1

Seroprevalence of Hepatitis B Infection Among Blood Donors in the Western Zone of Tanzania

Gadiel J. Marira

marirag@nm-aist.ac.tz

Ifakara Health Institute, Research and Training Center- Bagamoyo

Esther G. Kimaro

Nelson Mandela African Institution of Science and Technology

Elingarami Sauli

Nelson Mandela African Institution of Science and Technology

Research Article

Keywords: Seroprevalence, Hepatitis B virus, blood donors, Western-Tanzania

Posted Date: January 3rd, 2024

DOI: https://doi.org/10.21203/rs.3.rs-3825799/v1

Additional Declarations: No competing interests reported.

Version of Record: A version of this preprint was published at Informatics in Medicine Unlocked on May 1st, 2024. See the published version at https://doi.org/10.1016/j.imu.2024.101518.

Abstract

Background

In the western zone of Tanzania, there is limited information for the prevalence of hepatitis B infection. In this study, we analyzed the dataset of blood donors to determine seroprevalence and socio-demographic factors related to Hepatitis B Virus infection among blood donors in the western regions of Tanzania.

Material and Methods

The study was a cross-sectional retrospective hospital-based. Data were retrieved from blood donor dataset given at the Zonal Blood Transfusion Center. Information analyzed from the dataset includes reported Transfusion Transmissible Infections (TTIs) including Hepatitis B, donor demographics, donor status, donor type, donation place, and the year of donation. This study focused on five years period from January 2018 to December 2022. The seroprevalence rates of hepatitis B surface antigen (HBsAg) were determined, and the univariate and multivariate analysis were conducted to determine association between infection and demographic risk factors under STATA version 15.1.

Results

A total of 9604 retrospective blood donors were screened. Majority (93.3%) were men, and most were under 45 years (89.6%). The overall, seroprevalence for HBsAg was 6.9% (661) in this study, with Katavi (7.8%) being relatively high in the study area. The highest HBsAg seroprevalence of 8.2%, was found to be in age group range of 35 to 44 years. In addition, Polygamist 9.5%, and drivers at 17.1% were shown to have relatively high seroprevalence in this case. Using multivariate analysis, the results indicate blood donors who were drivers (OR 5.44, 95% CI; 2.43 12.20, p < 0.001), and the first-time donors (OR 5.19, 95% CI 2.56 = 10.52, P 4 < 0.001), were highly associated with an increased chance of hepatitis B infection.

Conclusion

The findings demonstrate that; there is a high seroprevalence of HBV in western regions. These findings bring to the attention of more advocacy for HBV immunization for all persons at high risk, as it is the most effective way to prevent HBV infection.

1. INTRODUCTION

The World Health Organization (WHO) has declared viral hepatitis B (HBV) as a significant life-threatening global public health issue [1]. About 296 million individuals worldwide live with chronic hepatitis B, with a rate of 1.5 million new cases every year and about 0.82 million deaths annually [1]. The prevalence was found to be higher (6.2%) in the Western Pacific Area, followed by Africa, with a 6.1% prevalence [2]. Chronic HBV is endemic and extremely common in sub-Saharan Africa, where it affects over 8% of the population [3], and about 12.5% of patients receiving blood transfusions are at risk of acquiring hepatitis infection [4]. It causes liver cancer, of which, about two out of every three (2/3) incidences are brought by chronic HBV, which develops liver cirrhosis [5].

Tanzania is an endemic country for Hepatitis B Virus (HBV), where it's prevalence was reported to be 6% in 2018 [6]. A recent report from the National Strategic Plan for the Control of Viral Hepatitis 2018/2019 to 2022/2023, shows the HBV seroprevalence from subpopulations ranges between 5.5–20% in different parts of the country [7]. Despite all government efforts for routine vaccination programs in neonates and public health care workers, the transmission rate is still high among different groups of people [2].However, the seroprevalence of HBV among blood donors in the western zone of Tanzania has not been known.

The magnitude of Hepatitis B Virus (HBV) varies geographically among countries in endemic areas [8]. However, the treatment for positive diagnosed patients is available, where antiviral therapy are effective to manage hepatitis B infected patients [9], and the disease is preventable through vaccination, which is available effective control measure [10] for the disease. The burden of HBV is still high in Africa, including Tanzania [3], The study carried out in the Northern regions of Tanzania from 2017 to 2019 revealed that, the most prevalent transfusion-transmitted infection (TTI) is the hepatitis B virus (HBV), with prevalence of 5.1% among blood donors [11].

Blood transfusions and contact with bodily fluids can both result in the spread of Hepatitis B Virus, which is highly contagious [12]. The virus belongs to the hepadnaviral family, an enveloped DNA virus that spreads by parenteral injection and can be found in bodily fluids like blood. The virus gets into the liver through bloodstream and reproduces in hepatocytes [13]. The risk factors for HBV infection include age, sex [14], unprotected sexual intercourse with multiple-partners, tattooing, family history of hepatitis B [15], place of residence [16], occupation [17], education, alcoholism, Human Immunodeficiency Virus (HIV) [4], and blood transfusion [18]. Several studies have reported different prevalence of HBV from different zones for different groups [2, 4, 22, 23] but not in Western Zone of Tanzania, including geographical distribution, and associated socio-demographic characteristics for HBV infection among blood donors. This study therefore aimed at generating information on seroprevalence of HBV in Western regions of Tanzania, its geographical distribution, and associated socio-demographic characteristics, for improving management of the disease and informing policy-making

process for needed appropriate interventions. The evidence generated by this research will update general knowledge on disease's current burden in the Western Tanzania and associated sociodemographic traits in the study groups for appropriate interventions planning in the western regions.

2. MATERIAL AND METHODS

2.1 Study Area

This study was conducted in the Western zone of Tanzania blood donation centers using collected retrospective data on blood donation. This study area was chosen based on latest Demographic Health Survey (DHS) report (2022) which indicated that, large number of women in Tabora deliver at home [21], and polygamy is most prevalent in this zone, which is one of the factors associated with Hepatitis B Virus infection.

2.2 Study design and population

This was a cross-sectional retrospective hospital-based study involving secondary data from blood donors collected from District hospitals for five years between January 2018 and December 2022. All collected blood was routinely tested using Chemiluminescent Microparticle Immunoassay (CMIA) technology. The study population involved all healthy male and female blood donors who were recruited from District hospitals in the Western regions. The sample size was calculated using the formula below for cross-sectional studies.

$$n = p\left(1 - p\right)\left(\frac{Z}{E}\right)^2$$

Where; P = Prevalence (0.5)

Z = Level of confidence (1.96)

E = Marginal error (0.01)

n = Sample size

Recent estimates for the prevalence of HBV among blood donors in Tanzania's northern zone were 5.1%. [11]. We predicted that, Western zone of Tanzania would have a higher prevalence (10%) among blood donors. The lack of Hepatitis B vaccination for all Tanzanian adults and challenges in getting medication for those who have been confirmed to have the infection may give credence to this hypothesis. To test this difference, we would require 9604 retrospective blood donors at a power of 100% and alpha set at 0.01.

