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## Seroprevalence and risk factors of hepatitis B, hepatitis C and HIV infections among prisoners in Jimma Town, Southwest Ethiopia

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### ABSTRACT

**Objective:** To determine the prevalence and risk factors of hepatitis B virus (HBV), hepatitis C virus (HCV) and HIV infections among prisoners in Jimma Town, Southwest Ethiopia.

**Methods:** A cross sectional study was conducted among 156 prisoners from January to June 2016. Socio-demographic and other data were collected using structured questionnaire. Antibodies against HCV and HIV, and hepatitis B surface antigens were determined in serum using ELISA techniques with commercial kits. Logistic regression analysis was employed to assess possible risk factors for the infections.

**Results:** From the totally 156 participants, 145 (93.0%) were males and 11 (7.0%) were females. The seroprevalence of HBV, HCV and HIV was 5.8% (9), 2.6% (4), and 2.6% (4), respectively. None of the study subjects had co-infections. History of sexually transmitted diseases (AOR = 26.1, 95% CI: 1.17–58.3,  $P = 0.039$ ) and tattooing (AOR = 9.3, 95% CI: 0.8–10.9,  $P = 0.05$ ) was predictor of HIV seropositivity. Having multiple heterosexual partners was significantly associated with HBV infection (AOR = 0.056, 95% CI: 0.03–0.9,  $P = 0.044$ ). None of the interviewed participants had practiced homosexuality. However, they heard that homosexuality was practiced in the prison.

**Conclusions:** Intermediate prevalence of HBV and HCV was detected among prisoners in Jimma Town. However, HIV prevalence was higher than that of the national report. It is crucial to build a system for monitoring, surveillance and preventive public health strategies to minimize the risk factors and block transmission of these infections among prisoners.

## 1. Introduction

There are about a million of people jailed in the prison center worldwide[1]. Ethiopia has the second highest number of prisoners next to South Africa. According to the reports of International Center for Prison Study in 2014, there are 93 044 prisoners in Ethiopia. This puts the country into the 15th leading imprisoning nation in the world[2]. The prison setting has been shown to be a high risk environment for blood-borne viral pathogens[3]. HIV and the most common types of viruses that cause viral hepatitis like hepatitis B virus (HBV) and hepatitis C virus (HCV) are a major

public health problem, and may put the prisoners at higher risk for infections[4].

During imprisonment, prisoners may acquire new infections due to a scarcity of proper infrastructure, inadequate medical facilities and health professionals, poor infection control and health care systems in the prisons[5]. In Ethiopia, the epidemiology and risk factors for viral infection among prisoners are known to be different across the country. Moreover, the prevalence of viral infections among prisoners is reported to be higher than that in the general population[6]. HIV adult prevalence in the general population is estimated to be 1.5% in 2011[7].

Most of viral hepatitis, especially HCV, spread through intravenous drug use or through contaminated blood during transfusion procedures, and the risk factors associated with HIV transmission are also similar to those of HBV and HCV as they share common routes of transmission[1,8,9]. HBV infection prevalence from three African countries was reported to be 4.2%, 2.2% and 12% among prisoners[10-12]. Whereas, the incidence of

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HCV infection among HIV infected patients in Nigeria was very low (0.7%)[11].

There is limited data on the prevalence and risk factors for viral infections among prisoners in Ethiopia. Furthermore, data derived from general population-based studies may not fully reflect the unique situation in the prison. This limits the design of specific prevention, control strategies and prioritizing programmatic interventions for viral infections in prison. Thus, regular assessment of prisoners' health and identification of infected cases and related risk factors play a major role in reducing the risk of transmission inside and outside prisons. Therefore, this study primarily aimed to determine the prevalence and risk factors for HBV, HCV and HIV infections among prisoners in Jimma Town, Southwest Ethiopia.

## 2. Materials and methods

### 2.1. Study design and setting

The study was a descriptive cross-sectional study conducted among prisoners in Jimma Town, Oromia Regional State, Southwest Ethiopia in 2016. Jimma Town is located at about 350 km in the southwest direction from the capital city, Addis Ababa. Based on the information obtained from the Jimma Zone Prison Administration Office, a total of 872 individuals were jailed during data collection period. A clinic in the prison compound has three health professionals (two clinicians and one assistant nurse) who provide health care for prisoners and prison officers.

