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Research article

Hepatitis B virus infection (HBV) and HIV-HBV coinfection among men who have sex with men, transgender women, and genderqueer individuals in Harare and Bulawayo Zimbabwe, 2019

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ABSTRACT

Objectives: To measure HIV and Hepatitis B virus (HBV) prevalence and associated risk behaviors among men who have sex with men (MSM) and transgender women/genderqueer individuals (TGW/GQ) in Zimbabwe.

Methods: We conducted a biobehavioral survey using respondent-driven sampling (RDS) among adult MSM and TGW/GQ in Harare and Bulawayo, Zimbabwe in 2019. Participants completed a questionnaire and underwent testing for HIV and HBV.

Results: Overall, 1,510 (Harare: 694, Bulawayo 816) participants were enrolled and consented to testing; 3.8 % (58) tested positive for HBV, 22.5 % (339) tested positive for HIV, and 2.2 % (33) tested positive for both HIV and HBV. HBV prevalence was higher among participants with HIV compared to HIV-negative participants (9.7 % vs. 2.1 %, $p < 0.0001$). Overall, HBV prevalence was not statistically different between MSM and TGW/GQ (3.7 % vs 4.5 %, $p = 0.49$) nor between Harare and Bulawayo (3.3 % vs 4.3 %, $p = 0.33$).

Conclusions: Our survey demonstrates the prevalence of HBV among MSM and TGW/GQ is lower than other estimates of HBV among MSM in Africa but remains high among our survey population living with HIV highlighting the need to expand HBV testing and treatment services, especially among people with HIV in Zimbabwe.

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1. Introduction

Hepatitis B virus (HBV) infection remains a significant public health issue with an estimated 296 million people living with chronic HBV infection in 2019 [1]. Despite a highly effective vaccine and potent antiviral treatments, an estimated 1.5 million people newly acquire HBV infections each year, and 820,000 people died from hepatitis B infection-related causes in 2019, mostly from chronic liver disease and liver cancer [1]. The burden of HBV infection is unevenly distributed across the globe as most new HBV infections occur in the WHO African Region [1]. The estimated prevalence of HBV infection in Africa is 6.1 %, which is considerably higher than the global estimated prevalence of 3.5 % [2]. However, determining accurate estimates is challenging as access to hepatitis testing is limited. In 2019, it was estimated that only 10 % of people globally with chronic HBV infection have been diagnosed, and 2.2 % of those with chronic HBV infection are receiving treatment [1]. Consequently, most people with chronic HBV infection are unaware of their status and are not receiving clinical care to prevent onward transmission.

Widespread use of childhood hepatitis B 3-dose (HepB3) vaccine started in the 1990s, therefore it is thought most people currently living with hepatitis B were born before ubiquitous vaccination [2]. In the absence of vaccination, most HBV infections globally occur before the age of five. Infections among adults also occur, though infection acquired in adulthood is less likely to lead to chronic infection [2]. Sub-populations, including men who have sex with men (MSM) and transgender women (TGW) are at an elevated risk of acquiring HBV infection in adulthood [2]. However, HBV data for these groups is sparse, particularly in Africa. Of the more than 50 African countries only a small number have reported HBV prevalence estimates among MSM and the estimates have varied widely – 4 % in South Africa [3], 5.4 % in Tanzania [4], 7.1 % in Togo [5], 10 % in Nigeria [6], 14–23 % in the Central African Republic [7], and 11.2 % in Burkina Faso, Côte d'Ivoire, Mali, and Togo combined [8]. Furthermore, data on HBV infection prevalence among TGW in Africa is minimal and is often not disaggregated from MSM data, making it challenging to identify any unique vulnerabilities [6]. Data on TGW has rarely been disaggregated from MSM for several reasons, including a historical conflation of gender and sex, statistical challenges with small sample sizes, and an emphasis on assumptions of behavior over identity (i.e., assuming that MSM and TGW share anatomy and sexual practices so they are the same) [9]. To our knowledge, there have not been any studies that have reported the prevalence of HBV infection among MSM, transgender women, or genderqueer individuals, a non-binary gender term, (TGW/GQ) in Zimbabwe. The most recent estimates from 2019 found the prevalence of HBV among the total population in Zimbabwe to be between 7.8 and 10.1 % [10,11].

HIV-HBV coinfection also presents a significant challenge in Africa, where many people living with HIV (PLHIV) reside. The global prevalence of HBV infection among PLHIV is estimated to be 7.4–8.4 % [2,12]. Africa accounts for a greater proportion of HIV-HBV coinfection due to co-endemicity and overlapping risk factors, such as unprotected sex and intravenous drug use [2,12]. Among PLHIV, untreated HBV coinfection is associated with more rapid progression of HBV-related liver disease, hepatocellular cancer, and death [1].

Even though MSM are at a higher risk for both HBV and HIV infection compared to other adults [2,13], there is little data on HIV-HBV coinfection among MSM in Africa and almost no data on HIV-HBV coinfection among TGW worldwide. Prior research conducted in South Africa, Nigeria, and West Africa found the prevalence of HIV-HBV coinfection among MSM to be 2 %, 6 %, and 14 %, respectively, but limited information exists in other settings [3,6,8].

There is little epidemiological data on HBV infections in Zimbabwe due to a lack of systemic screening and treatment for HBV infection, and limited HBV surveillance in the country [14]. Our survey aims to help fill this epidemiological data gap by describing the prevalence of HBV infection and HIV-HBV coinfection among a large sample of MSM and TGW/GQ using data from a biobehavioral survey (BBS) conducted in Harare and Bulawayo, Zimbabwe in 2019. To our knowledge, this is the first survey to provide estimates of the prevalence of HBV and HIV-HBV coinfection in MSM and TGW in Zimbabwe, providing valuable information to better inform the development and implementation of HBV and HIV prevention and control programs in Harare and Bulawayo Zimbabwe for MSM and TGW/GQ individuals.