Power estimation for the one-sample proportion tests

Ho: p = p0 versus Ha: p = p0

Study parameters:

alpha = 0.010

N = 9604

delta = 0.049

p0 = 0.051

pa = 0.100

The Estimated power:

power = 1.000

Where: Alpha = Significance level

Delta = Effect size

N = Number of subjects (Sample size)

p0 = The value of the proportion under the null hypothesis, or the null proportion

pa = Alternative proportion or the value of the proportion under the alternative hypothesis

Therefore, with the sample size of n = 9604, we achieve a power of 100%.

A total of 42550 hospital-based clean data were retrieved from Western Zone Blood Transfusion Center database (eDelphyn), for three Regions in five years, where 9707 were from Katavi, 8267 from Kigoma and 24576 from Tabora. Proportional calculation was conducted and 2190 retrospective blood donors from Katavi, 1865 from Kigoma and 5549 from Tabora were obtained. Proportionally calculated sample size per Region was evenly divided in five years of study period. However, in order to obtain the actual sample, all donors per year per Region was randomly arranged where randomization formula was used "=RAND()" and all donors were rearranged using randomization column and the first appeared group of donors in the list was chosen as representative sample in that particular year.

2.3 Hepatitis B Surface Antigen (HBsAg) Detection

All donated blood was routinely tested with Chemiluminescent Microparticle Immunoassay (CMIA) technology, which is recommended by WHO because it is very specific and ideally sensitive. It is a refined and improved version of the Enzyme-Linked Immuno-Sorbent Assay (ELISA) technology. The ARCHITECT HBsAg assay is a chemiluminescent microparticle immunoassay (CMIA) for quantitative assessment of hepatitis B surface antigen (HBsAg) in human serum and plasma. It detects HBsAg using microparticles coated with monoclonal anti-HBs [22]. The blood donors were registered at blood donation centers and an assessment for eligibility criteria for blood donation was instituted using a standardized donor questionnaire. The questionnaire inquired about participants' socio-demographic characteristics, such as age, marital status, occupation, and address; donor status (first-time donor or repeat donor), the type of donor-voluntary or replacement; and general health check of the donor in terms of diseases and risks for acquiring transmissible infections like HIV, HBV, and others. Blood donation proceeded after an individual signed a written informed consent form. According to National testing standards and procedures, every given blood was screened for TTIs, with an emphasis on HIV, HBV, Hepatitis C virus (HCV), and Syphilis-causing *Treponema pallidum* (*T. pallidum*). Candidates who obtained negative test results were marked and not recalled for the next donation. The blood that tested positive from the original screening test was discarded and put to a duplicate repeat test. Donors whose blood units tested positive after this duplicate repeat were permanently rejected, while those discovered to have medical disorders, including TTIs, were urged to seek emergency medical assistance.

2.4 Data Management and Analysis

Data from blood donors was retrieved from Western Zone Blood Transfusion Center (WZBTC). data base from the main zonal blood donation center which is located in Tabora town at Kitete Regional Hospital, from March to June 2023, and the collected variables were donation year, region, age, sex, donor status, donor type, marital status, occupation, blood group, and TTIs results.

Collected data were then cleaned, followed by data cording, and analysis using STATA version 15.1. A descriptive analysis was done to determine the infection in each year and in different groups, with different geographical areas, where the numerical variables such as age was presented as mean, median and standard deviation. The categorical variables such as sex, age-group, donor status, donor type, marital status, and occupation were summarized in the form of frequencies and percentages. The period (annual) and cumulative seroprevalence of hepatitis B infection was determined and expressed as a percentage from the proposition of all seropositive donors in the total studied population of donors. The statistical differences were compared using Chi-square ($\chi 2$) test, whereas the odds ratio (OR) and the corresponding 95% (CI) confidence interval was calculated for determining factors that contribute to hepatitis B infection (multivariate logistic regression) among blood donors. Also, a P-value of < 0.05 was considered as statistically significant.

2.5 Ethical Consideration

An Institutional review board from Ifakara Health Institute (IHI) granted ethical approval for this study (**IHI/IRB/No: 17-2023**). The permission to conduct the study using blood donor data was granted by the Ministry of Health (MoH). The information which was provided by the Western Zone Blood Transfusion Services (WZBTS) was secured under confidentiality and privacy by avoiding access to data by any unauthorized personnel and results were approved by Tanzania National Blood Transfusion Services (NBTS), National Institute for Medical Research and The Nelson Mandela African Institution of Science and Technology before publication.

3. RESULTS

3.1 Social demographic characteristics of the Study participants

A total of 9604 blood donors were involved in this study (Table 1). Majority of blood donors (57.8%) comes from Tabora region compared to the two regions in the study area. Majority of blood donors recruited from this study (93.3%) were males and 89.6% of all donors were younger than 45 years, married (78.1%) and first-time blood donors (94.2%). Additionally, 58.4% (5608) of donors were voluntary donors, while 41.6% were replacement donors and almost half of blood donors (48.8%) were blood group O+(positive) as presented in Table 1.

Table 1
Socio-demographic characteristics of the study population (n = 9604)

Variable	Category	Frequency (n) (N = 9604)	Percentage (%) (%=100)
Region of residence	Katavi	2190	22.8
	Kigoma	1865	19.4
	Tabora	5549	57.8
Age-	17–24 Years	2385	24.8
	25–34 Years	3805	39.6
	35–44 Years	2418	25.2
	45–54 Years	846	8.8
	55 + Years	150	1.6
Sex-	Male	8963	93.3
	Female	641	6.7
Donor status-	Repeated donation	559	5.8
	First time donation	9045	94.2
Donor type-	Voluntary donors	5608	58.4
	Replacement donors	3996	41.6
Marital status-	Married	7500	78.1
	Not married	2047	21.3
	Polygamy	21	0.2
	Divorced	26	0.3
	Widowed	10	0.1
Blood Groups	O -Positive	4682	48.8
	O -Negative	130	1.3
	A -Positive	2559	26.6
	A -Negative	62	0.7
	B -Positive	1749	18.2
	B -Negative	33	0.3
	AB -Positive	377	3.9
	AB -Negative	12	0.1
Occupation	Students	578	6.0
	Farmer	8148	84.8
	Business	386	4.0
	Technicians	170	1.8
	Drivers	88	0.9
	Teachers	43	0.5
	Religion Leader	23	0.2
	Health Care Workers	26	0.3
	Industrial Workers	30	0.3
	Security Servants	112	1.2

Majority of participants occupations were Peasants (85%), followed by students (6%), Table 1.

