

# Serological Evidence and Associated Factors of Hepatitis B Virus and Hepatitis C Virus Among Waste Handlers: A Cross-Sectional Study from Northeastern Ethiopia

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**Background:** The World Health Organization (WHO) has identified viral hepatitis, caused by hepatitis B virus (HBV) and hepatitis C virus (HCV), as one of the main global public health issues. People who work in the collection of waste materials, from either household or medical environments, are at greatest risk.

**Objective:** To determine the prevalence of and factors associated with HBV and HCV among medical and domestic waste handlers in Northeast Ethiopia.

**Methods:** A comparative cross-sectional study was conducted from January to April 2021 at selected healthcare facilities and municipal settings in Dessie town, Northeast Ethiopia. The sample size was determined using a double population proportion formula, and a simple random sampling technique was employed to select 70 individuals in the medical waste handlers (MWHs) group and 206 in the domestic waste handlers (DWHs) group. Five milliliters of venous blood was collected from each participant and tested for HBV and HCV using an enzyme-linked immunosorbent assay. Data were analyzed using SPSS version 23; the prevalence was computed, Fisher's exact test was used, and logistic regression was applied.

**Results:** A total of 276 study participants were enrolled and the overall seroprevalence of hepatitis virus was 5.1%. The seroprevalence of HBV infection among MWHs and DWHs was 8.6% and 1.9%, respectively. The overall seroprevalence of HCV infections among MWHs and DWHs was 4.3% and 0.5%, respectively. Medical waste handling, having a history of needle stick injury, and not using personal protective equipment were factors significantly associated with HBV infection.

**Conclusion:** The overall seroprevalence of viral hepatitis was high. The prevalence of HBV infection among MWHs was in line with the high endemicity classification of the WHO, and there was a significant difference in prevalence between DWHs and MWHs. Both groups of waste handlers should receive proper attention to protect them from HBV and HCV infection.

**Keywords:** waste handlers, HBV, HCV, Northeast Ethiopia

## Introduction

The World Health Organization (WHO) has identified viral hepatitis, caused by hepatitis B virus (HBV) and hepatitis C virus (HCV), as one of the main global public health issues.<sup>1</sup> The WHO announced a strategy in 2016 to end viral hepatitis as an imminent danger to public health by 2030.<sup>2</sup> It is estimated that 354 million people are living with chronic HBV (296 million) and HCV (58 million). Viral hepatitis caused more than 1.1 million deaths in 2019, mostly due to complications of cirrhosis and hepatocellular cancer.<sup>3</sup> Between the years 1990 and 2013, the global death rate due to viral hepatitis increased from 0.89 to 1.45 million.<sup>4</sup> Even though the global seroprevalence of HBV and HCV decreased from 2015 to 2020, the target of elimination by 2030 may not be practical and it may prove difficult to achieve this goal.<sup>5,6</sup> In resource-limited areas of the world in particular, the target of eliminating the two viral infections is hampered by many problems, such as diagnostic capability, population awareness, and the COVID-19 pandemic.<sup>7,8</sup>

Workers engaged primarily in the collection and transportation of waste materials face biological, chemical, and physical risks to their health when in contact with waste, and this scenario is more severe in low- and middle-income countries.<sup>9,10</sup> People who work in the collection of waste materials from either household or medical environments are at greatest risk of developing infection owing to the presence of infectious agents such as HBV and HCV.<sup>11</sup> The rate of HBV infection among medical waste handlers is significantly higher than that among non-medical waste handlers; this situation is even worse in developing countries.<sup>12,13</sup> In some situations, healthcare and domestic waste exposures have been linked to comparable risks of HBV infection.<sup>14</sup> Healthcare providers and those who manage medical waste are at risk of contracting HBV in Ethiopia, possibly as a result of prior contact with infected patients.<sup>15</sup> Public health facilities in Ethiopia produce a sizable amount of biomedical waste, and if this is not managed appropriately, there may be a higher likelihood of such waste being a potential source of an infectious agent.<sup>16</sup>

In two successive systematic reviews conducted in Ethiopia, the pooled prevalence of HCV was 3.1%<sup>17</sup> and 2%,<sup>18</sup> indicating that the disease may be on the decline. However, according to systematic review and meta-analysis reports from Ethiopia, the overall prevalence of HBV remains a significant health problem in various population categories.<sup>17,19</sup> The seroprevalence of HBV among medical and non-medical waste handlers was 6% and 1%, respectively, in another study from Ethiopia.<sup>13</sup> According to a study carried out in Addis Ababa, Ethiopia, medical waste handlers have a significantly increased chance of contracting HBV.<sup>20</sup> Related research conducted in public health facilities in eastern Ethiopia, where 20% of the study participants had HBV infection, provided support for this conclusion.<sup>21</sup>