2. Methods

2.1. Survey design

A detailed description of the survey design and data collection can be found elsewhere [15]; key features are described here. To inform the development of the BBS, a formative assessment was first conducted in Harare and Bulawayo from December 2018–January 2019 to identify sociocultural factors that limit or facilitate access to key populations (KP) and assess logistical and operational needs to conduct the BBS, including identifying potential seeds and KP-friendly health service providers. A cross-sectional BBS using respondent-driven sampling (RDS) was then conducted among MSM and TGW/GQ in Harare and Bulawayo from March to July 2019. The methods used in the BBS were adapted from the *Global HIV Strategic Information Working Group Biobehavioural Survey Guidelines for Populations at Risk for HIV* [16].

2.2. Survey population

MSM and TGW/GQ were eligible to participate in the BBS if they were assigned male status at birth; engaged in anal or oral sex with a man in the past 12 months; were 18 years or older; resided in Harare/Bulawayo for at least the past one month; spoke English, Shona, or Ndebele; provided written informed consent; and had a valid recruitment coupon (for candidate participants).

Initial survey participants ("seeds") were identified with help from KP organizations and recruited by the survey team to start

Table 1
HBV results among MSM and TGW/GQ, Harare and Bulawayo Zimbabwe, 2019.

	Overall (N = 1,510) n [% (95 % CI)]	MSM (N = 1,175) n [% (95 % CI)]	TGW/GQ (N = 335) n [% (95 % CI)]	p-value[a]	Harare[d]				Bulawayo[d]			
					Total (N = 694) n [% (95 % CI)]	MSM (N = 415) n [% (95 % CI)]	TGW/GQ (N = 279) n [% (95 % CI)]	p-value[a]	Total (N = 816) n [% (95 % CI)]	MSM (N = 760) n [% (95 % CI)]	TGW/GQ (N = 56) n [% (95 % CI[c])]	p-value[b]
HBV Positive	58 [3.8 % (2.9, 4.8)]	43 [3.7 % (2.6, 4.7)]	15 [4.5 % (2.3, 6.7)]	0.49	23 [3.3 % (2.0, 4.7)]	10 [2.4 % (0.9, 3.9)]	13 [4.7 % (2.2, 7.1)]	0.10	35 [4.3 % (2.9, 5.7)]	33 [4.3 (2.9, 5.8)]	2 [3.6 % (0.0, 8.4)]	1.0
HBV Negative	1,452 [96.2 % (95.2, 97.1)]	1,132 [96.3 % (95.3, 97.4)]	320 [95.5 (93.3, 97.7)]		671 [96.7 % (95.4, 98.0)]	405 [97.6 % (96.1, 99.1)]	266 [95.3 % (92.9, 97.8)]		781 [95.7 % (94.3, 97.1)]	727 [95.7 % (94.2, 97.1)]	54 [96.4 % (91.6, 100)]	

HBV, hepatitis B virus; MSM: men who have sex with men; TGW/GQ: transgender women/genderqueer.
Some percentages might not sum to 100 % due to rounding differences.

[a] Chi-square.
[b] Fisher's Exact test.
[c] Clopper-Pearson exact confidence intervals (used when crosstabulation cells were <5).
[d] Prevalence of HBV infection was not statistically different between cities (Harare: 3.3 % vs. Bulawayo: 4.3 %, p = 0.33) (data not shown).

recruitment chains in their respective social networks. Seeds were purposively recruited to reflect diversity in sociodemographic characteristics (e.g., age, sexual orientation and gender identity, education, residence, marital status, language, religion). Seeds were given three referral coupons and instructions for peer recruitment. Participants were compensated USD5 during their first visit and an additional USD5 during their second visit to cover transport costs to and from the survey site. They also received USD5 for each successfully recruited peer (maximum of three peers) to cover communication and related costs incurred during the peer recruitment process.

Potential participants were screened for eligibility and if eligible and interested in participating, then written, informed consent was obtained. Individuals could separately consent to different components (questionnaire, biomarker testing, blood specimen storage, and being contacted for follow-up purposes).

2.3. Interviews

Survey staff sensitized to KP-relevant issues administered a structured questionnaire adapted from the *Global HIV Strategic Information Working Group Biobehavioural Survey Guidelines for Populations at Risk for HIV* [16] using a tablet in English, Shona, or Ndebele. The questionnaire collected information on socio-demographics; sexual history; behaviours and attitude related to, and knowledge about, HIV and sexually transmitted infections (STIs); condom and lubricant use; alcohol and drug consumption; and experience with health and support programs available to MSM and TGW/GQ, and with stigma and discrimination. Participants then scheduled a second visit to the survey office to verify if their peer recruits had been enrolled, complete the second visit questionnaire, and receive viral load and HIV recency results. On the second questionnaire, participants were asked how many eligible candidates they approached, how many referral coupons they handed out, and why any approached eligible candidates did not accept the coupons. Participants were also asked about referral completion.