3.2 Seroprevalence of Hepatitis B

The overall seroprevalence of hepatitis B infection was 6.9% (661/9604) of which, the hepatitis B infection was the most prevalent among all Transfusion Transmissible Infections (TTIs) across the three regions. Other Transfusion Transmissible Infection reported in the dataset were Human immune virus, Syphilis and hepatitis C virus (Fig. 1).

The seroprevalence of hepatitis B infection increased with age, where blood donors aged between 35—44 years had the highest seroprevalence (8.2%) compared to the other age groups (Table 2). The seroprevalence of hepatitis B was slightly higher in males (6.9%) than females, while, polygamy had relatively higher seroprevalence of 9.5%. Moreover, the seroprevalence of HBV in replacement donors was 7.8% and that of first-time donors were 7.2%. The seroprevalence of hepatitis B as participant occupational activities indicated that the drivers had the highest seroprevalence of 17.1%, (Fig. two)

The seroprevalence of hepatitis B in blood group A + participants was 7.35%, while blood group B + had seroprevalence of 7.5%, blood group O + participants had seroprevalence of 6.4%, and blood group O- had relatively higher seroprevalence of 6.9%. The blood group AB + donors had seroprevalence of 7.7% while blood group AB- had 8.3%.

The overall seroprevalence of Transfusion Transmissible Infections (TTIs) in the Western zone of Tanzania from 2018 to 2022 in hospital-based blood donors was 18.6%, of which the seroprevalence of hepatitis C (HCV) in this study was 380 (3.9%), which was slightly lower to that of Syphilis 4.5% (431). However, the HIV infection was found to be lowest, 3.2% (310/9604), among all the TTIs as presented in Figure one.

The rate of hepatitis B positive was significantly higher in blood donors who were HIV positive (10.0%) as per Table 3. Moreover, 380 (3.9%) of blood donors had hepatitis C infection (Table 2), of which (17) 4.5% were also hepatitis B positive. Furthermore, HBV infection within HCV negative tested blood donors were significantly higher (6.9%) compared to HCV positive blood donors as shown in Table 3. A total of 431 (4.5%) of blood donors were infected with Syphilis causing -*Treponema pallidum*, (Table 2), of which 41 (9.5%) were HBV and Syphilis co-infected. However, the rate of hepatitis B positive was significantly higher in blood donors who were syphilis positive compared to syphilis negative (6.8%) (Table 3)

Table 2
Seroprevalence of HBV under different sociodemographic characteristics

Variable	Category	Hepatitis B infection		Total
		Positive	Negative	
Region	Katavi	171(7.8%)	2019(92.2%)	2190
	Kigoma	131(7.0%)	1734(92.9%)	1865
	Tabora	359(6.5%)	5190(92.5%)	5549
Age	17–24 Years	121(5.1%)	2264(94.9%)	2385
	25–34 Years	264(6.9%)	3541(93.1%)	3805
	35–44 Years	199(8.2%)	2219(91.8%)	2418
	45–54 Years	68(8.0%)	778(91.9%)	846
	55 + Years	9(6.0%)	141(94.0%)	150
Sex	Male	622(6.9%)	8341(93.1%)	8963
	Female	39(6.1%)	602(93.9%)	641
Donor status	Repeated donation	8(1.4%)	550(98.6%)	558
	First time donation	653(7.2%)	8393(92.8%)	9046
Donor type	Voluntary donors	350(6.2%)	5258(93.8%)	5608
	Replacement donors	311(7.8%)	3685(92.2%)	3996
Marital status	Married	575(7.7%)	6925(92.3%)	7500
	Not married	83(4.1%)	1964(95.9%)	2047
	Polygamy	2(9.5%)	19(90.5%)	21
	Divorced	1(3.8%)	25(96.2%)	26
	Widowed	0(0%)	10(100%)	10
Blood group	O -Positive	298(6.4%)	4384(93.6%)	4682
	O -Negative	9(6.9%)	121(93.1%)	130
	A -Positive	188(7.4%)	2371(92.6%)	2559
	A -Negative	2(3.2%)	60(96.8%)	62
	B -Positive	132(7.6%)	1617(92.4%)	1749
	B -Negative	2(6.1%)	31(93.9%)	33
	AB -Positive	29(7.7%)	348(92.3%)	377
	AB -Negative	1(8.3%)	11(91.7%)	12

Table 3
Seroprevalence of HBV Co-infected with HCV, HIV and Syphilis

Variable	Category	Hepatitis B infection		Total
		Positive	Negative	
Hepatitis C	Hepatitis C Positive	17(4.5%)	363(95.5%)	380
	Hepatitis C Negative	644(7.0%)	8580(93.0%)	9224
HIV	HIV Positive	31(10.0%)	279(90.0%)	310
	HIV Negative	630(6.8%)	8664(93.2%)	9294
Syphilis	Syphilis Positive	41(9.5%)	390(90.5%)	431
	Syphilis Negative	620(6.8%)	8553(93.2%)	9173

3.3 Periodic seroprevalence and geographical distribution of Hepatitis B infection

The highest seroprevalence was observed in Katavi region (7.8%), followed by Kigoma (7.0%), but lower in Tabora (6.5%) Table 2. The year-on-year infection trend was highest in 2018 (7.6%), but declined moderately from 2019 (6.6%) and 2020 (6.0%), followed by a moderate increase to 7.4% in 2021, and 6.9% in 2022. (Fig. 3). The seroprevalence of hepatitis B infection among blood donors in Katavi Region was the highest (10.7%) in the year 2018, 7.5% in 2019, and lower in the year 2020 (5.5%), Moreover, the seroprevalence of HBV infection in the year 2021 and 2022 gradually increased to 7.3% and 7.9% respectively. (Fig. 3)

Kigoma Region showed the highest seroprevalence of hepatitis B infection in the year 2020 (7.8%), and lowest seroprevalence (6.4%) in 2019 and 2022. But the seroprevalence in the year 2018 was 6.9%, and 7.5% in 2021 (Fig. 3)

The seroprevalence in Tabora Region was most prevalent in a year 2021 (7.4%), and less prevalent in 2020 (5.7%). The seroprevalence in a year 2018 was 6.5%, and 6.2% in 2019, but slightly higher (6.6%) in the year 2022 (Fig. three).

