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ORIGINAL RESEARCH

Hepatitis B and Hepatitis C Viral Infections and Associated Factors Among Prisoners in Northeast Ethiopia

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Background: Hepatitis is an inflammation of the liver and often caused by viruses. Hepatitis viruses are the leading causes of liver-related morbidity and mortality worldwide, with Hepatitis B and C viruses share the great majority. Studies have shown that prison settings are one of the high-risk environments for the transmission of these viruses. However, there is limited information on the seroprevalence and associated factors of hepatitis B and C viral infection among Ethiopian prisoners.

Methods: A facility-based cross-sectional study was conducted among 339 prisoners in Dessie town, Ethiopia from February to April 2020. Hepatitis B surface antigen and antibody against hepatitis C virus in serum were determined using Enzyme-Linked Immunosorbent Assay. We imputed the data using "EpiData 3.1" software and exported it to Statistical Package for Social Sciences version 20.0 for analysis, and a p-value of <0.05 was considered statistically significant.

Results: The overall seroprevalence of hepatitis B surface antigen and anti-hepatitis C virus among prisoners was 22/339 (6.5%) (95% CI = 3.8–9.4), and 4/339 (1.2%) (95% CI = 0.0–2.4), respectively. Multiple sexual partners, previous imprisonment, body tattooing, and contact with the jaundiced patient were independently associated with hepatitis B virus infection. Prisoners who had a history of blood transfusion, and dental extraction were independently associated with hepatitis C virus infection.

Conclusion: The seroprevalence of hepatitis B and hepatitis C viral infection among Dessie town prisoners was intermediate and low, respectively. The finding of a significant association between the presence of Hepatitis B surface antigen and hepatitis C virus antibodies among prisoners and factors calls for the need of serological testing for both Hepatitis B and C viruses to high-risk individuals. Strengthening screening strategies and prevention programs in prison settings is advisable to prevent disease transmission.

Keywords: hepatitis B virus, hepatitis C virus, prison, associated factors, Ethiopia

Background

Viral hepatitis is considered a significant public health problem worldwide;[1] it is responsible for the deaths of approximately 1.4 million people per year. Of those deaths, ~96% are attributable to the Hepatitis B virus (HBV) and Hepatitis C virus (HCV) infection.[1,2] Hepatitis B virus, along with HCV, accounts for 60% of cirrhosis and 80% of hepatocellular carcinoma (HCC) and causes one million deaths each year around the globe. Worldwide, an estimated 71 million people (African region accounts for 11 million) are living with chronic HCV infection,

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with a seroprevalence of between 2% - 3%.[1–3] Hepatitis C virus can cause both acute and chronic infection and is a major cause of liver cancer.[4] Globally, HCV accounts for an estimated 28% and 26% of cases of cirrhosis and HCC, respectively.[5,6]

Even though there are effective vaccine and antiviral therapies for HBV infection that makes the elimination of HBV possible, there is a lot to do, especially in low-income countries.[7] In the case of HCV, in addition to the absence of an effective vaccine, the presence of diversified genotypes, drug-resistant variants, occult HCV infection, and other cost and awareness-related factors make its elimination difficult.[8,9] For the elimination of HBV and HCV to be possible, working hard on awareness creation, testing, and vaccinating people in high-risk groups, including people in prisons and those who are intravenous drug users is mandatory.[8–11]

Insufficient infection control, poor medical diagnosis, inaccessible to treatment, and the absence of harm reduction practice in prisons make prisoners exposed to various infectious diseases.[12–14] As a result, prisoners are considered as one of the high-risk group populations and are the focus of many researchers across the world.[12,15–21] Since sharing needles and sharp materials is common in the prison setting, the incidence of HCV infection is expected to be high in these populations.[22] Furthermore, different studies documented that the prevalence of HCV and HBV infection among prisoners is much higher than that of the general population.[13,23–25]

Worldwide, more than 10.74 million people are incarcerated in penal institutions. In Africa, Ethiopia has the second-highest number of prisoners. According to the 12th edition of the world prison population list, in 2018, there were 113,727 prisons distributed across Ethiopia.[26] In Ethiopia, studies conducted on HBV[27,28] and HCV[27] infection among prisoners are limited to a few reports. We believed that investigating the seroprevalence of HBV and HCV among prisoners is relevant to public health for maintaining the chain of infection transmission. Therefore, this study aimed to determine the prevalence and associated factors of HBV and HCV infections among prisoners in Dessie town.