2.4. Biomarker testing

All survey participants were offered onsite testing for HBV, HIV, and syphilis regardless of self-reported status. While participants were free to opt out of biomarker testing, they were counseled on the benefits of early diagnosis and remaining negative if uninfected. Participants who consented to biomarker testing received pre-test/risk reduction counseling according to Zimbabwe's national guidelines [17]. Consenting participants were tested for HBV surface antigen, a marker for current infection, using the Alere Determine HBsAg Rapid Test. They were tested for HIV, using a 3-test algorithm adapted from the national HIV testing algorithm (Alere HIV Combo, Chembio HIV 1/2 STAT-PAK, INSTI HIV-1/HIV-2 antibody test) [17]. Those who tested HIV-positive also received onsite CD4 and HIV recency testing and had specimens sent for offsite HIV viral load testing. Consenting participants were tested for active syphilis using the Chembio Dual Path Platform Syphilis Screen. Test results, post-test counseling, and referral to care and treatment for those who tested positive for any biomarker were provided immediately following rapid testing. Participants who tested HIV-positive and reported not being in care, and those who tested positive for active HBV or syphilis infection, were linked to appropriate services. Additionally, HIV-negative participants were referred for pre-exposure prophylaxis at KP-friendly healthcare facilities.

2.5. Statistical analysis

The population used in all analyses was limited to individuals who consented to biomarker testing and had reported ever having anal or oral sex with a man or TGW. Gender identity, including TGW and genderqueer, was self-reported, and based on feedback from local stakeholders, we combined TGW and GQ in our analysis. Data on key demographic, behavioral, and health outcomes were stratified by city and KP group and presented in tables. Bivariate analyses were performed using Chi-square and Fisher's Exact tests to assess the association between HBV infection or HIV-HBV coinfection and selected factors, which were chosen based on published literature and their hypothesized influence on sexual behavior and HBV transmission, such as number of male sexual partners, condom use, and age. For estimates of precision around prevalence estimates, Wald confidence intervals were estimated; Clopper-Pearson exact confidence intervals (CIs) were estimated when crosstabulation cells were less than five. Data were analyzed without applying RDS weights as some key variables did not reach convergence, including HIV status. Data analysis was conducted using SAS software, Copyright © 2021 SAS Institute Inc. Cary, NC, USA.

3. Results

A total of 1,538 MSM and TGW/GQ individuals participated in the BBS. Of the 1,538 participants, 1,510 (98 %) had HBV and HIV biomarker results, did not have missing data on lifetime history of anal or oral sex, and reported having anal or oral sex with a man or TGW and were included in the final analysis. Of the included participants, 78 % (n = 1,175) were MSM and 22 % (n = 335) identified as TGW/GQ. The median age of survey participants was 25 (min-max range: 18–73) and the largest proportion was aged 20–24 years (35 %, n = 534), and most reported being single (82 %, n = 1,231). In terms of sexual orientation, 59 % (n = 893) of participants identified as gay/homosexual and 40 % (n = 611) as bisexual. Additional participant demographic information has been previously published [15].

Overall, 3.8 % (n = 58) of participants tested positive for HBV infection (Table 1). The prevalence of HBV infection was not statistically different between KP groups (MSM: 3.7 % vs. TGW/GQ: 4.5 %, p = 0.49) or cities (Harare: 3.3 % vs. Bulawayo: 4.3 %, p = 0.33), nor between KP groups in Harare (MSM: 2.4 % vs. TGW/GQ: 4.7 %, p = 0.10) or Bulawayo (MSM: 4.3 % vs. TGW/GQ: 3.6 %, p

= 1.0) (Table 1).

Among all participants, 22.5 % (n = 339) tested positive for HIV and 2.2 % (n = 33) tested positive for both HBV and HIV. The prevalence of HBV infection was more than four times higher among PLHIV compared to HIV-negative participants (9.7 % vs 2.1 %, p < 0.0001) (Table 2). When stratified by KP group, the difference in HBV prevalence by HIV status remained significant for both MSM (10.1 % PLHIV vs. 1.9 % HIV-negative, p < 0.0001) and TGW/GQ (8.7 % PLHIV vs. 2.9 % HIV-negative, p = 0.03). Among PLHIV, the prevalence of HBV infection was not statistically different between KP group (MSM: 10.1 % vs. TGW/GQ: 8.7 %, p = 0.69) nor city (Harare: 7.4 % vs. Bulawayo: 11.5 %, p = 0.21) (data not shown).

In bivariate analyses, HBV infection was significantly lower between participants aged 18–19 vs all other age subgroups (p ≤ 0.05) (Table 3). HBV infection was significantly lower (3 % vs. 6 %; p = 0.0003) between participants with 1–5 lifetime male anal sex partners compared to those with 11+ partners; between participants who tested negative for syphilis compared to those who had shown to have a previous syphilis infection (4 % vs. 9 %; p = 0.047); and between participants who did not receive information on condom use and safe sex in the past 12 months compared to those who did (2 % vs. 5 %; p < 0.01).

In bivariate analyses among participants living with HIV, HBV infection was significantly lower (7 % vs. 14 %; p = 0.04) between participants who engaged in receptive anal sex with their main male partner at last sex compared to those who engaged in insertive anal sex (Table 4). HBV infection was also significantly lower (4 % vs. 13 %; p = 0.01) among participants who did not receive information on condom use and safe sex in the past 12 months compared to those who did. There was no association between $CD4^+$ T-cell count and HBV (<200 cells/mm^3: 13 % vs. 500+ cells/mm^3: 7 %, p = 0.33) nor KP group and HBV (MSM: 10 % vs. TGW/GQ: 9 %, p = 0.69) among PLHIV. Additionally, among participants who self-reported living with HIV 93 % (142/152) reported ever taking antiretroviral medication (ARV), and there was no association between participants ever taking ARV and HBV (ARV: 13 % vs. no ARV: 20 %, p = 0.62).