Several studies have been conducted regarding the seroprevalence of HBV and HCV infection among various study groups in Ethiopia.<sup>22–24</sup> Few studies on the prevalence of the two most common viral hepatitis types among waste handlers have been conducted in defined areas. Studies investigating the prevalence of HBV and HCV among waste handlers in health facilities and in municipal settings are rare, particularly in the northeastern part of Ethiopia. Hence, the current study was conducted to fill this gap in the literature on the prevalence of and factors associated with HBV and HCV among medical and domestic waste handlers in Northeast Ethiopia.

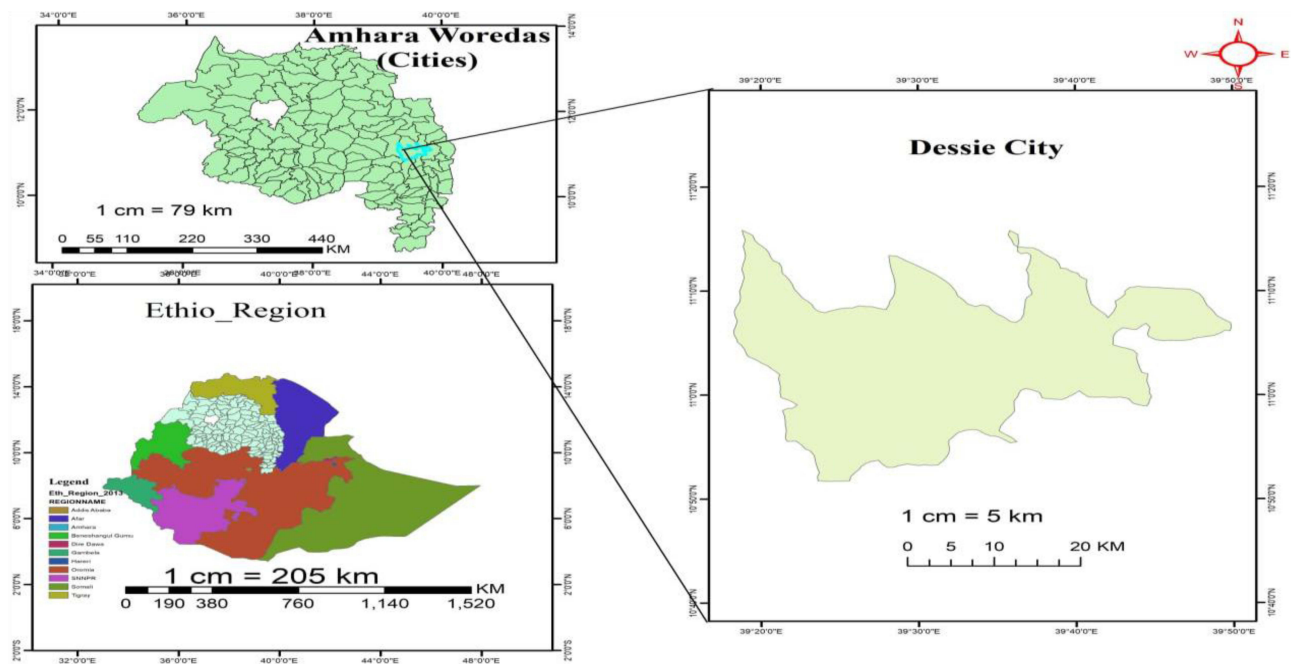
## Methodology

### Study Settings and Population

A comparative cross-sectional study was conducted from January to April 2021 at selected health facilities and municipal settings in Dessie town, Northeast Ethiopia (Figure 1). Dessie is found at a latitude of 11°8' N and a longitude of 39°38' E, at an altitude of 2470–2550 m above sea level. It is located 401 km northeast of Addis Ababa and 478 km from Bahir-Dar. The town administration has five sub-cities, with eight health centers, one comprehensive specialized hospital and one general hospital under government control, and five general hospitals (private), 32 higher private clinics, one family guidance association center, and one Marie Stopes International reproductive health service clinic. According to the 2015 Amhara Regional State Statistics Bureau report, Dessie city administration has total an estimated population of 2,908,529, of whom 1,480,369 are male and 1,428,160 are female. In the town, there are a total of 350 domestic waste handlers (DWHs) and in the healthcare facilities there are also 116 medical waste handlers (MWHs). All DWHs and MWHs who volunteered to participate and gave their informed written consent were included in the study, while waste handlers who had lived in the town for less than 6 months, non-volunteers, and those who were unable to give consent owing to physical and/or mental illness were excluded from the study.