### 2.2. Sample size and sampling technique

The sample size was determined by formula used for single population proportion by taking the prevalence of HBV infection among the prisoners from the previous study[13]. The incidence of HBV infection among prisoners provided us the larger sample size at 95% CI and 5% margin of error when compared with the prevalence of HIV and HCV infections. Therefore, including 10% nonresponse rate, the total sample size obtained was 156. Finally, study participants were selected by using the lottery method during the data collection time.

### 2.3. Data collection procedure

Data including demographic data as well as information about risk factors were collected using structured questionnaires. The participants were interviewed face to face and questionnaires were completed by two pre-trained nurses under the supervision of the investigators.

**Table 1**

Kits used for screening of anti-HIV, anti-HCV and HBsAg among prisoners at Jimma University serology laboratory, southwest Ethiopia, from January to June, 2016.

Kits name	Company/Manufacturer	Sensitivity	Specificity
Wanti HIV 1+2 Ag/Ab ELISA Kit	Beijing Wanti Biological Pharmacy Enterprise Co., Ltd.	100%	99.80%
Quick Guide-anti-HCV ELISA kit	Human Gesellschaft für Biochemica und Diagnostica mbh, Germany	100%	99.75%
Dialab ELISA test kit for HBsAg	Dialab Production und Vertrieb von Chemisch-technischen Produkten und Laborinstrumenten Gesellschaft m.b.h.	100%	99.50%

### 2.4. Serological tests

Approximately 4 mL of venous blood was collected from each participant using sterile disposable syringe and vacutainer tubes containing EDTA following aseptic techniques. Serum was collected after centrifuging the samples at 1000 r/min for one minute. Serological examination for antibodies to HCV, HIV and hepatitis B surface antigen (HBsAg) was performed by standard ELISA techniques with commercial kits at Jimma University Serology Laboratory. The sources, sensitivity and specificity of the test kits used for this research purposes were summarized and presented in Table 1.

### 2.5. Ethical consideration

Ethical approval was obtained from Ethical Review Board of Jimma University. Official permission was also obtained from Jimma Town Prison Administration Office after explaining the aim of the study. Informed written consent was also obtained from all study participants.

### 2.6. Data analysis and interpretation

The collected data were edited, coded, and entered into SPSS version 20.0 software program for analysis. Bivariate logistic regression analysis was used to determine the effect of independent variables on the outcome variables and those variables with  $P \leq 0.25$  were exported to multiple logistic regressions for further analysis. Descriptive statistics was applied to describe the study population in relation to outcome variables. The degree of association between independent and dependent variables was assessed using odds ratio with 95% confidence interval. Variables with  $P \leq 0.05$  were considered as statistically significant.

## 3. Results

### 3.1. Socio-demographic characteristics

A total of 156 prisoners were included in the study with a 100% response rate. Of these participants, 145 (93.0%) were males and 11 (7.0%) were females. Totally 70 (45.0%) of the participants were in the age group of 21–30 years and the mean age was (28.10 ± 1.02) years. Regarding participants' marital status prior to imprisonment, 55.7%, 40.4%, 2.6%, and 1.3% were single, married, widowed and divorced, respectively. From the participants, the most of prisoners [72 (46.2%)] were farmers prior to imprisonment, followed by government employee [23 (14.7%)]. About 36% of participants

reported that they had never received formal education. More than half [80 (51.3%)] of the study participants had been incarcerated for at least more than one year at the time of the data collection (Table 2).