Methods

Study Design and Setting

A facility-based cross-sectional study was conducted among prisoners in Dessie town from February to April 2020. Dessie town is located at South Wollo Zone of Amhara Regional State, 401 km north of the capital city, Addis Ababa. Based on the information from the Dessie Prison Administration Office, during the data collection period, there were about 1350 detainees at the prison center. The prison has a clinic with six health professionals delivering healthcare service to the prisons. A total of 339 prisoners were tested for HBsAg and HCV antibody.

Sample Size and Sampling Technique

We calculated the sample size for this study using a single population proportion formula[29] ($n = \left(Z_{a/2}\right)^2 XP(1-P)d^2$) for estimation of prevalence based on a 10.4% prevalence of HBV infection among prisoners.[28] The 10.4% prevalence provided us with the larger sample size (n = 398) at 95% CI, 3% margin of error (d) and 10% non-response rate. Since the number of prisoners in the Dessie prison center (N = 1350) was less than 10,000, we used a correction formula ($nf = \frac{n}{1+\frac{n}{N}}$) and got a final sample size of 339. Study participants were selected using the systematic random sampling technique, where after the first participant was selected using the lottery method, we selected other participants at a regular interval.[30]

Study Variables

The presence of HBsAg and anti-HCV was the outcome variable while socio-demographic characteristics, type of crime, current duration of stay in prison, number of sexual partners, history of blood transfusion, history of operation, dental extraction, sharing of sharp materials in prison, injectable drug use (IDU), tattooing practice or ear-piercing, and history of sexually transmitted diseases (STDs) were the predictor variables.

Definitions

Hepatitis B infection is diagnosed when HBsAg in the serum sample is detected using a serological test.[10]

Hepatitis C infection is diagnosed when anti-HCV antibodies in the serum sample are detected using serological tests.[11]

Data Collection and Laboratory methods

Data Collection

Data including socio-demographic characteristics and associated factors or history of high-risk behaviors were collected using a structured questionnaire. The

questionnaire was completed by trained data collectors who can speak and write the local language and under the supervision of the principal investigator.

Specimen Collection and Processing

Trained laboratory technologist collected five milliliters of venous blood with a plain tube from each study participant. The blood sample was allowed to clot at room temperature and centrifuged at 5000 rpm for 15 minutes, and then the serum separated. We transported the serum sample to the Ethiopian Red Cross Society Blood Bank of Dessie branch by using a cold box and stored it at −20°C until tested.[27]

Laboratory Methods

We tested the serum specimen for HBsAg and anti-HCV using the Beijing Wantai's enzyme-linked immune sorbent assay (ELISA) test kits, developed by Wantai Biological Pharmacy Enterprise Co., Ltd. Wantai AiD^{TM} HBsAg ELISA test kit with a sensitivity of 100% and specificity of 99.92% and Wantai AiD^{TM} anti-HCV ELISA test kit with a sensitivity of 100% and specificity of 99.55% were used to test the presence of HBsAg and HCV antibodies in the serum, respectively.

Quality Control

A pre-tested and structured questionnaire was used to collect the data. Furthermore, the quality of data was also maintained by providing training for data collectors and conducting regular supervision. Standard operating procedures of sample collection and laboratory work were strictly followed.

Data Analysis

The collected data was entered into EpiData 3.1 software then exported to SPSS version 20.0 (SPSS, Chicago, IL, USA) for analysis. A descriptive and inferential statistics is used to present findings. Variables that show a *p*-value of <0.2 during univariate analysis were selected for multivariable analysis. Adjusted odds ratios (AOR) and their 95% confidence intervals (CIs) were used as indicators of the strength of association. A *p*-value <0.05 was used to indicate statistical significance. We have used previously defined endemicity levels to report the prevalence of HBV and HCV infection. The prevalence of HBsAg has been categorized as low (<2%), intermediate (2–8%), and high (>8%),[31] and the prevalence of anti-HCV antibodies as high (>3.5%), moderate (1.5–3.5%), and low (<1.5%).[32]

Results

A total of 339 prisoners have participated in our study, with the mean age of 34 (± 13.2) years, ranged from 18 to 83 years. Above eighty-nine percent (89.4%) of the prisoners were male, 54.6% were from urban areas, and 49.3% were single (Table 1).