4. Discussion

The results from our survey among MSM and TGW/GQ in Harare and Bulawayo Zimbabwe found a relatively low prevalence of current HBV infection (3.8 %) compared to the most recent (2015) estimated prevalence of HBV across Africa (6.1 %) [2]. Our results are lower than two previously reported estimates of HBV infection in Zimbabwe – 15 % among people aged 10–61 in 1996 [18] and 10 % among all ages in 2019 [10]. This could in part be due to improvements in HBV vaccination coverage after HBV vaccination was introduced in Zimbabwe in 1994. However, widespread immunization did not begin in Zimbabwe until 1999–2000 [19], and vaccine coverage did not reach 90 % until 2011 [19]. Moreover, while Zimbabwe does not include a universal hepatitis B birth dose to prevent vertical transmission of HBV in its national immunization programme [1], infant HBV vaccination rates remained high (87–97 %) between 2010 and 2019 [10,19].

The prevalence of HBV among PLHIV who participated in our survey (9.7 %) is slightly lower than previous estimates of HIV-HBV coinfection in adult PLHIV in Zimbabwe initiating ART which ranged from 10 to 17 % based on studies conducted between 2003 and 2019 [20–22]. The most recent of these studies, conducted at a single clinic in Bulawayo between 2017 and 2019, reported a similar HIV-HBV coinfection prevalence (10 %). However, none of the previously reported estimates can be used as direct comparisons as they were conducted among ART-seeking individuals while our survey was not.

Our survey found that the prevalence of HBV was more than four times higher among PLHIV compared to HIV-negative participants. These results are in line with other studies among MSM in Kenya [23], United States [24], and Peru [25] which showed higher incident rates or prevalence of HBV among PLHIV, but differs from studies in Nigeria and West Africa which showed that among MSM HBV prevalence was not significantly different between those with and without HIV [6,8]. Identifying HIV-HBV coinfection is critically important as viral hepatitis progresses faster and causes more liver-related health problems among PLHIV than people who do not have HIV [26]. Coinfection with HIV-HBV has also been reported to lead to higher levels of HBV replication [27]. Furthermore, detection of

Table 2
HBV results among MSM and TGW/GQ stratified by HIV result, Harare and Bulawayo Zimbabwe, 2019.

	Overall (N = 1,510) n [% (95 % CI)]			MSM (N = 1,175) n [% (95 % CI)]			TGW/GQ (N = 335) n [% (95 % CI)]		
	HIV-positive	HIV-negative	p-value[a]	HIV-positive	HIV-negative	p-value[a]	HIV-positive	HIV-negative	p-value[b]
HBV Positive	33 [9.7 % (6.6, 12.9)]	25 [2.1 % (1.3, 3.0)]	<0.0001	25 [10.1 % (6.4, 13.9)]	18 [1.9 % (1.1, 2.8)]	<0.0001	8 [8.7 % (2.9, 14.5)]	7 [2.9 % (0.8, 5.0)]	0.03
HBV Negative	306 [90.3 % (87.1, 93.4)]	1,146 [97.9 % (97.0, 98.7)]		222 [89.9 % (86.1, 93.6)]	910 [98.1 % (97.2, 99.0)]		84 [91.3 % (85.6, 97.1)]	236 [97.1 % (95.0, 99.2)]	

HBV: hepatitis B virus; MSM: men who have sex with men; TGW/GQ: transgender women/genderqueer.
Some percentages might not sum to 100 % due to rounding differences.
[c]Among PLHIV, prevalence of HBV infection was not statistically different between cities (Harare: 7.4 % vs. Bulawayo: 11.5 %, p = 0.21) (data not shown).
[a] Chi-square.
[b] Fisher's Exact test.

Table 3
Association of demographic and sexual behavior factors with HBV infection among MSM and TGW/GQ, Harare and Bulawayo Zimbabwe, 2019.