### 3.2. Seroprevalence of HIV, HBV, and HCV and associated risk factors of HIV infections

The seroprevalence of HBV, HCV and HIV infections determined in the present study was 5.8%, 2.6%, and 2.6%, respectively. None of the participants had co-infections during the study period. The prevalence for HIV was higher in females [1 (9.0%)] although not statistically significant ( $P = 0.229$ ). Eight (5.1%) respondents reported that they had been treated for some type of sexually transmitted diseases (STDs) before imprisonment. Furthermore, history of STDs was significantly associated with HIV infection ( $P = 0.039$ ). A total of 21 (13.5%) of the participants reported practicing a tattoo in some part of their bodies, and 2 (9.5%) of them were positive for antibodies against HIV. Four (2.6%) prisoners have had

a history of blood transfusion during incarceration in prison, and two of them were found infected with HCV. There was a significant association between HIV seropositivity and tattooing (AOR = 9.3, 95% CI: 0.8–10.9,  $P = 0.05$ ) and history of sexually transmitted disease (AOR = 26.1, 95% CI: 1.17–58.3,  $P = 0.039$ ). Having the history of tattooing and history of sexually transmitted disease were predictors of HIV infection among prisoners (Table 3).

### 3.3. Associated risk factors of HBV and HCV infections

After adjustment for other factors, there was no significant association between HBV and HCV seropositivity and age, gender, marital status, duration in a prison, history of sharing shaving materials or dental extraction. Prisoners with history of multiple heterosexual partners before imprisonment were significantly associated with HBV infection (AOR = 0.06, 95% CI: 0.03–0.9,  $P = 0.044$ ). On the other hand, history of blood transfusion (AOR = 5.7, 95% CI: 5.2–6.2,  $P = 0.001$ ) was significantly associated with HCV infection among prisoners (Tables 4 and 5).

**Table 2**

Socio-demographic characteristics and seroprevalence of HIV, hepatitis B and C viruses infections among prisoners at Jimma Town, southwest Ethiopia, from January to June, 2016 ( $n = 156$ ).

Variable	Total [ $n$ (%)]	HIV		HBV		HCV	
		Positive [ $n$ (%)]	Negative [ $n$ (%)]	Positive [ $n$ (%)]	Negative [ $n$ (%)]	Positive [ $n$ (%)]	Negative [ $n$ (%)]
<b>Age (years)</b>							
20	42 (27.0)	0 (0.0)	42 (100)	1 (2.38)	42 (100)	0 (0.0)	42 (100)
21–30	70 (45.0)	3 (4.3)	67 (95.7)	2 (2.85)	66 (100)	0 (0.0)	70 (100)
31–40	28 (18.0)	0 (0.0)	28 (100)	3 (4.25)	26 (92.8)	3 (10.7)	25 (89.3)
> 40	16 (10.0)	1 (6.3)	15 (93.7)	3 (18.80)	13 (81.2)	1 (6.3)	15 (93.7)
<b>Gender</b>							
Male	145 (93.0)	3 (2.0)	142 (98.0)	8 (5.5)	137 (94.5)	3 (2.1)	142 (97.9)
Female	11 (7.0)	1 (9.0)	10 (91.0)	1 (9.1)	10 (90.9)	1 (9.1)	10 (90.9)
<b>Marital status prior to imprisonment</b>							
Single	87 (55.7)	2 (2.3)	85 (97.7)	1 (1.2)	86 (98.8)	1 (1.2)	86 (98.8)
Married	63 (40.4)	2 (3.2)	61 (96.8)	7 (11.2)	56 (88.8)	3 (4.8)	60 (95.2)
Widowed	4 (2.6)	0 (0.0)	4 (100)	0 (0.0)	4 (100)	0 (0.0)	4 (100)
Separated/divorced	2 (1.3)	0 (0.0)	2 (100)	1 (50.0)	1 (50.0)	0 (0.0)	2 (100)
<b>Religion</b>							
Muslim	112 (71.8)	3 (2.7)	109 (97.3)	6 (5.4)	106 (94.6)	4 (3.6)	108 (96.4)
Orthodox	33 (21.2)	1 (3.0)	32 (97.0)	2 (6.1)	31 (93.9)	0 (0.0)	33 (100)
Protestant	9 (5.8)	0 (0.0)	9 (100)	1 (11.1)	8 (88.9)	0 (0.0)	9 (100)
Others	2 (1.2)	0 (0.0)	2 (100)	0 (0.0)	2 (100)	0 (0.0)	2 (100)
<b>Duration in prison</b>							
< 1 year	76 (48.7)	1 (1.3)	75 (98.7)	6 (7.9)	70 (92.1)	0 (0.0)	76 (100)
> 1 year	80 (51.3)	3 (3.8)	77 (96.2)	3 (3.8)	77 (96.2)	4 (5.0)	76 (95.0)
<b>Home address</b>							
Urban	61 (39.1)	3 (4.9)	58 (95.1)	2 (3.3)	59 (96.7)	1 (1.6)	60 (98.4)
Rural	95 (60.9)	1 (1.1)	94 (98.9)	7 (7.4)	88 (92.6)	3 (3.2)	92 (96.8)
<b>Occupation prior to imprisonment</b>							
Government employee	23 (14.7)	1 (4.3)	22 (95.7)	1 (4.3)	22 (95.7)	0 (0.0)	23 (100)
Farmer	72 (46.2)	1 (1.4)	71 (98.6)	7 (9.7)	65 (90.3)	3 (4.2)	69 (95.8)
Merchants	17 (10.9)	1 (5.9)	16 (94.1)	0 (0.0)	17 (100)	0 (0.0)	17 (100)
Students	22 (14.1)	1 (4.5)	21 (95.5)	1 (4.5)	21 (95.5)	0 (0.0)	22 (100)
Daily laborer	22 (14.1)	0 (0.0)	22 (100)	0 (0.0)	22 (100)	1 (4.5)	21 (95.5)
<b>Educational status</b>							
Never attended	56 (35.9)	2 (3.6)	54 (96.4)	5 (9.0)	51 (91.0)	4 (7.2)	52 (92.8)
Primary school	19 (12.2)	0 (0.0)	19 (100)	2 (10.5)	17 (89.5)	0 (0.0)	19 (100)
Secondary school	55 (35.3)	1 (1.9)	54 (98.1)	1 (1.9)	54 (98.1)	0 (0.0)	55 (100)
Diploma +	26 (16.6)	1 (3.8)	25 (91.2)	1 (3.8)	25 (91.2)	0 (0.0)	26 (100)
<b>Total</b>	<b>156 (100)</b>	<b>4 (2.6)</b>	<b>152 (97.4)</b>	<b>9 (5.8)</b>	<b>147 (94.2)</b>	<b>4 (2.6)</b>	<b>152 (97.4)</b>