Prevalence

The seroprevalence of HBV infection was 22/339 (6.5%). More than half of the participants tested positive were age greater than 44. A relatively higher prevalence of HBsAg 18/154 (11.7%) was observed among rural dweller prisoners. The difference in seroprevalence of HBV among age groups, marital statuses, residences, and educational statuses of the prisoners was significant (*p*-value <0.05). The overall seroprevalence of HCV infections was 1.2% (4/339). The Fisher's exact test showed that none of the sociodemographic characteristics of the prisoners were associated with the presence of HCV antibody (*p*-value >0.05) (Table 1).

History of the Prisoners

The mean duration of stay in prison was 3.5 ± 3.2 years, with a range of 1 month to 13 years. One hundred twenty-four (36.6%) participants had a history of the previous imprisonment and are more likely to be positive for HBsAg (*p*-value <0.001). One hundred forty-three 143 (42.2%) and 191 (56.3%) of the prisoners had a history of multiple sexual partner and tattooing, respectively. The presence of antibody to HCV was significantly higher among prisoners with a history of blood transfusion (*p*-value = 0.010), history of operation (*p*-value = 0.023), and history of dental extraction (*p*-value = 0.004) (Table 2).

Associated Factors of HBV and HCV Infections

In multivariate analysis, individuals with age >44 years, rural residence, history of multiple sexual partners, previous imprisonment, body tattooing, and contact with jaundiced patients were significantly associated with the presence of HBsAg in the prisoners (*p*-value <0.05) (Table 3). Seroprevalence of HCV was significantly higher among prisoners with a history of blood transfusion (*p*-value = 0.008) and dental extraction (*p*-value = 0.003) (Table 4).

Discussion

People detained in prisons are at a higher risk of being infected with different infectious agents, including

Table 1 Socio-Demographic Characteristics of Prisoners in Dessie, Northeast Ethiopia (N=339)

Variables	Category	Frequency: N^{O} (%)	HBsAg (22/339)		Fisher's Exact Test (p-value)	Anti-HCV (4/339)		Fisher's Exact Test (p-value)
			Positive: N^{O} (%)	Negative: N^{O} (%)		Positive: N^{O} (%)	Negative: N^{O} (%)	
Gender	Male	303 (89.4)	21 (6.9)	282 (93.1)	0.490	4 (1.3)	299 (98.7)	1.000
	Female	36 (10.6)	1 (2.7)	35 (97.3)		0	36 (100)	
Age (years)	18–24	82 (24.2)	1 (1.2)	81 (98.8)	0.003*	2 (2.4)	80 (97.6)	0.548
	25–34	126 (37.2)	7 (5.5)	119 (94.5)		2 (1.8)	124 (98.4)	
	35–44	64 (18.8)	3 (4.7)	61 (95.3)		0	64 (100)	
	≥45	67 (19.8)	11 (16.4)	56 (83.5)		0	67 (100)	
Marital status	Married	134 (39.5)	2 (1.5)	132 (98.5)	0.002*	1 (0.7)	133 (99.3)	0.583
	Single	167 (49.3)	18 (10.8)	149 (89.2)		2 (1.2)	165 (98.8)	
	Divorced/ Widow	38 (11.2)	2 (5.26)	36 (94.74)		1 (2.63)	37 (97.37)	
Residence	Rural	154 (45.4)	18 (11.7)	136 (88.3)	0.001*	2 (1.2)	152 (98.7)	1.000
	Urban	185 (54.6)	4 (2.1)	181 (97.8)		2 (1.1)	183 (98.9)	
Education status	Unable to read and write	78 (23.0)	12 (15.4)	66 (84.6)	0.009*	1 (1.3)	77 (98.7)	0.644
	Primary school	129 (38.1)	6 (4.7)	123 (95.3)		1 (0.8)	128 (99.2)	
	Secondary school	77 (22.7)	2 (2.6)	75 (97.4)		2 (2.6)	75 (97.4)	
	College/University	55 (16.2)	2 (3.6)	53 (96.4)		0	55 (100)	
Occupational status	Farmer	101 (29.8)	7 (6.9)	94 (93.1)	0.311	0	101 (100)	0.090
	Daily laborer	58 (17.1)	6 (10.3)	52 (89.7)		2 (3.4)	56 (96.6)	
	Governmental employee	76 (22.4)	3 (3.9)	73 (96.1)		0	76 (100)	
	Unemployed	40 (11.8)	4 (10.0)	36 (90.0)		0	40 (100)	
	Student	53 (15.6)	1 (1.9)	52 (98.1)		2 (3.8)	51 (96.2)	
	Housewife	11 (3.2)	1 (9.1)	10 (90.9)		0	11 (100)	