### Sample Size Determination and Sampling Technique

The sample size was determined using a double population proportion formula in Epi Info version 7.1, considering a 95% confidence interval, 80% power, unexposed to exposed ratio of 3, 1% of HBV in DWHs, and 6.3% of HBV in MWHs.<sup>20</sup> As a result, the sample size was 133 MWHs and 397 DWHs. The sample size was higher than the existing total population in each group. Thus, a sample size reduction formula was used to find the minimum sample size, including a 10% non-response rate, and the final sample size was 70 MWHs and 206 DWHs, with a total sample size of 276. A simple random sampling technique was used to select the study subjects. The registered institutional identification



**Figure 1** Maps showing the study area (Dessie City). The maps were generated by the authors using ArcGIS version 10.8 software.

numbers of study participants were used as a sampling frame. Then, proportional allocation was used to determine the number of study participants in the nine health institutions and the five sub-cities based on their source population.

## Data Collection and Laboratory Procedures

A pretested structured questionnaire was used to collect socio-demographic, behavioral, and risky behavior characteristics. The questionnaire was administered by trained data collectors under strict supervision. After obtaining informed consent, a laboratory technologist collected 5 mL of venous blood in a labeled plain tube from each study participant. The blood sample was allowed to clot at room temperature and the serum was separated by centrifugation at 5000 rpm for 15 minutes. Serum samples were transported to the Ethiopian Red Cross Society Blood Bank, Dessie branch, in a cold box, and stored at  $-20^{\circ}\text{C}$  until testing. Serum specimens were tested for HBV and HCV with the AiD<sup>TM</sup> HBsAg ELISA (Wantai Hepatitis B Virus Diagnostics, Beijing, China), with a sensitivity of 100% and specificity of 99.92%, and the AiD<sup>TM</sup> anti-HCV ELISA plus (Wantai Hepatitis C Virus Diagnostics, Beijing, China), with a sensitivity of 100% and specificity of 99.55%.

## Quality Control

Quality-control checks were carried out before, during, and after data collection to generate high-quality and reliable data. The structured questionnaire was pretested on 5% of the study participants in Hayk town, which is located about 30 km away from Dessie town. Data collectors received two days' training at each site before data collection started. Moreover, the quality of the laboratory test results was ensured using the internal quality control of the ELISA, as well as known negative and positive samples. All laboratory analyses were carried out using standard operating procedures.

## Data Management and Analysis

Data were first coded and cleaned, and then entered and analyzed using SPSS version 23.0. The prevalence of HBV and HCV infections was computed. Fisher's exact test was used to assess the differences in the proportion of hepatitis virus infections between the MWH and DWH groups. Bivariable logistic regression was computed and variables with a  $P$ -value  $<0.3$  were entered into the multivariable logistic regression analysis; their adjusted odds ratios (AORs) were calculated and variables with a  $P$ -value  $<0.05$  were taken as statistically significant.

## Ethical Considerations

Ethical clearance was obtained from the Research and Ethics Review Committee of Wollo University, College of Medicine and Health Sciences. Then, permission was obtained from Dessie town health administration and municipality. Written informed consent was obtained from each study participant. Finally, participants who were positive for HBsAg and/or anti-HCV antibodies were referred for further management, investigation, and treatment. All aspects of this study were carried out in conformity with the ethical principles of the Declaration of Helsinki.

## Results

### Socio-Demographic Characteristics of Respondents

A total of 276 study participants were enrolled, with a response rate of 100%. The mean ( $\pm$ SD) age of the total participants was 38.53 ( $\pm$ 9.21) years, while the mean ( $\pm$ SD) age of MWHs and DWHs was 37.63 ( $\pm$ 9.17) and 38.83 ( $\pm$ 9.23) years, respectively. About 42% of participants were above 40 years old, and around 90.9% (251/276) were female, of whom municipal participants accounted for 78.1% (196/251) (Table 1).