	HBV-Positive (N = 58)			HBV-Negative (N = 1452)			p-value
	Count	Column N%	Row N%	Count	Column N%	Row N%	
Age							
18-19	0	0 %	0 %	174	12 %	100 %	ref
20-24	13	22 %	2 %	521	36 %	98 %	0.046[b]
25-29	10	17 %	3 %	306	21 %	97 %	0.02[b]
30-34	16	28 %	7 %	203	14 %	93 %	0.0003[a]
35-39	10	17 %	8 %	111	8 %	92 %	0.0001[b]
40+	9	16 %	6 %	137	9 %	94 %	0.0007[b]
Employment							
Employed full-time, part-time, or self-employed	29	50 %	4 %	700	48 %	96 %	ref
Full-time student	5	9 %	2 %	198	14 %	98 %	0.3[a]
Retired	0	0 %	0 %	5	<1 %	100 %	1.0[b]
Unemployed	24	41 %	4 %	547	38 %	96 %	0.84[a]
Other	0	0 %	0 %	2	<1 %	100 %	1.0[b]
Income earned last month[c,d]							
<USD 51	10	36 %	4 %	256	36 %	96 %	ref
USD 51-100	10	36 %	4 %	220	31 %	96 %	0.74[a]
>USD 100	8	29 %	3 %	226	32 %	97 %	0.84[a]
Highest education attended							
None or Primary	6	10 %	7 %	76	5 %	93 %	ref
Secondary	41	71 %	4 %	1031	71 %	96 %	0.14[b]
Tertiary or Vocational	11	19 %	3 %	345	25 %	97 %	0.10[b]
City							0.33[a]
Harare	23	40 %	4 %	671	46 %	96 %	
Bulawayo	35	60 %	3 %	781	54 %	97 %	
KP Group							0.49[a]
MSM	43	74 %	4 %	1132	78 %	96 %	
TGW/GQ	15	26 %	4 %	320	22 %	96 %	
HIV Status							<0.0001[a]
Positive	33	57 %	10 %	306	21 %	90 %	
Negative	25	43 %	2 %	1146	79 %	98 %	
Received free condoms, past 12 months							0.07[a]
Yes	46	79 %	4 %	986	68 %	96 %	
No	12	21 %	3 %	466	32 %	97 %	
Received information on condom use and safe sex, past 12 months							<0.01[a]
Yes	44	76 %	5 %	800	55 %	95 %	
No	14	24 %	2 %	652	45 %	98 %	
Selling Sex: received money, goods, or services in exchange for sex, past 6 months[e]							0.22[b]
Yes	7	12 %	6 %	115	8 %	94 %	
No	50	88 %	4 %	1317	92 %	96 %	
Lifetime number of male anal sex partners							
1-5	22	39 %	3 %	807	56 %	97 %	ref
6-10	12	21 %	4 %	279	19 %	96 %	0.21[a]
11+	23	40 %	6 %	347	24 %	94 %	0.003[a]
Number of male anal or oral sex partners, past 6 months							
0	2	4 %	5 %	35	2 %	95 %	ref
1-5	46	81 %	4 %	1262	88 %	96 %	0.38[b]
6-10	4	7 %	4 %	88	6 %	96 %	1.0[b]
11+	5	9 %	9 %	48	3 %	91 %	0.70[b]
Alcohol Dependence (AUDIT score ≥15)[f]							0.20[a]
Yes	17	29 %	5 %	322	22 %	95 %	
No	41	71 %	4 %	1130	78 %	97 %	
Injection drug use, lifetime							1.0[b]
Yes	0	0 %	0 %	13	<1 %	100 %	
No	58	100 %	4 %	1439	99 %	96 %	
Network Size: number of men or TGW you know who have sex with other men/TGW							
0-8	15	26 %	4 %	412	28 %	96 %	ref
9-18	8	14 %	2 %	324	22 %	98 %	0.38[a]
19-50	17	29 %	4 %	424	29 %	96 %	0.79[a]
51+	18	31 %	6 %	292	20 %	94 %	0.14[a]
Syphilis infection[g]							
Active infection	4	7 %	5 %	80	6 %	95 %	0.54[b]
Previous infection	5	9 %	9 %	48	3 %	91 %	0.047[b]
Negative	49	84 %	4 %	1316	91 %	96 %	ref
Circumcised							0.77[a]
Yes	20	34 %	4 %	528	36 %	96 %	
No	38	66 %	4 %	924	64 %	96 %	
Diagnosed with STI in the past 12 months, other than HIV							0.09[a]

(*continued on next page*)

Table 3 (*continued*)

	HBV-Positive (N = 58)			HBV-Negative (N = 1452)			p-value
	Count	Column N%	Row N%	Count	Column N%	Row N%	
Yes	10	17 %	6 %	148	10 %	94 %	
No	48	83 %	4 %	1304	90 %	96 %	
One or more STI symptoms, past 12 months							0.76[a]
Yes	12	21 %	4 %	277	19 %	96 %	
No	46	79 %	4 %	1175	81 %	96 %	
Likely presence of a major depressive disorder[h]							0.80[a]
Yes	6	10 %	3 %	166	11 %	97 %	
No	52	90 %	4 %	1286	89 %	96 %	
Type of anal sex with main male partner at last sex[i]							
Receptive	17	31 %	4 %	428	31 %	96 %	ref
Insertive	35	64 %	4 %	745	54 %	96 %	0.58[a]
Both	3	5 %	1 %	216	16 %	99 %	0.08[a]
Engaged in condomless receptive anal intercourse at last sex, past 6 months (main male partner)[j]							0.29[a]
Yes	6	11 %	3 %	227	16 %	97 %	
No	50	89 %	4 %	1190	84 %	96 %	
Condom use at last sex with main male partner[k]							0.93[a]
Yes	37	67 %	4 %	927	67 %	96 %	
No	18	33 %	4 %	462	33 %	96 %	
Condom use with main male partner, past 6 months[l]							
Always/Most of the time	31	55 %	4 %	844	60 %	96 %	0.94[a]
Sometimes/Rarely	15	27 %	5 %	308	22 %	95 %	0.54[a]
Never	10	18 %	4 %	265	19 %	96 %	ref
Condom use at last sex with main transgender female partner[m]							1.0[b]
Yes	3	75 %	10 %	79 %	79 %	90 %	
No	1	25 %	13 %	21 %	21 %	88 %	

HBV, hepatitis B virus; MSM: men who have sex with men; TGW/GQ: transgender women/genderqueer.
Some variables do not add up to the total number because of skip patterns (ie, based on the answer to a parent question, subsequent questions might or might not be asked), missing data, participants not knowing the answer to the question, or participants refusing to answer.
Some percentages might not sum to 100 % due to rounding differences.

[a] Chi-square.
[b] Fisher's Exact test.
[c] Question not asked to students or unemployed participants.
[d] n = 6 don't know/refused to answer.
[e] n = 21 don't know/refused to answer.
[f] Using the Alcohol Use Disorders Identification Test (AUDIT).
[g] n = 8 inconclusive test result.
[h] Based on a score ≥3 on the Patient Health Questionnaire-2 (PHQ2).
[i] Of those reporting anal sex with a main male partner in the past 6 months and not responding don't know/refused to answer.
[j] Of those reporting anal sex with a main male partner in the past 6 months.
[k] n = 46 never had anal sex with this partner/don't know/refused to answer.
[l] n = 17 don't know/refused to answer.
[m] Of those reporting having had sex with a transgender female partner in the last 6 months.

coinfection is essential as the WHO-recommended first-line HIV treatment drug tenofovir doubles as a treatment for chronic HBV-infection, and can help prevent further transmission of HBV [2].