**Table 3**Regression analysis of risk factors for HIV infection among prisoners at Jimma Town, Southwest Ethiopia, from January to June, 2016 (*n* = 156).

Variable	Total [ <i>n</i> (%)]	Anti-HIV+ [ <i>n</i> (%)]	COR (95% CI)	<i>P</i> -value	AOR (95% CI)	<i>P</i> -value
Age (years)						
20	42 (27.0)	0 (0.0)	2.0 (0.119–33.5)	0.630		
21–30	70 (45.0)	3 (4.3)	2.27 (0.17–46.2)	0.480		
31–40	28 (18.0)	0 (0.0)	1.48 (0.08–24.9)	0.787		
> 40 <sup>R</sup>	16 (10.0)	1 (6.3)	-			
Gender						
Male	145 (93.0)	3 (2.0)	4.73 (0.45–49.7)	0.195	0.18 (0.12–2.9)	0.229
Female <sup>R</sup>	11 (7.0)	1 (9.0)	-		-	
Duration in Prison						
> 1 year	80 (51.3)	3 (3.8)	2.92 (0.29–28.7)	0.358		
< 1 year <sup>R</sup>	76 (48.7)	1 (1.3)	-			
Home address						
Urban	61 (39.1)	3 (4.9)	0.206 (0.1–2.03)	0.175	3.33 (0.19–57.0)	0.406
Rural <sup>R</sup>	95 (60.9)	1 (1.1)	-		-	
History of sharing shaving materials						
Yes	9 (5.8)	2 (22.2)	20.71(2.53–69.4)	0.005	2.46 (0.14–43.1)	0.537
No <sup>R</sup>	147 (94.2)	2 (1.36)	-		-	
History of STD						
Yes	8 (5.1)	2 (25.0)	24.3 (2.9–20.3)	0.003	26.1 (1.17–58.3)	0.039
No <sup>R</sup>	148 (94.9)	2 (1.4)	-		-	
Tattooing						
Yes	21 (13.5)	2 (9.5)	7.0 (0.93–52.6)	0.05	9.3 (0.8–10.9)	0.05
No <sup>R</sup>	135 (86.5)	2 (1.5)	-		-	
Drug use in prison						
Yes	48 (30.8)	3 (6.25)	7.13 (0.72–70.4)	0.093	3.17 (0.288–35)	0.346
No <sup>R</sup>	108 (69.2)	1 (0.93)	-		-	
Dental extraction						
Yes	17 (10.9)	2 (11.8)	9.133 (1.2–69.6)	0.033	6.26 (0.59–70.2)	0.137
No <sup>R</sup>	139 (89.1)	2 (1.4)	-		-	