3.4. Association between HBV infection with demographic characteristics

Under univariate logistic regression analysis, the increased age was related with higher odds for hepatitis B infection at (OR 1.16, 95% CI: 1.07–1.26), and this association was statistically significant ($p < 0.001$). The age group between 25—34 was significantly associated with hepatitis B infection (OR 1.39, 95% CI 1.12–1.74, $p = 0.003$). The significant association with higher risk for hepatitis B infection also existed in the age group between 35—44 (OR 1.67, 95% CI 1.33–2.12, $p < 0.001$) and 45—54 years age group also showed significant association with hepatitis B infection (OR 1.63, 95% CI 1.20–2.23, $p = 0.002$). Moreover, the first- time donors were 5.35 times more likely to be hepatitis B positive than repeat donors at (OR 5.35, 95% CI 2.649577–10.79844, $p < 0.001$). Blood donors who were married were also more likely to be hepatitis B positive than those who were single/divorced/widowed/polygamist (OR 1.96, 95% CI 1.55 2.48, $p < 0.001$). Being a replacement donor was also associated with higher chance for being Hepatitis B positive (OR 1.26, 95% CI 1.08 1.48, $p = 0.003$) as seen in Table 4. However, being a farmer was related with significantly increased risk for hepatitis B infection (OR 3.14, 95% CI: 1.83–5.37, $p < 0.001$), as seen in Table 5. Businessmen were also significantly more likely to test hepatitis B positive (OR 2.67, 95% CI; 1.36–5.23, $p = 0.004$). Moreover, drivers were 8.27 times more likely to test hepatitis B positive (OR 8.27, 95% CI; 3.84 17.84, $p < 0.001$), and teachers were likewise more likely to be tested hepatitis B positive (OR 4.13, 95% CI; 1.29–13.14, $p = 0.016$).

After adjusting for all other potential variables using a multivariate analysis, blood donors who were married remained at increased risk for Hepatitis B virus infection (OR 1.49, 95% CI 1.110294 2.010616, $P = 0.008$). However, the first-time donors also remained to be significantly associated with increased chance for being hepatitis B positive after adjusting for other potential variables (OR 5.19, 95% CI 2.559923 10.52345, $P < 0.001$) as presented in Table 4. Also, after adjusting for various confounding factors, farmers remained at a significantly higher chance of being positive for Hepatitis B virus (OR 1.97, 95% CI; 1.09–3.56, $p = 0.023$), and also drivers remained to be strongly associated with hepatitis B infection (OR 5.44, 95% CI; 2.43–12.20, $p < 0.001$), as presented in Table 5.

Table 4
Association of hepatitis B with sociodemographic characteristics

Variable	Category		Hepatitis B infection			
		No. of Participants	cOR (95% CI)	p-Value	aOR(95%CI)	P-Value
Age	17–24 Years	2385	1	0.003	1.01 (0.781 1.311)	0.928
	25–34 Years	3805	1.39 (1.117 1.741)	< 0.001	1.20 (0.912 1.591)	0.188
	35–44 Years	2418	1.67 (1.328 2.119)	0.002	1.19 (0.848 1.692)	0.304
	45–54 Years	846	1.63 (1.201 2.225)	0.618	0.92 (0.446 1.894)	0.821
	55 + Years	150	1.19 (0.594 2.400)			
Sex	Female	641	1	0.409	1.05 (0.750 1.486)	0.754
	Male	8963	1.15 (0.824 1.607)			
Donor status	Repeat donor	558	1	< 0.001	5.19 (2.559 10.523)	< 0.001
	First time donor	9046	5.35 (2.649 10.798)			
Donor type	Voluntary donors	5608	1	0.003	1.21 (1.030 1.432)	0.021
	Replacement donors	3996	1.26 (1.082 1.485)			
Marital status	Not married	2047	1	< 0.001	1.49 (1.110 2.010)	0.008
	Married	7500	1.96 (1.552 2.486)	0.225	2.06 (0.457 9.358)	0.345
	Polygamy	21	2.49 (0.570 10.870)	0.957	0.68 (0.090 5.243)	0.719
	Divorced	26	0.94 (0.126 7.069)			
	Widowed	10	0			
Blood group	AB-	12	1	0.935	0.88 (0.108 7.240)	0.911
	AB+	377	0.92 (0.114 7.351)	0.855	0.94 (0.106 8.272)	0.955
	O-	130	0.82 (0.094 7.067)	0.781	0.73 (0.092 5.795)	0.769
	O+	4682	0.75 (0.096 5.810)	0.429	0.34 (0.028 4.231)	0.407
	A-	62	0.37 (0.030 4.400)	0.896	0.84 (0.107 6.772)	0.882
	A+	2559	0.87 (0.112 6.792)	0.788	0.67 (0.054 8.311)	0.757
	B-	33	0.71 (0.058	0.918	0.88 (0.110 6.992)	0.904
	B+	1749				

cOR = Crude Odds ratio, aOR = Adjusted Odds ratio

Variable	Category	Hepatitis B infection				
		No. of Participants	cOR (95% CI)	p-Value	aOR(95%CI)	P-Value
			8.620)			
			0.89 (0.115 7.008)			
cOR = Crude Odds ratio, aOR = Adjusted Odds ratio						

Table 5
Association of hepatitis B with Socio-economic characteristics

Variable	Category	Hepatitis B infection				
		No. of Participants	cOR(95% CI)	p-Value	aOR(95%CI)	p-Value
Occupation	Student	578	1 (base)			
	Farmers	8148	3.14(1.838 5.379)	< 0.001	1.97(1.096 3.569)	0.023
	Business	386	2.67(1.363 5.231)	0.004	1.81(0.884 3.711)	0.104
	Technicians	170	1.73(0.686 4.358)	0.245	1.22(0.474 3.171)	0.673
	Drivers	88	8.27(3.840 17.843)	< 0.001	5.44(2.431 12.200)	< 0.001
	Teachers	43	4.13(1.298 13.148)	0.016	2.56(0.778 8.455)	0.122
	Religion Leaders	23	0	-	0	-
	Health Care Workers	26	0	-	0	-
	Industrial Workers	30	0	-	0	-
	Security Servants	112	2.68(1.058 6.813)	0.038	1.67(0.639 4.412)	0.293
cOR = Crude Odds ratio, aOR = Adjusted Odds ratio						

3.5 Association of HBV infection with other TTIs

Univariate logistic regression analysis (Table 6) indicates HIV positive blood donors were significantly 1.53 times more likely to be hepatitis B positive (OR 1.53, 95% CI; 1.04–2.23, p = 0.029) than HIV negative blood donors, and also blood donors with syphilis were more likely to test hepatitis B positive than non-infected donors (OR 1.45, 95% CI; 1.04–2.02), and were significantly associated with HBV infection. However, the HCV infected blood donors were statistically negatively associated with HBV infection (OR 0.57, 95% CI; 0.35–0.95, p = 0.031) (Table 6).