We did not find an association between $CD4^+$ T-cell count and HBV among PLHIV. This is noteworthy as it has been hypothesized that lower $CD4^+$ T-cell count may lead to higher levels of HBV replication [21], as $CD4^+$ T-cells are an essential part of the adaptive immune response and aid in viral clearance of both HBV and HIV [28]. Our results differ from two previous studies that found an association between HBV-infection and lower $CD4^+$ T-cell counts in people coinfected with HIV-HBV compared to those with only HIV [21,29]. However, those studies were not exclusively among MSM or TGW/GQ and were made up of ART-naïve HIV-HBV coinfected adult men and women. Additionally, one of those studies only included participants with $CD4^+$ T-cell count <300 cells/mm^3 [21], and the other contained participants with a median $CD4^+$ T-cell count of ≤ 130 cells/mm^3 [29], while most of our participants had a $CD4^+$ T-cell count ≥ 200 cells/mm^3. Additionally, we could not subcategorize participants in our survey with <200 $CD4^+$ T-cells/mm^3 due to their small number (n = 5). Additional studies are needed specifically among MSM/TGW to better understand the effect of HBV infection on $CD4^+$ T-cell count among PLHIV.

The association between age and HBV infection among MSM and TGW/GQ individuals in Africa is less evident in the literature. Our results show that age is associated with HBV infection, in line with a study among MSM in Thailand [30], but other studies from Kenya and West Africa did not find age to be significantly associated with HBV infection [8,23]. Notably, none of our survey participants aged 18–19 tested positive for HBV. Childhood vaccination against HBV in Zimbabwe began in the late 1990s, so it is possible that some of these youngest participants may have been vaccinated as children protecting them from acquiring HBV through sexual transmission. However, as we did not collect information on HBV vaccination status, we are unable to tell which participants, if any, have been vaccinated. It is possible age and potential HBV vaccination status could also account for the significant difference in HBV infection

Table 4
Characteristics of MSM and TGW/GQ living with HIV Stratified by HBV Biomarker Test Result, Harare and Bulawayo Zimbabwe, 2019.

	HBV-Positive (N = 33)			HBV-Negative (N = 306)			p-value
	Count	Column N%	Row N%	Count	Column N%	Row N%	
Aware of HIV-positive status[c]							0.06[a]
Yes	20	61 %	13 %	132	43 %	87 %	
No	13	39 %	7 %	174	57 %	93 %	
Ever taken antiretroviral medications (ARV) to treat HIV infection[d]							0.62[b]
Yes	18	90 %	13 %	124	94 %	87 %	
No	2	10 %	20 %	8	6 %	80 %	
Currently taking ARVs[e]							0.62[b]
Yes	18	90 %	13 %	124	94 %	87 %	
No	2	10 %	20 %	8	6 %	80 %	
CD4$^+$ T-cell Count							
<200 cells/mm^3	5	15 %	13 %	35	11 %	88 %	ref
200-349 cells/mm^3	8	24 %	10 %	72	24 %	90 %	0.76[b]
350-499 cells/mm^3	11	33 %	12 %	81	26 %	88 %	1.0[b]
500+ cells/mm^3	9	27 %	7 %	118	39 %	93 %	0.33[b]
Viral Load							0.93[a]
<1,000 copies/mL	20	61 %	10 %	188	61 %	90 %	
≥1,000 copies/mL	13	39 %	10 %	118	39 %	90 %	
HIV Recency Test[f,g,h]							0.09[b]
Long term HIV infection	10	77 %	6 %	161	93 %	94 %	
Recent infection	3	23 %	19 %	13	7 %	91 %	
Age							
18–19	0	0 %	0 %	11	4 %	100 %	ref
20–24	7	21 %	10 %	62	20 %	90 %	0.59[b]
25–29	3	9 %	4 %	77	25 %	96 %	1.0[b]
30–34	9	27 %	13 %	60	20 %	87 %	0.35[b]
35–39	8	24 %	20 %	33	11 %	80 %	0.18[b]
40+	6	18 %	9 %	63	21 %	91 %	0.59[b]
Employment							
Employed full-time, part-time, or self-employed	17	52 %	9 %	179	59 %	91 %	ref
Full-time student	1	3 %	5 %	18	6 %	95 %	1.0[b]
Retired	0	2 %	0 %	2	<1 %	100 %	1.0[b]
Unemployed	15	45 %	12 %	106	35 %	88 %	0.29[a]
Other	0	0 %	0 %	1	<1 %	100 %	1.0[b]
Income earned last month[i,j]							
<USD 51	6	38 %	9 %	58	32 %	91 %	ref
USD 51-100	4	25 %	7 %	56	31 %	93 %	0.75[b]
>USD 100	6	38 %	8 %	67	37 %	92 %	0.81[b]
Highest education attended							
None or Primary	4	12 %	16 %	21	7 %	84 %	ref
Secondary	23	70 %	9 %	222	73 %	91 %	0.29[b]
Tertiary or Vocational	6	18 %	9 %	63	21 %	91 %	0.45[b]
City							0.21[a]
Harare	11	33 %	7 %	137	45 %	93 %	
Bulawayo	22	67 %	12 %	169	55 %	88 %	
KP Group							0.69[a]
MSM	25	76 %	10 %	222	73 %	90 %	
TGW/GQ	8	24 %	9 %	84	27 %	91 %	
Received free condoms, past 12 months							0.13[a]
Yes	28	85 %	11 %	222	73 %	89 %	
No	5	15 %	6 %	84	27 %	94 %	
Received information on condom use and safe sex, past 12 months							0.01[a]
Yes	28	85 %	13 %	188	61 %	87 %	
No	5	15 %	4 %	118	39 %	96 %	
Selling Sex: received money, goods, or services in exchange for sex, past 6 months[k]							0.78[b]
Yes	3	9 %	7 %	38	13 %	93 %	
No	30	91 %	10 %	266	88 %	90 %	
Lifetime number of male anal sex partners							
1–5	11	33 %	8 %	124	41 %	92 %	ref
6–10	8	24 %	11 %	68	22 %	89 %	0.56[a]
11+	14	42 %	11 %	113	37 %	89 %	0.43[a]
Number of male anal or oral sex partners, past 6 months							
0	2	6 %	25 %	6	2 %	75 %	ref
1–5	24	73 %	8 %	259	85 %	92 %	0.15[b]
6–10	4	12 %	16 %	21	7 %	84 %	0.62[b]
11+	3	9 %	14 %	19	6 %	86 %	0.59[b]
Alcohol Dependence (AUDIT score ≥15)[l]							0.40[a]
Yes	11	33 %	12 %	81	26 %	88 %	