Notes: *The observed difference is statistically significant ($p < 0.05$).
Abbreviations: HBsAg, hepatitis B surface antigen; Anti-HCV, anti- hepatitis C virus antibodies.

hepatitis-causing viruses; they can be a reservoir of these agents and a source of infection within the community.[14,33] In the prison setting, HBV and HCV can be easily transmitted within inmates because of overcrowded conditions, injecting drug use practices, or sharing blood contaminated supplies (syringes, needles, scissors, or razors).

Prevalence of HBsAg

In the present study, the prevalence of HBsAg among prisoners was 6.5% (95% CI = 3.8–9.4); can be categorized as intermediate.[31] This result is in line with studies in Jimma, Ethiopia (5.8%),[27] India (3.89%),[34] Switzerland (5.9%),[35] and Iran (6.9%).[36] The prevalence in the present study is lower than studies conducted in Woldia prison, Ethiopia 10.4%,[28] West Africa 12.5%,[37] Nigeria 13.7%,[38] and Iran 18%.[39] However, it was higher than the result reported from Mexico (0.4%)[40] and Iran (3.3%).[41] The discrepancy might be due to variation in geographical regions, time of study period, diagnostic methodology, types of risk exposure, the immunization status of the population, behavioral differences for the potential risk factors of HBV infection, and sample size. It may also be due to variation in circulating genotypes, which is responsible for disease severity as well as treatment responses.[42]

Prevalence of anti-HCV

This study has found a 1.2% (95% CI = 0.0–2.4) prevalence of anti-HCV antibodies, and can be reported as very low, considering the prison population.[32] Our finding is in agreement with results reported in India (1.27%),[34] West Africa (0.5%),[37] and Turkey (0.5%)[17] but lower than results in Jimma (2.6%), Ethiopia.[27] Higher prevalence of HCV infection was reported in United States

Table 2 Prison History and Risk Behaviors of Prisoners in Dessie, Northeast Ethiopia (N=339)

Variables	Category	Frequency: N^{O} (%)	HBsAg (22/339)		Fisher's Exact Test p-value	Anti-HCV (4/339)		Fisher's Exact Test p-value
			Positive: N^{O} (%)	Negative: N^{O} (%)		Positive: N^{O} (%)	Negative: N^{O} (%)	
Duration spent	<1year 1–3 years >3 years	112 (33) 90 (26.5) 137 (40.5)	9 (8.0) 2 (2.2) 11 (8.0)	103 (92.0) 88 (97.8) 126 (92.0)	0.138	2 (1.8) 1 (1.1) 1 (0.7)	110 (98.2) 89 (98.9) 136 (99.3)	0.826
History of previous imprisonment	Yes No	124 (36.6) 215 (63.4)	17 (13.7) 5 (2.3)	107 (86.3) 210 (97.7)	<0.001*	2 (1.6) 2 (0.9)	122 (98.4) 213 (99.1)	0.625
Multiple sexual partner	Yes No	143 (42.2) 196 (57.8)	18 (12.6) 4 (2.0)	125 (87.4) 192 (98.0)	<0.001*	1 (0.7) 3 (1.53)	142 (99.3) 193 (98.47)	0.641
History of sexually transmitted disease	Yes No	124 (36.6) 215 (63.4)	7 (5.64) 15 (6.97)	117 (94.36) 200 (93.03)	0.820	0 4 (1.86)	124 (100) 211 (98.14)	0.301
History of blood transfusion	Yes No	48 (14.2) 291 (85.8)	4 (8.33) 18 (6.18)	44 (91.67) 273 (93.82)	0.532	3 (6.25) 1 (0.34)	45 (93.75) 290 (99.66)	0.010*
History of surgical procedures	Yes No	65 (19.2) 274 (80.8)	6 (9.23) 16 (5.84)	59 (90.77) 258 (94.16)	0.398	3 (4.62) 1 (0.36)	62 (95.38) 273 (99.64)	0.023*
History of sharing sharp materials	Yes No	74 (21.8) 265 (78.2)	8 (10.8) 14 (5.28)	66 (89.2) 251 (94.72)	0.108	2 (2.7) 2(0.75)	72 (97.3) 263 (99.25)	0.209
Injectable drug use	Yes No	13 (3.8) 326 (96.2)	1 (7.7) 21 (6.44)	12 (92.3) 305 (93.56)	0.589	0 4 (1.23)	13 (100) 322 (98.77)	1.000
Tattooing	Yes No	191 (56.3) 148 (43.7)	20 (10.47) 2 (1.35)	171 (89.53) 146 (98.65)	0.001*	3 (1.57) 1 (0.67)	188 (98.43) 147 (99.33)	0.635
Ear/ nose piercing	Yes No	90 (26.5) 249 (73.5)	8 (8.9) 14 (5.62)	82 (91.1) 235 (94.38)	0.319	0 4 (1.6)	90 (100) 245 (98.4)	0.577
Homosexual	Yes No	7 (2.1) 332 (97.9)	1 (14.3) 21 (6.33)	6 (85.7) 311 (93.67)	0.378	0 4 (1.2)	7 (100) 328 (98.8)	1.000
History of dental extraction	Yes No	35 (10.3) 304 (89.7)	4 (11.43) 18 (5.9)	31 (88.57) 286 (94.1)	0.264	3 (8.57) 1 (0.33)	32 (91.43) 303 (99.67)	0.004*
Contact with jaundiced patient	Yes No	179 (52.8) 160 (47.2)	16 (8.9) 6 (3.75)	163 (91.1) 154 (96.25)	0.076	3 (1.68) 1 (0.63)	176 (98.32) 159 (99.37)	0.625