### Prevalence of HBV and HCV Infection

The overall seroprevalence of hepatitis virus in this study was 5.1% (14/276; 95% CI: 2.5–8.0). The seroprevalence of HBV infection among MWHs and DWHs was 8.6% (6/70; 95% CI: 4.1–16.0) and 1.9% (4/206; 95% CI: 0.5–4.4), respectively. The overall seroprevalence of HCV infections among MWHs and DWHs was 4.3% (3/70; 95% CI: 0.0–7.4) and 0.5 (1/206; 95% CI: 0.0–1.5), respectively. Statistically significant differences were noted in the rate of overall hepatitis virus infection ( $P=0.002$ ) and HBV infection ( $P=0.019$ ) between the MWH and DWH groups, as shown in Table 2.

A higher prevalence of HBsAg was observed among MWHs and DWHs who did not use personal protective equipment (PPE) [4/18 (22.5%) and 3/56 (5.4%), respectively] than in those who did use PPE. The differences in seroprevalence of HBV among DWHs who had a history of positive blood contact, compared to those who did not, and in males, compared to females, were significant ( $P<0.05$ ). Similarly, the prevalence of HCV in males in the DWH group

**Table 1** Socio-Demographic Characteristics of Waste Handlers in Dessie Town, Northeast Ethiopia, 2021

Variables		MWHs	DWHs	Total
		N (%)	N (%)	N (%)
Age years	18–29	16 (22.9)	43 (20.9)	59 (21.4)
	30–40	28 (40.0)	73 (35.4)	101 (36.6)
	≥41	26 (37.1)	90 (43.7)	116 (42.0)
Sex	Male	15 (21.4)	10 (4.9)	25 (9.1)
	Female	55 (78.6)	196 (95.1)	251 (90.9)
Marital status	Single	23 (32.9)	53 (25.7)	76 (27.5)
	Married	16 (22.8)	70 (34.0)	86 (31.2)
	Divorced	23 (32.9)	51 (24.8)	74 (26.8)
	Widowed	8 (11.4)	32 (15.5)	40 (14.5)
Educational status	Illiterate	14 (20.0)	47 (22.8)	61 (22.2)
	Primary level	36 (51.4)	80 (38.8)	116 (42.0)
	Secondary level	20 (28.6)	75 (36.4)	95 (34.4)
	Tertiary level	0 (0.0)	4 (1.9)	4 (1.4)
Monthly salary (ETB)	≤1000 ETB	24 (34.3)	55 (26.7)	79 (28.6)
	>1000 ETB	46 (35.7)	151 (73.3)	197 (71.4)
Length of service (years)	≤10	33 (47.1)	92 (44.6)	125 (45.23)
	>10	37 (52.9)	114 (55.4)	151 (54.71)

**Abbreviations:** MWH, medical waste handler; DWH, domestic waste handler; ETB, Ethiopian birr.

**Table 2** Statistical Associations for HBV, HCV, and Overall Hepatitis Virus Infection Among Medical and Domestic Waste Handlers in Dessie Town, Northeast Ethiopia, 2021

Variables		HBV		P-Value	HCV		P-Value	Overall Hepatitis		P-Value
		Positive, N (%)	Negative, N (%)		Positive, N (%)	Negative, N (%)		Positive, N (%)	Negative, N (%)	
Waste handler type	Domestic	4 (1.9)	202 (98.1)	0.019*	1 (0.5)	205 (99.5)	0.056	5 (2.4)	201 (97.6)	0.002*
	Medical	6 (8.6)	64 (91.4)		3 (4.3)	67 (95.7)		9 (12.9)	61 (87.1)	

**Notes:** \*Statistically significant ( $P < 0.05$ ); Fisher's exact test was used.

**Abbreviations:** HBV, hepatitis B virus; HCV, hepatitis C virus.

was 10% (1/10;  $P = 0.0049$ ), and this was the only variable found to be associated with anti-HCV. Thus, there was no common predictive factor for both groups (MWHs and DWHs) (Table 3).

## Risk Factors Associated with HBV and HCV Infection

In multivariable analysis, working area, MWH ( $P = 0.037$ ), history of needle stick injury ( $P = 0.003$ ), and not using PPE ( $P = 0.019$ ) were factors significantly associated with HBV infection (Table 4).

The seroprevalence of HCV was significantly higher among waste handlers with a history of not using PPE ( $P = 0.016$ ) (Table 5).