Table 6
Association of hepatitis B with other TTIs, and region of residence

Variable	Category	Hepatitis B infection				
		No. of Participants	cOR(95% CI)	p-Value	aOR (95%CI)	p-Value
Region of residence	Katavi	2190	1 (base)	0.343	0.93 (0.732 1.185)	0.566
	Kigoma	1865	0.89(0.704 1.129)	0.036	0.83 (0.682 1.009)	0.062
	Tabora	5549	0.82(0.675 0.986)			
TTIs	HCV	380	0.62(0.381 1.021)	0.061	0.57(0.352 0.951)	0.031*
	HIV	310	1.53(1.045 2.233)	0.029	1.44(0.980 2.114)	0.063
	Syphilis	431	1.45(1.040 2.021)	0.028	1.23(0.879 1.730)	0.224
cOR = Crude Odds ratio, aOR = Adjusted Odds ratio						
Under univariate logistic regression analysis, (Table 6). Blood donors from Tabora were 0.82 times more likely to be detected with HBV (OR 0.82, 95% CI; 0.67 0.98) than blood donors from Katavi region, and the association was statistically significance (p = 0.036)						

4. DISCUSSION

The viral hepatitis B infection is a significant life-threatening global public health problem, which also leads to concerns about the safety of blood transfusion practices in blood transfusion centers worldwide [23]. To our knowledge this is the first study to determine the seroprevalence of HBV infection, its associated geographical distribution and sociodemographic characteristics among blood donors in Western zone of Tanzania. Findings from this study are important to sensitize more uptakes of vaccinations to reduce HBV infection and the burden of this disease.

The majority of blood donors involved in this study were males, accounting for 93.3% of all donors. This high participation of males can be explained by the significant postponement of potential female donors due to some physiological reasons such as menstruation periods, pregnancy, lactation and childbirth [11]. Also, majority of blood donors (85%) in this study were farmers (peasants) who had significantly higher proportion among all other blood donors. Regions in the western zone are among the regions that have potential fertility which can support a variety of crops and hence agricultural activities are the major economic activities in this study area. In our study, the majority of blood donors (89.6%) were under the age of 45 years, this is the age group which is healthy, productive and are involved in development activities. It brings sense as most of African countries population dominated by youth. Majority of the blood donors (94.2%) were first time donors, and voluntary non-remunerated blood donors accounted for the most (58.4%), which is higher compared with family replacement donors.

This study established that, the HBV was the most prevalent transfusion-transmitted infections (TTIs), among other TTIs determined among blood donors in this zone, where similar findings was also reported from Northern Tanzania [11]. This indicates that the respective populations are at high risk of exposure for contracting HBV infection in this community. Nevertheless, in recent years there has been sensitization of HBV vaccine uptake in Tanzania especially for the population who were born from 2003 to date as it is being offered to infants in the routine immunization programs [7]. Yet for those who succumbed to HBV infection before starting vaccinations can act as source of infection in these communities especially through the identified risk factors such as increased unsafe sex, living with infected persons, materials sharing or through vertical transmission. The findings from this study also signifies the presence of HBV infection in the general population as seen in other studies for different groups [2, 4, 23], in different zones in Tanzania. All observed variations between this study and other studies could be attributed to variations in donor recruitment procedures, economic activities, geographical locations, the behavioral characteristics of different age groups, and availability of highly sensitive screening methods [11, 24, 25]. Another plausible explanation is that screening blood donors for HBsAg does not totally eliminate the risk for HBV infection by blood transfusion, because donors with occult HBV infection who did not have detectable levels of HBsAg were tested as negative. This highlights the necessity for a more sensitive and stringent blood donor screening methodology, even in remote areas [26].

The seroprevalence of HBV (6.9%) found in this study indicates endemicity and a higher risk for HBV infection among blood donors. It is within the range of 5.5–20% as reported by the Tanzania Ministry of Health [7] for subpopulations in Tanzania. The HBV prevalence in western regions seems to be higher than the findings from another study conducted in Northern regions of Tanzania from 2017 to 2019, which reported 5.1% prevalence of HBV among blood donors [11], and 3.4%, which was reported by the study conducted in Kenya east Africa involving adolescent blood donors [27]. Another study from Ethiopia reported prevalence of 3.8% among mothers in Ethiopia [28] and overall prevalence of 6.03% [29], which was almost similar to East Africa. However, the present study findings is lower than 11.1% prevalence of HBV in Côte d'Ivoire (2010–2012) among voluntary blood donors [30], 11.5% among medical students in Ethiopia [31], 7.6% among adults in Uganda [32], and 9.8% among blood donors in southern Ethiopia [4]. Importantly, the determined seroprevalence from this current study falls within the range of hepatitis B prevalence in Sub-Saharan Africa, which is considered intermediate endemic, with infection rates ranging from 2–7% [33], which agrees with other findings [29–31] that, the endemic regions with highest HBV prevalence in the world is Sub-Saharan Africa, including Tanzania.

Different age groups were found to have variations in HBsAg seroprevalence, which was also reported in several previous studies globally. Moreover, the HBsAg seroprevalence varied among different age groups where it was most prevalent in 35 to 44 years age groups (8.2%), but low in the 17 to 24 age groups, and the age above 55 years. The reason for increased seroprevalence among 35–44 age group, which is a sexually more active group, is not very clear, but possible explanation is that, there is more persistent risk for exposure to HBV during sexual life time and hence the increased risk for Hepatitis B infection.

Moreover, young adults are susceptible to HBV exposure risk due to their adventurous sexual behavior influenced by their age [37]. This study agrees with another study [38] in Rwanda, which showed a high HBV infection prevalence in the age group between 35 to 44 years.

Another important observation in this study was sex dependent differences in HBB prevalence, which showed the highest seroprevalence in males compared to female donors. This has also been reported in another study from Côte d'Ivoire [30]. This might be due to frequent movement of males to different areas where they can interact with infected people, compared to females who most of time stay at home with their families.

The results on HBV infections occurrence among retrospective blood donors in Western zone of Tanzania were compared to assess the trends in five consecutive years, 2018, 2019, 2020, 2021 and 2022. However, year-on-year infection was not highly varied but the small differences existed as in 2018 had high overall seroprevalence of 7.6%, and low (6.0%) in 2020. The decreasing trend in HBV infections in our research population could be attributed to reduced exposure to some of risk factors combined with enhanced health services, such as vaccination coverage, social distance, and hands washing, especially in a year 2020 during COVID 19 Pandemic. The decreasing trend of infection and increasing rate of positivity to HBsAg both suggests that horizontal rather than vertical transmission is the major source of this endemicity. Moreover, lower seroprevalence of HBsAg among blood donors was reported from some regions in different years. This could be because blood donors with clinical signs and symptoms of hepatitis have been excluded during blood donation.