Note: *The observed difference is statistically significant ($p < 0.05$).
Abbreviations: HBsAg, hepatitis B surface antigen; Anti-HCV, anti- hepatitis C virus antibodies.

(10.1%),[43] Iranian (national data, 2015) (9.48%)[44] and Brazilian (5.3%)[19] prisoners. This noticeable difference could be due to the higher number of subjects who use injectable drugs (eg, injectable drug users among Iranian prisoners were reported as 17%, while in our case, they accounted 3.8%) and homosexuals reported in the above studies. In Ethiopia, IDU and homosexuality may be under-reported or practiced at a very minimal level since they are not acceptable by the community and by law.[45–47] The difference in the number of participants (sample size) can also impact the prevalence estimation.

Associated Factors for HBV Infection

In the current study, being over 44 years of age was significantly associated with the presence of HBsAg, a finding that was in line with a report from another study.[16] The reason for this association may be a proxy for lifetime exposure, indicating that, over time, there is a high risk of HBV infection linked to sexual activity and percutaneous exposures. There was a higher seroprevalence of HBsAg among rural dweller prisoners. This finding was in agreement with a previous study conducted in Nigeria.[48] The reasons for high seroprevalence in rural

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Table 3 Bivariate and Multivariate Analysis of Risk Factors for HBV Infection Among Prisoners in Dessie, Northeast Ethiopia (N=339)