(*continued on next page*)

Table 4 (*continued*)

	HBV-Positive (N = 33)			HBV-Negative (N = 306)			p-value
	Count	Column N%	Row N%	Count	Column N%	Row N%	
No	22	67 %	9 %	225	74 %	91 %	
Injection drug use, lifetime							1.0[b]
Yes	0	0 %	0 %	4	1 %	100 %	
No	33	100 %	9 %	302	99 %	91 %	
Network Size: number of men or TGW you know who have sex with other men/TGW							
0–8	5	15 %	7 %	63	21 %	93 %	ref
9–18	5	15 %	8 %	56	18 %	92 %	1.0[b]
19–50	9	27 %	8 %	97	32 %	92 %	0.79[b]
51+	14	42 %	13 %	90	29 %	87 %	0.21[b]
Syphilis infection[m]							
Active infection	3	9 %	8 %	33	11 %	92 %	1.0[b]
Previous infection	4	12 %	14 %	24	8 %	86 %	0.50[b]
Negative	26	79 %	10 %	244	81 %	90 %	ref
Circumcised							0.89[a]
Yes	8	24 %	10 %	71	23 %	90 %	
No	25	76 %	10 %	235	77 %	90 %	
Diagnosed with STI in the past 12 months, other than HIV							0.59[b]
Yes	5	15 %	12 %	38	12 %	88 %	
No	28	85 %	9 %	268	88 %	91 %	
One or more STI symptoms, past 12 months							0.28[a]
Yes	5	15 %	6 %	72	24 %	94 %	
No	28	85 %	11 %	234	76 %	89 %	
Likely presence of a major depressive disorder[n]							1.0[b]
Yes	3	9 %	8 %	34	11 %	92 %	
No	30	91 %	10 %	272	89 %	90 %	
Type of anal sex with main male partner at last sex[o]							
Receptive	9	29 %	7 %	129	43 %	93 %	ref
Insertive	20	65 %	14 %	125	42 %	86 %	0.04[a]
Both	2	6 %	4 %	46	15 %	96 %	0.73[b]
Engaged in condomless receptive anal intercourse at last sex, past 6 months (main male partner)[p]							0.12[a]
Yes	3	10 %	4 %	64	21 %	96 %	
No	28	90 %	11 %	236	79 %	89 %	
Condom use at last sex with main male partner[q]							0.28[a]
Yes	22	71 %	11 %	183	61 %	89 %	
No	9	29 %	7 %	117	39 %	93 %	
Condom use with main male partner, past 6 months[r]							
Always/Most of the time	16	50 %	9 %	159	52 %	91 %	0.57[a]
Sometimes/Rarely	11	34 %	13 %	77	25 %	88 %	0.24[a]
Never	5	16 %	7 %	67	22 %	93 %	ref
Condom use at last sex with main transgender female partner?[s]							1.0[b]
Yes	3	75 %	27 %	8	89 %	73 %	
No	1	25 %	50 %	1	11 %	50 %	

HBV, hepatitis B virus; MSM: men who have sex with men; TGW/GQ: transgender women/genderqueer.
Some variables do not add up to the total number because of skip patterns (ie, based on the answer to a parent question, subsequent questions might or might not be asked), missing data, participants not knowing the answer to the question, or participants refusing to answer.
Some percentages might not sum to 100 % due to rounding differences.

[a] Chi-square.
[b] Fisher's Exact test.
[c] Of those who previously tested for HIV.
[d] Of those who previously tested for HIV and self-reported being HIV-positive.
[e] Of those who previously tested for HIV and self-reported being HIV-positive.
[f] Of those who self-reported a new HIV infection.
[g] Rapid test results from the Asante HIV-1 Rapid Recency Assay excluding viral load confirmatory testing.
[h] n = 1 Inconclusive.
[i] Question not asked to students or unemployed participants.
[j] n = 2 don't know/refused to answer.
[k] n = 2 don't know/refused to answer.
[l] Using the Alcohol Use Disorders Identification Test (AUDIT).
[m] n = 5 inconclusive test result.
[n] Based on a score ≥3 on the Patient Health Questionnaire-2 (PHQ2).
[o] Of those reporting anal sex with a main male partner in the past 6 months and not responding don't know/refused to answer.
[p] Of those reporting anal sex with a main male partner in the past 6 months.
[q] n = 7 never had anal sex with this partner/don't know/refused to answer.
[r] n = 3 don't know/refused to answer.
[s] Of those reporting having had sex with a transgender female partner in the last 6 months.

among participants reporting 1–5 lifetime male anal sex partners versus 11+ partners as younger persons aged 18–29 reported having proportionately fewer sexual partners than older individuals aged 30 and over (data not shown).