A relatively higher seroprevalence of HBV infection in married donors (7.7%), is due to the fact that, these viruses are transmitted through contacting bodily fluids, including via sexual intercourse, sharing of sharp objects, physical contacts, and living with an infected person [37]. The married group had higher chance for acquiring hepatitis Viruses from their partners. This was also supported by the study conducted in Yemen [39], which revealed high prevalence of HBsAg in married blood donors.

This study agrees with other findings that, hepatitis B affects large number of people and is more infectious than HIV [29–31] as the seroprevalence of HIV infected participants in this study was 3.2%. However, hepatitis B and HIV Co-infected showed a seroprevalence of 10.0%, which is higher than that obtained from Burkina Faso [40], and high percentage (9.5%) for HBV and syphilis co-infected donors were observed in our study. This indicate that, the major route of infection is through sexual intercourse and the participants were exposed to unsafe sexual contacts. The hepatitis B co-infected with HIV and syphilis was statistically positively associated as revealed by univariate logistic regression, but HBV and HCV co-infected donors were negatively associated.

In our study, after adjusting for other confounding factors in multivariate logistic regression, Farmer's and married blood donors were 1.9 and 1.5 times more likely to be infected with HBV respectively, and the association was statistically significance. The high seroprevalence among drivers might be due to their frequent exposures to different working environments where they tend to meet with different sexual partners along the journey. Despite having high seroprevalence, drivers were 5.4 times more to be detected with HBV than other occupations after controlling for other confounding factors. However, first-time donor were 5.2 times more likely to be detected with HBV, this might be because the first-time donor they are not aware with their health status on HBV compared to repeat donors.

Other important finding was overall seroprevalence of TTIs in the donated blood within the last five years in the Western Zone of Tanzania was 18.6%, which is higher compared to the previous study findings from Northern Tanzania [11]. Availability and safety of blood continue to be major obstacles in Tanzania, as they are in many other sub-Saharan African nations. The high incidence of HBV, HCV, HIV and syphilis, continues to be a serious problem. However, despite improvements that have been made in nations where WHO national haemo-vigilance procedures have been implemented, the danger for TTIs is still a significant problem in Tanzania, as justified by findings from this study in the Western zone of Tanzania.

Conclusion and Recommendations

This study has involved hospital based donated blood in the Tanzania Western Zone blood transfusion centers from 2018 to 2022, of which HBV accounted for about 6.9%. As a result, HBV remains one of the most serious hazards to blood safety in this scenario. To improve blood safety in the regions, restricting adherence to selection and retention criteria, including voluntary, non-remunerated low-risk blood donors, is highly recommended. Also, thorough adherence to the donor screening procedure is strongly advised with great emphasis on community-based modification of risk behaviors, individual education improvement, and assuring safe clinical practices to reduce infection rate in developing countries. We highly recommend voluntary non-remunerated donors for donation centers and vaccination to all Drivers.

In order to develop effective intervention strategies, it is also crucial to have frequent evaluation of prevalence and trends of a range of HBV infection in the donor community. The findings from this study emphasize increased immunization coverage against HBV to all adults at high risk, which is the most effective measure to prevent HBV infection. Compulsory screening of pregnant women is also highly recommended in endemic countries.

A number of limitations were found in this study, such as the nature of study design, which was a cross-sectional study, which does not establish causality per se. Another limitation was the nature of the study being retrospective, making it impossible for the study to provide in-depth information on risk factors for hepatitis B, which may have influenced the results in this study. Moreover, the range of risk factors evaluated in this study was limited, as it dealt with only information fed in the database. Finally, the exclusion of blood donors who had incomplete information in the database, thus a careful interpretation of the study findings is necessary.

Declarations

This manuscript is original work and that it has not been submitted to any other university for the award of a degree or any other award. Also, no any conflict of interest regarding this study

Author Contribution

Author 1. GJM. conceptualized and designed the study, retrieved data, performed data analysis, and wrote a first draft of the manuscript. 2. EGK and ES conceptualized and designed the study, reviewed the manuscript for intellectual content and approved the final manuscript.

Acknowledgements

We thank the Ifakara Health Institute for financial support, and the National Blood Transfusion Services (NBTS) under the Ministry of Health-Tanzania for permitting us to conduct research by using blood donor data. Also, we thank Aidan Christopher Chaligha, Pauline Masagati Mafuru, and Gissela P. Kway for their technical support on data extraction, and Yuster L. Massanja, and Salum A. Chiamba for their contribution in data cleaning.