Variables	Categories	HBsAg		COR (95% CI)	p-value	AOR (95% CI)	p-value
		Positive: N^{O} (%)	Negative: N^{O} (%)				
Age	18–24	1 (1.2)	81 (98.8)	1		1	
	25–34	7 (5.5)	119 (94.5)	4.76 (0.57–39.46)	0.15	2.26 (0.19–26.06)	0.51
	35–44	3 (4.7)	61 (95.3)	3.98 (0.40–39.2)	0.23	5.19 (0.38–70.997)	0.21
	≥45	11 (16.4)	56 (83.5)	15.9 (1.99–26.75	0.009	18.7 (1.73–20.37)	0.016*
Educational level	Not read & write	12 (15.4)	66 (84.6)	4.08 (1.03–22.47)	0.045	3.29 (0.35–30.88)	0.29
	Primary school	6 (4.7)	123 (95.3)	1.29 (0.257–6.61)	0.758	1.2 (0.122–12.27)	0.86
	Secondary school	2 (2.6)	75 (97.4)	0.7 (0.096–5.176)	0.73	0.4 (0.02–5.67)	0.50
	College/University	2 (3.6)	53 (96.4)	1		1	
Residence	Rural	18 (11.7)	136 (88.3)	4.47 (1.60–12.4)	0.004	8.51 (2.00–36.12)	0.004*
	Urban	4 (2.1)	181 (97.8)	1		1	
Number of sexual partners	1	3 (2.7)	110 (97.3)	2.23 (0.22–21.8)	0.48	0.81 (0.06–11.09)	0.879
	≥2	18 (12.6)	125 (87.4)	11.8 (1.54–90.16)	0.02	8.65 (1.79–93.8)	0.026*
	0	1 (1.2)	82 (98.8)	1		1	
History of previous imprisonment	Yes	17 (13.7)	107 (86.3)	6.67 (2.39–18.5)	0.00	7.15 (1.91–26.7)	0.003*
	No	5 (2.3)	210 (97.7)	1		1	
Tattooing	Yes	20 (10.5)	171 (89.5)	8.53 (1.96–37.14)	0.004	15.03 (1.68–134.3)	0.015*
	No	2 (1.4)	146 (98.6)	1		1	
History of sharing sharp materials	Yes	8 (11.0)	66 (89.0)	2.20 (0.88–5.4)	0.08	2.93 (0.77–11.1)	0.11
	No	14 (5.3)	251 (94.7)	1		1	
History of dental extraction	Yes	6 (4.8)	118 (95.2)	2.05 (0.65–6.44)	0.01	1.09 (0.20–5.85)	0.91
	No	16 (7.4)	199 (92.6)	1		1	
Contact with jaundiced patient	Yes	16 (8.9)	163 (91.1)	3.02 (1.08–8.45)	0.03	4.35 (1.14–16.5)	0.03*
	No	6 (3.1)	154 (96.9)	1		1	

Note: *The observed difference is statistically significant ($p < 0.05$).

Abbreviations: HBsAg, hepatitis B surface antigen; COR, crude odds ratio; AOR, adjusted odds ratio.

Table 4 Bivariate and Multivariate Analysis of Risk Factors for HCV Infection Among Prisoners in Dessie, Northeast Ethiopia (N=339)

Variables		Anti-HCV		COR (95% CI)	AOR (95% CI)	p-value
		Positive: N^{O}_ (%)	Negative: N^{O}_ (%)			
History of blood transfusion	Yes	3(6.3)	45(93.8)	19.33(1.96–189.93)	27.63(2.34–325.59)	0.008*
	No	1(0.3)	290(99.7)	1	1	
History of operation	Yes	3(4.6)	62(95.4)	13.21(1.35–129.135)	5.68(0.41–78.59)	0.19
	No	1(0.4)	273(99.6)	1	1	
Sharing of sharp material	Yes	2(2.7)	72(97.3)	3.70(0.51–26.75)	7.07(0.05–10.05)	0.843
	No	2(0.8)	263(99.2)	1	1	
History of dental extraction	Yes	3(2.4)	121(97.6)	28.4(2.87–281.15)	39.94(3.40–68.58)	0.003*
	No	1(0.5)	214(99.5)	1	1	

Notes: *The observed difference is statistically significant ($p < 0.05$).
Abbreviations: Anti-HCV, anti- hepatitis C virus antibodies; COR, crude odds ratio; AOR, adjusted odds ratio

dwellers might be due to low economic status, low educational level, inability to obtain healthcare information from the media, or limited access to medical care than urban dwellers.[49,50]

In this study, the history of imprisonment had a significant association with the presence of HBsAg (AOR = 7.15, 95% CI: 1.91–26.7) and this result is supported by studies among prisoners in Iran.[39,44] Several risk factors act together with the crowded prison condition may facilitate the transmission of this virus. Prisoners having multiple sexual partners had about 8.6 times higher HBsAg in their serum compared to their counterparts. It is consistent with the reports of the study conducted among prisoners in Jimma, Ethiopia[27] and Indonesia.[51] The high seroprevalence rate among promiscuous prisoners may be the fact that HBV is sexually transmitted, and the transmission rises with the duration of sexual activity and the number of sexual partners. Tattooing is also significantly associated with the presence of HBsAg among prisoners. A high proportion of the inmates (56.3%) are practicing tattooing while incarcerated. Similar findings were reported from Mexico[40] and Indonesia.[51] The high prevalence rate among tattooed prisoners may be due to the sharing and reuse of instruments among inmates.