While HBV infection was significantly lower among participants who did not receive information on condom use and safe sex compared to those who did, we do not think receiving information on condom use and safe sex is a risk factor for HBV infection. This association is potentially a byproduct of the fact that people who engage in, or have previously engaged in, risk behaviours that may lead to HBV infection (i.e., unprotected sexual intercourse and sexual activities with multiple partners) may be more likely to visit sexual health clinics, get tested for STIs, and receive information on condom use and other protective sexual practices.

Our survey has a few limitations. First, despite having a relatively large overall sample size (n = 1,510), we could not conduct multivariable regression to adjust for additional variables due to the small number of individuals who tested positive for HBV infection (n = 58). In particular, there were only two HBV-positive TGW/GQ in Bulawayo, which hindered our ability to conduct stratified analysis by KP status, city, or other variables. Second, we only tested for hepatitis B surface antigen (HBsAg) and did not conduct antibody testing, therefore we were unable to distinguish between chronic or acute HBV infection. However, survey participants likely had chronic infections as acute infections last for <6 months and the virus is usually cleared by the body naturally among people infected as adults. The BBS did not collect information on HBV vaccination status, hence, it is impossible to know whether participants had been vaccinated against HBV. However, given it is a childhood vaccination and requires multiple doses, participants may not have been able to report on it reliably. Further, among participants with HIV who reported ever taking ARV, we did not specifically ask about their ARV drug combination so it is possible that some participants' ARV could contain tenofovir disoproxil fumarate (TDF) or emtricitabine (FTC) which are also used to treat HBV and could affect HBV infection status. Our survey also relied on self-reported information for many factors which could be a source of measurement error. While participant identities were kept anonymous, some participants may have also felt uncomfortable revealing sensitive information due to social stigmatization. Finally, while Harare and Bulawayo are the two largest cities in Zimbabwe and we recruited a large sample using RDS, lack of convergence on key indicators when applying weights prevented us from standardizing to the population of all MSM and TGW/GQ in Harare and Bulawayo, therefore our findings are not generalizable and do not apply to all MSM and TGW/GQ in Zimbabwe.

This BBS also has several strengths. To our knowledge, this is the first survey published in a peer-reviewed journal to estimate HBV infection or HIV-HBV coinfection among MSM or TGW/GQ in Zimbabwe and the first published survey to provide a separate estimate for the prevalence of HBV among TGW/GQ in Africa [6]. Moreover, our survey had a larger overall sample size (n = 1510) than many similar studies that have reported the prevalence of HBV among MSM individuals in Africa. By using biomarker testing rather than relying on self-reported status, we obtained accurate HBV and HIV diagnoses for all participants in our survey. Given the lack of HBV and HIV data among TGW/GQ in Africa, further research among this key population is warranted to better quantify the prevalence of HBV and HIV and identify ways to link TGW/GQ with appropriate health services.

This BBS provides encouraging data that the overall prevalence of HBV among MSM and TGW/GQ in Zimbabwe is lower than previous estimates from the general population in Zimbabwe. Still, scaled up screening, care, and treatment services for HBV infection, particularly among MSM and TGW/GQ living with HIV, could be beneficial to further slow HBV transmission. There is a critical need to expand HBV screening and testing services in Zimbabwe overall [14], and these results underscore that need, especially to reach individuals coinfected with HIV-HBV. Finally, results from our survey could provide valuable information to the Zimbabwe Ministry of Health and Child Care as they develop future national guidelines and implementation plans for preventing and eliminating HBV nationally and among key populations.

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Ethical approval statement

Our survey was approved by the Columbia University Institutional Review Board (IRB-AAAR89500) and the Medical Research Council of Zimbabwe (MRCZ/A/2156). It was also reviewed per the US Centers for Disease Control and Prevention (CDC CGH HSR tracking # 2018-444) human research protection procedures and was determined to be research, though CDC investigators did not interact with human participants or have access to identifiable data or specimens for research purposes. All project staff were experienced in conducting similar surveys, trained in Good Clinical Practices and signed a confidentiality agreement. No personal identifying information was recorded as part of the questionnaire. Contact information was obtained from consenting participants with positive test results to facilitate referral follow-up. Regardless of test results or reported experiences, all participants were provided with a list of health and social services available in their area.

Data availability statement

Given the sensitivity of the data due to the social and legal context, deidentified participant data along with supporting documentation (survey protocol, data dictionary) are available upon request from the last author (TGH) pending appropriate Institutional Review Board and institutional (ICAP at Columbia University, Zimbabwean Ministry of Health and Child Care, and CDC) leadership approval.

CRediT authorship contribution statement

Robin W.B. Breen: Writing – review & editing, Writing – original draft, Formal analysis. **Lauren E. Parmley:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Munyaradzi P. Mapingure:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Innocent Chingombe:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Owen Mugurungi:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Godfrey Musuka:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Avi J. Hakim:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **John H. Rogers:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Brian Moyo:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Chesterfield Samba:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Sophia S. Miller:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Matthew R. Lamb:** Writing – review & editing, Formal analysis. **Tiffany G. Harris:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e25790.

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