References

1. WHO, “Hepatitis B,” World Health Organization, 2022. https://www.who.int/news-room/fact-sheets/detail/hepatitis-b
2. K. Geffert *et al.*, “Prevalence of chronic HBV infection in pregnant woman attending antenatal care in a tertiary hospital in Mwanza, Tanzania: A cross-sectional study,” BMC Infect. Dis., vol. 20, no. 1, pp. 1–10, 2020, doi: 10.1186/s12879-020-05096-2.
3. F. Tognon *et al.*, “Seroprevalence of hepatitis B and hepatitis C among blood donors in Sierra Leone: A multi-year retrospective study,” Int. J. Infect. Dis., vol. 99, pp. 102–107, 2020, doi: 10.1016/j.ijid.2020.07.030.
4. G. Beykaso *et al.*, “Estimating the transmission risks of viral hepatitis and hiv among blood donors in hossana, Southern Ethiopia,” Risk Manag. Healthc. Policy, vol. 14, pp. 3117–3127, 2021, doi: 10.2147/RMHP.S323057.
5. D. Maucort-Boulch, C. de Martel, S. Franceschi, and M. Plummer, “Fraction and incidence of liver cancer attributable to hepatitis B and C viruses worldwide,” Int. J. Cancer, vol. 142, no. 12, pp. 2471–2477, 2018, doi: 10.1002/ijc.31280.
6. E. R. Shao *et al.*, “Seroprevalence of hepatitis B virus infection and associated factors among healthcare workers in northern Tanzania,” BMC Infect. Dis., vol. 18, no. 1, pp. 1–10, 2018, doi: 10.1186/s12879-018-3376-2.
7. MoHCDGEC, “The national strategic plan for control of Viral Hepatitis (NSPVH) 2018/19 -2022/23,” *Development*, vol. 7, no. 5,371,780,231.09, pp. 2,274,923,575.00-29.08, 2018.
8. M. Samje, S. Sop, C. T. Tagny, and D. Mbanya, “Knowledge, attitude and seropositivity of hepatitis b virus among blood donors in the bamenda regional hospital blood bank, cameroon,” Pan Afr. Med. J., vol. 39, 2021, doi: 10.11604/pamj.2021.39.33.28911.
9. A. Jaquet, G. Muula, D. K. Ekouevi, and G. Wandeler, “Elimination of Viral Hepatitis in Low and Middle-Income Countries: Epidemiological Research Gaps,” Curr. Epidemiol. Reports, vol. 8, no. 3, pp. 89–96, 2021, doi: 10.1007/s40471-021-00273-6.
10. D. Aaron, T. J. Nagu, J. Rwegasha, and E. Komba, “Hepatitis B vaccination coverage among healthcare workers at national hospital in Tanzania: How much, who and why?,” BMC Infect. Dis., vol. 17, no. 1, pp. 1–7, 2017, doi: 10.1186/s12879-017-2893-8.
11. A. Mremi, J. J. Yahaya, M. Nyindo, and E. Mollel, “Transfusion-Transmitted Infections and associated risk factors at the Northern Zone Blood Transfusion Center in Tanzania: A study of blood donors between 2017 and 2019,” *PLoS One*, vol. 16, no. 3 March, pp. 1–12, 2021, doi: 10.1371/journal.pone.0249061.
12. M. Abebe, B. Alemnew, and S. Biset, “Prevalence of hepatitis b virus and hepatitis c virus among blood donors in nekemte blood bank, Western Oromia, Ethiopia: Retrospective 5 years study,” J. Blood Med., vol. 11, pp. 543–550, 2020, doi: 10.2147/JBM.S282099.
13. Hepatitis B Foundation, “What is Hepatitis B,” *hepb.org*, 2023. https://www.hepb.org/what-is-hepatitis-b/what-is-hepb/
14. I. Kamali *et al.*, “Prevalence and associated risk factors for hepatitis B and C viruses among refugee populations living in Mahama, Rwanda: A cross-sectional study,” *PLoS One*, vol. 16, no. 10 October, pp. 1–14, 2021, doi: 10.1371/journal.pone.0257917.
15. G. Demeke, G. M. Ayalneh, A. A. Shiferaw, M. Toru, and T. Dilnessa, “Sero-prevalence and associated factors of hepatitis b virus among pregnant women at north west ethiopia: An institution-based cross-sectional study,” Int. J. Gen. Med., vol. 14, pp. 2799–2805, 2021, doi: 10.2147/IJGM.S320711.
16. T. Nkoa *et al.*, “Prevalence and risk factors of Hepatitis B virus infection among blood donors in Gabonese National Blood Transfusion Center: A cross-sectional and analytic study,” Int. J. Med. Med. Sci., vol. 13, no. June, pp. 5–12, 2021, doi: 10.5897/IJMMS2021.1455.
17. J. M. Eko Mba *et al.*, “Prevalent hepatitis B surface antigen among first-time blood donors in Gabon,” PLoS One, vol. 13, no. 4, pp. 1–10, 2018, doi: 10.1371/journal.pone.0194285.
18. G. Shayo, I. Makundi, and L. Luzzatto, “The prevalence of human immunodeficiency and of hepatitis B viral infections is not increased in patients with sickle cell disease in Tanzania,” BMC Infect. Dis., vol. 21, no. 1, pp. 4–9, 2021, doi: 10.1186/s12879-021-06726-z.
19. S. B. Kilonzo, D. W. Gunda, B. C. T. Mpondo, F. A. Bakshi, and H. Jaka, “Hepatitis B Virus Infection in Tanzania: Current Status and Challenges,” *J. Trop. Med.*, vol. 2018, 2018, doi: 10.1155/2018/4239646.
20. Z. Mohamed *et al.*, “High prevalence and poor linkage to care of transfusion-transmitted infections among blood donors in Dar-es-Salaam, Tanzania,” J. Viral Hepat., vol. 26, no. 6, pp. 750–756, 2019, doi: 10.1111/jvh.13073.
21. TNBS, “The United Republic of Tanzania Demographic and Health Survey and Malaria Indicator Survey 2022,” *Pap. Knowl.. Towar. a Media Hist. Doc.*, pp. 12–26, 2022.
22. Abbott Laboratories, “Architect HBsAg,” p. 7, 2009.
23. B. Degefa *et al.*, “Prevalence of hepatitis B virus, hepatitis C virus, and human immunodeficiency virus among blood donors of Mekelle blood bank, Northern Ethiopia: A three-year retrospective study,” J. Med. Virol., vol. 90, no. 11, pp. 1724–1729, 2018, doi: 10.1002/jmv.25248.
24. O. A. S. Wasfi and N. A. Sadek, “Prevalence of hepatitis B surface antigen and hepatitis C virus antibodies among blood donors in Alexandria, Egypt,” East. Mediterr. Heal. J., vol. 17, no. 3, pp. 238–242, 2011, doi: 10.26719/2011.17.3.238.
25. T. Solomon, D. Mekonnen, J. Blood, B. Center, and M. Nigatu, “Prevalence of Hepatitis B virus and its predictors among volunteer blood donors in Jimma, Ethiopia, 2018,” pp. 1–16, 2021, [Online]. Available: https://doi.org/10.21203/rs.3.rs-587485/v1
26. B. Nkrumah, M. Owusu, H. O. Frempong, and P. Averu, “Hepatitis B and C viral infections among blood donors from rural Ghana.,” Ghana Med. J., vol. 45, no. 3, pp. 97–100, 2011.
27. H. O. Awili, G. C. Gitao, and G. M. Muchemi, “Seroprevalence and Risk Factors for Hepatitis B Virus Infection in Adolescent Blood Donors within Selected Counties of Western Kenya,” *Biomed Res. Int.*, vol. 2020, 2020, doi: 10.1155/2020/8578172.