COR: Crude odds ratio; AOR: Adjusted odds ratio; Anti-HIV+: Positive result for HIV antibody test; R: Reference category for comparison.

**Table 4**Logistic regressions of risk factors for hepatitis B virus infection among prisoners in Jimma Town, Southwest Ethiopia, From January to June, 2016, (*n* = 156).

Variable	Total [ <i>n</i> (%)]	HBV+ [ <i>n</i> (%)]	COR (95% CI)	<i>P</i> -value	AOR (95% CI)	<i>P</i> -value
Gender						
Male	145 (93.0)	8 (5.5)	1.7 (0.2–15.0)	0.628		
Female <sup>R</sup>	11 (7.0)	1 (9.1)	-			
Home address						
Rural	95 (60.9)	7 (7.4)	2.34 (0.47–11.6)	0.298		
Urban <sup>R</sup>	61 (39.1)	2 (3.3)	-			
Sharing shaving materials						
Yes	9 (5.8)	1 (11.1)	2.17 (0.24–19.5)	0.489		
No <sup>R</sup>	147 (94.2)	8 (5.4)	-			
History of STD						
Yes	8 (5.1)	2 (25.0)	6.71 (1.14–39.4)	0.035	1.47 (0.14–16.4)	0.752
No <sup>R</sup>	148 (94.9)	7 (4.7)	-		-	
Tattooing						
Yes	21 (13.5)	1 (4.8)	1.26 (0.15–10.6)	0.832		
No <sup>R</sup>	135 (86.5)	8 (5.9)	-			
Drug use in prison						
Yes	48 (30.8)	4 (8.3)	1.87 (0.48–7.3)	0.366		
No <sup>R</sup>	108 (69.2)	5 (4.6)	-			
Multiple heterosexual partners						
Yes	45 (28.8)	4 (8.9)	10.0 (1.9–52.1)	0.006	0.06 (0.03–0.9)	0.044
No <sup>R</sup>	111 (71.2)	5 (4.5)	-		-	
History of blood transfusion						
Yes	4 (2.6)	1 (25.0)	6 (0.56–64.3)	0.139	5.28 (0.19–14.2)	0.328
No <sup>R</sup>	152 (97.4)	8 (5.3)	-		-	

AOR: Adjusted odds ratio; COR: Crude odds ratio; HBV+: Positive result for hepatitis B surface antigen test; R: Reference category for comparison.

**Table 5**

Logistic regressions of risk factors for hepatitis C virus infection among prisoners in Jimma Town, Southwest Ethiopia, From January to June, 2016, ( $n = 156$ ).