Associated Factors for HCV Infection

In our study, all the socio-demographic characteristics of the participants were not significantly associated with the presence of HCV antibody. In contrast, studies by Kinner et al., 2017,[52] Soholm et al., 2019,[53] and Miller et al.[20] reported that the prevalence was higher among older prisoners. Increased exposure to the risk of infection at the prison and the high probability of the presence of irreversible HCV seroconversion may explain higher prevalence in older age groups. In terms of sex, some studies also reported a higher prevalence among female prisoners than males. Intravenous drug use (IDU) is reported as the main risk factor for HCV infection in prison settings, where widespread sharing of contaminated equipment is prevalent. According to a WHO report, most HCV infections (67%) are related to IDU practices.[1] Studies such as Zampino et al.,[33] Soholm et al.,[53] Puga et al.,[54] Guimaraes et al.,[55] and Bahzadifar et al.[15] reported that a history of IDU was a risk factor for HCV infection. In our study, we reported that prisoners use injecting drugs for medical purposes only, which was administered by health professionals, but not for other purposes. Since illegal use of intravenous drugs is not widely and openly practiced in Ethiopia, especially in the study area, the seroprevalence of HCV infection is expected to be lower than results from other countries where intravenous drug use is prevalent.

The finding of greater HCV antibody prevalence in prisoners with blood transfusion is consistent with the study from Jimma.[27] The possible explanation for a significant association between HCV infection and blood transfusion might be the lack of improved laboratory screening methods of HCV infection from blood donors before transfusion. The seroprevalence of HCV was higher in participants with a history of dental extraction is supported by a study conducted among prisoners in Egypt.[16] The possible reason may be due to traditional tooth extraction practices,[56] shortage of electricity, dental equipment

spare parts, or trained healthcare workers in health institutions of the developing world, which hinders the proper decontamination or sterilization techniques.[57]

Limitation

This research article is limited in assessing anti-HBcAg. Since individuals having infection prior to six months may not be positive for HBsAg (resolution of infection), the prevalence of HBV infection might be underestimated. Furthermore, due to availability and financial reasons, HCV-RNA could not be measured, which is a more specific test for infectious individuals.

Conclusion

In Ethiopia, it was reported that awareness of hepatitis virus disease, complications, transmission, control, prevention, and treatment options were poor. Furthermore, screening for viral hepatitis was not widely practiced, and diagnosed patients were not receiving available treatments.[58] We reported an intermediate seroprevalence rate of HBV infection among prisoners and is associated with high-risk behavior, including history of multiple sexual partners, previous imprisonment, body tattooing, and contact with the jaundiced patient. Although many studies classified prison settings as a high-risk environment for HCV infection, we reported a lower prevalence of HCV antibodies among them. However, higher prevalence of HCV antibodies among prisoners with a history of blood transfusion and dental extraction calls for the need for serological testing. The regional health bureau, the prison authorities, and healthcare workers are expected to deliver health education on the reduction of high-risk behaviors, mode of HBV and HCV transmission, and control and prevention mechanisms to prisoners.

Abbreviations

ELISA, Enzyme Linked Immunosorbent Assay; HBsAg, Hepatitis B Surface Antigen; HBV, Hepatitis B Virus; HCV, Hepatitis C virus; HCC, Hepatocellular Carcinoma; IDU, Injection drug use; STD, Sexually Transmitted Disease; WHO, World Health Organization.

Data Sharing Statement

The datasets used and/or analyzed during the study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the research and Ethical Review Committee of the School of Biomedical and Laboratory Sciences, College of Medicine and Health Sciences, University of Gondar and a formal letter was obtained. Official permission also obtained from Dessie town prison Administration Office after explaining the aim of the study. In addition to that, following an explanation of the purpose of the study, written informed consent was obtained from study participant and/or their guardian officers before data collection. Furthermore, the study was conducted in accordance with the declaration of Helsinki (59). Personal identifiers were not used, and data were retrieved only for the study purpose to ensure confidentiality. Finally, prisoners who are positive for HBsAg and anti-HCV was linked to prison physicians for further investigation and treatment.

Consent for Publication

Each study participant was informed and signed for publication.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no competing interests in this work.

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