28. M. Geta *et al.*, “Seroprevalence of hepatitis B virus infection and associated factors among mothers in Gondar, North-west Ethiopia: A population based study,” Ethiop. Med. J., vol. 57, no. 2, pp. 97–106, 2019.
29. H. M. Kafeero, D. Ndagire, P. Ocama, A. Kudamba, A. Walusansa, and H. Sendagire, “Prevalence and predictors of hepatitis B virus (HBV) infection in east Africa: evidence from a systematic review and meta-analysis of epidemiological studies published from 2005 to 2020,” Arch. Public Heal., vol. 79, no. 1, pp. 1–19, 2021, doi: 10.1186/s13690-021-00686-1.
30. B. Seri *et al.*, “Twenty-year evolution of hepatitis B virus and human immunodeficiency virus prevalence and incidence in voluntary blood donors in Côte d’Ivoire,” Open Forum Infect. Dis., vol. 5, no. 4, pp. 1–8, 2018, doi: 10.1093/ofid/ofy060.
31. T. Tesfa, B. Hawulte, A. Tolera, and D. Abate, “Hepatitis B virus infection and associated risk factors among medical students in eastern Ethiopia,” PLoS One, vol. 16, no. 2 February, pp. 1–11, 2021, doi: 10.1371/journal.pone.0247267.
32. P. Madrama Lulu, J. Bosco Alege, and P. M. Lulu, “Prevalence of Hepatitis B viral infection and associated factors among adults in Moyo district, North-Western Uganda,” *medRxiv*, p. 2022.06.23.22276817, 2022, [Online]. Available: https://www.medrxiv.org/content/10.1101/2022.06.23.22276817v1%0Ahttps://www.medrxiv.org/content/10.1101/2022.06.23.22276817v1.abstract
33. and F. G. Jinlin Hou1, Zhihua Liu1, “Epidemiology and Prevention of Hepatitis B Virus Infection,” *Int. J. Med. Sci. ISSN 1449*–1907 *www.medsci.org 2005 2(1)50–57*, vol. 34, no. 4, pp. 483–502, 2005, doi: 10.1007/BF02476710.
34. L. B. Peliganga, M. A. P. Horta, and L. L. Lewis-Ximenez, “Enduring Challenges despite Progress in Preventing Mother-to-Child Transmission of Hepatitis B Virus in Angola,” Pathogens, vol. 11, no. 2, pp. 1–16, 2022, doi: 10.3390/pathogens11020225.
35. B. B. Antuamwine, E. D. Herchel, and E. M. Bawa, “Comparative prevalence of hepatitis B virus infection among pregnant women accessing free maternal care in a tertiary hospital in Ghana,” PLoS One, vol. 17, no. 3 March, pp. 1–10, 2022, doi: 10.1371/journal.pone.0263651.
36. H. Mohammed Alhassan *et al.*, “Profile of Hepatitis B Sero Markers Among Blood Donors Attending Usmanu Danfodiyo University Teaching Hospital, Sokoto-Nigeria,” J. Biomed. Res. Environ. Sci., vol. 2, no. 5, pp. 412–417, 2021, doi: 10.37871/jbres1251.
37. A. Joseph, oluyemi joseph, and B. Olokoba, “Knowledge of Hepatitis B among young adults in a Higher learning Institution in Nigeria and its implication on effective disease control.,” Microbes Infect. Dis., vol. 0, no. 0, pp. 0–0, 2020, doi: 10.21608/mid.2020.32784.1022.
38. J. Umutesi, C. Klett-Tammen, S. Nsanzimana, G. Krause, and J. J. Ott, “Cross-sectional study of chronic hepatitis B virus infection in Rwandan high-risk groups: Unexpected findings on prevalence and its determinants,” BMJ Open, vol. 11, no. 12, 2021, doi: 10.1136/bmjopen-2021-054039.
39. N. T. Al-Nwany, N. Ahmad, A. M. Nawi, M. R. Hassan, R. Hod, and M. Baharom, “Seroprevalence of hepatitis b virus infection and its associated factors among blood donors in yemen,” Malaysian J. Med. Sci., vol. 28, no. 5, pp. 54–63, 2021, doi: 10.21315/mjms2021.28.5.5.
40. A. Simpore *et al.*, “Prevalence of serological markers for Hepatitis B and C Viruses, human immuno-deficiency virus and Treponema pallidum among blood donors in Ouagadougou, Burkina Faso,” Int. J. Biol. Chem. Sci., vol. 16, no. 1, pp. 13–22, 2022, doi: 10.4314/ijbcs.v16i1.2.

Figures

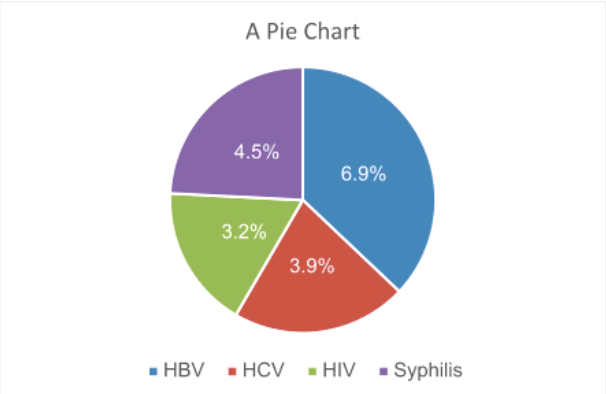

Figure 1

A pie chart presenting Seroprevalence of Transfusion Transmissible Infections.

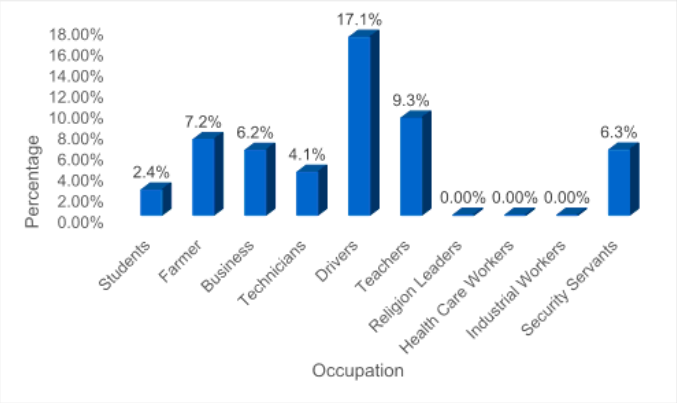

Figure 2

A bar chart presenting HBV prevalence under different occupations

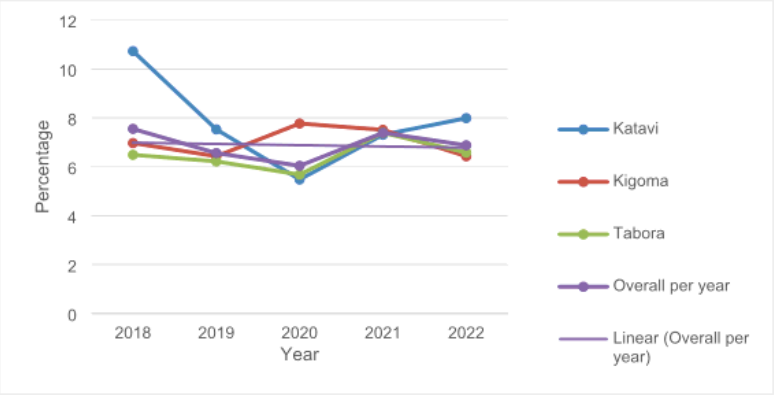

Figure 3

A graph showing infection trend of the Disease among blood donors, within a region per year, in the Western Zone of Tanzania