Variable	Total [n (%)]	HCV+ [n (%)]	COR (95% CI)	P-value	AOR (95% CI)	P-value
Gender						
Male	145 (93.0)	3 (2.1)	4.7 (0.45–49.7)	0.295		
Female <sup>R</sup>	11 (7.0)	1 (9.1)				
Home address						
Rural	95 (60.9)	3 (3.2)	1.95 (0.12–19.2)	0.565		
Urban <sup>R</sup>	61 (39.1)	1 (1.6)	-			
Sharing shaving materials						
Yes	9 (5.8)	2 (22.2)	20.7 (2.53–169)	0.005		
No <sup>R</sup>	147 (94.2)	2 (1.4)	-			
History of STD						
Yes	8 (5.1)	2 (25.0)	24.3 (2.91–203)	0.003	11.3 (0.23–55)	0.222
No <sup>R</sup>	148 (94.9)	2 (1.4)	-		-	
Tattooing						
Yes	21 (13.5)	1 (4.8)	2.2 (0.22–22.1)	0.504	0.3 (0.02–39)	0.633
No <sup>R</sup>	135 (86.5)	3 (2.2)	-		-	
Drug use in prison						
Yes	48 (30.8)	3 (6.25)	7.1 (0.72–70.4)	0.093	12 (0.2–83.0)	0.238
No <sup>R</sup>	108 (69.2)	1 (0.9)	-		-	
Multiple heterosexual partners						
Yes	45 (28.8)	3 (6.7)	29.7 (2.4–36.9)	0.008	0.09 (0.02–4.8)	0.236
No <sup>R</sup>	111 (71.2)	1 (0.9)	-		-	
History of blood transfusion						
Yes	4 (2.6)	2 (50.0)	75 (6.7–83.1)	0.001	5.7 (5.2–6.2)	0.001
No <sup>R</sup>	152 (97.4)	2 (1.3)	-		-	

AOR: Adjusted odds ratio; COR: Crude odds ratio; HCV+: Positive result for HCV antibody test; R: Reference category for comparison.

#### 4. Discussion

This cross-sectional study was carried out among the prisoners to determine the seroprevalence of HBV, HCV and HIV infections and associated risk factors. Among the 156 prisoners enrolled in this study, the prevalence of HIV, HBV and HCV infections was 4 (2.6%), 9 (5.8%) and 4 (2.6%) among prisoners, respectively. HBV infection was the most prevalent (5.8%) infection detected in this study. This result was higher compared to previously reported prevalence, which was 3.7%[14], but comparable with studies done among general population of Addis Ababa and in individuals attending hospital for seeking healthcare[15,16]. This difference might be due to the difference in study population and method of diagnosis used.

In the present study the rate of HIV infection detected was 2.6%, which is lower than previously reported rate among prisoners (6.0%)[5]. This difference might be due to the factors associated with the transmission of HIV infection in a closed prison, which put prisoners at high risk for HIV infection, like lack of condom availability or their social misbehavior before coming to prison which is different from one area to the other[3]. On the other hand, the rate of HIV seroprevalence in our study was lower than that reported in Woldiya (6.3%)[14] among prisoners. Although the studied populations were all prisoners, this dissimilarity

reflects the fact that HIV transmission is different from place to place. Moreover, this variation might be attributed to differences in time, culture of the specific community, awareness about the transmission and prevention and also the particular prison environment.

The prevalence rate of HCV infection in this study was lower than that of different studies done at different areas. For example, HCV prevalence rates among prisoners reported from Togo, Iran and Brazil were higher, which was about 6.0%, 31.5% and 13.6%[17-19], respectively. This difference might be due to the possible difference in practice of homosexuality and use of injectable drugs, which are the main risk factors described in the previous studies. Moreover, it should be noted that participants confirmed the practice of homosexuality; this probably happens among Ethiopian prisoners but at a very minimal level since such practice is not acceptable by the community and by law.

In the current study, age, gender, marital status, duration in a prison, history of sharing shaving materials or dental extraction were not significantly associated with HIV seropositivity. This finding was similar with previously reported studies[5,11]. However, study participants with body tattoo on any part of their bodies were 9.3 times more likely to be HIV infected. Prisoners with history of STDs before imprisonment were 26.1 times more likely to be HIV seropositive. Therefore, history of STDs and tattooing was

identified as the predictors for HIV infection among the study group. This findings was similar with other study[16].

The prevalence of HBV and HCV infection among prisoners in Jimma Town was intermediate when compared with World Health Organization report. Lower prevalence of HIV infection was observed among prisoners compared with the urban population. Responsible organizations have to work on integrating screening program in all prisoners in Ethiopia regardless of their sero-status to prevent the potential spread of these infections inside and outside prisons. Furthermore, health education programs focusing on infection prevention and advocating on how to build low risk behaviors, and facilitating access to suitable treatment care, should be in place in prison settings.

### Conflict of interest statement

We declare that we have no conflict of interest.

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