## Discussion

In many countries, healthcare waste management practice has not gained much attention from stakeholders in facilities<sup>25,26</sup> and a huge amount of waste material is generated in different divisions of the healthcare services.<sup>16,26,27</sup> Various factors are associated with biomedical waste management practice, such as educational level, training, access to bins in the working department, and attitude.<sup>28</sup> Healthcare waste is illegally dumped along roads or in the bush in some cases, openly burned, and buried in yards. Vomit, urine, and sputum are disposed of in open areas near the homes as liquid healthcare waste.<sup>29,30</sup> Sometimes, the household may not have sufficient sanitation facilities and the waste generated may not be disposed of in the environment in the proper manner.<sup>31</sup> These scenarios may expose municipal and medical waste collectors to infectious diseases of various types.<sup>32</sup> A meta-analysis that found a link between HBV infection and handling medical waste serves as proof of this hypothetical situation.<sup>12</sup> Another review paper can be cited as evidence of the linking factor between HBV infection and exposure to either household or medical solid waste.<sup>33</sup>

**Table 3** Significant Distribution of HBV and HCV Infection Among MWHs and DWHs in Dessie Town, Northeast Ethiopia, 2021

Type of Hepatitis	Variables		MWHs		P-Value	DWHs		P-Value
			Positive, N (%)	Negative, N (%)		Positive, N (%)	Negative, N (%)	
HBV	Sex	Male	1 (6.7)	14 (93.3)	1.000	2 (20)	8 (80)	0.012*
		Female	5 (9.1)	50 (90.9)		2 (1.0)	194 (99)	
	Needle stick injury	No	4 (6.3)	60 (93.7)	0.079	2 (1.2)	170 (98.8)	0.128
		Yes	2 (33.3)	4 (66.7)		2 (5.9)	32 (94.1)	
	Positive blood contact	No	6 (8.6)	64 (91.4)	NA	3 (1.5)	201 (98.5)	0.039*
		Yes	0 (0.0)	0 (0.0)		1 (50.0)	1 (50)	
Utilization of PPE	Yes	2 (3.8)	50 (96.2)	0.034*	1 (0.7)	149 (99.3)	0.046*	
	No	4 (22.5)	14 (77.5)		3 (5.4)	53 (94.6)		
HCV	Sex	Male	1 (6.7)	14 (93.3)	0.521	1 (10.0)	9 (90)	0.0049*
		Female	2 (3.6)	53 (96.4)		0 (0.0)	196 (100)	

**Notes:** \*Significant association ( $P < 0.05$ ); Fisher's exact test was used.

**Abbreviations:** HBV, hepatitis B virus; HCV, hepatitis C virus; MWH, medical waste handler; DWH, domestic waste handler; NA, not applicable.

**Table 4** Bivariable and Multivariable Logistic Regression of Factors of HBV Among Waste Handlers in Dessie Town, Northeast Ethiopia, 2021

Characteristics		HBV Infection		COR (95% CI)	P-Value	AOR (95% CI)	P-Value
		Positive, N (%)	Negative, N (%)				
Sex	Male	3 (12.0)	22 (88)	4.753 (1.148–19.687)	0.032	4.882 (0.821–29.02)	0.081
	Female	7 (2.8)	244 (97.2)				
Waste handlers' type	DWH	4 (1.9)	202 (98.1)		0.019		0.037*
	MWH	6 (8.6)	64 (91.4)	4.734 (1.295–17.30)		5.348 (1.103–25.928)	
Needle stick injury	No	6 (2.5)	230 (97.5)		0.031		0.003*
	Yes	4 (10.0)	36 (90)	4.219 (1.146–15.83)		15.293 (2.59–90.22)	
Blood transfusion	No	9 (3.4)	258 (96.6)		0.252		0.634
	Yes	1 (11.1)	8 (88.9)	3.583 (0.404–31.77)		1.937 (0.127–29.5)	
Positive blood contact	No	9 (3.3)	265 (96.7)		0.048		0.119
	Yes	1 (50.0)	1 (50)	29.44 (1.703–509.18)		38.84 (2.31–190.56)	
History of tattoo	No	6 (2.9)	199 (97.1)		0.299		0.791
	Yes	4 (5.6)	67 (94.4)	1.98 (0.542–7.23)		1.25 (0.24–6.51)	
Utilization of PPE	Yes	3 (1.5)	199 (98.5)		0.006		0.019*
	No	7 (9.5)	67 (90.5)	6.93 (1.743–27.56)		6.84 (1.366–34.24)	
Technical training	Yes	1 (0.8)	130 (99.2)		0.043		0.108
	No	9 (6.2)	136 (93.8)	8.603 (1.075–68.85)		7.495 (0.642–87.488)	

Note: \*Significant association ( $P < 0.05$ ).

Abbreviations: HBV, hepatitis B virus; PPE, personal protective equipment; COR, crude odds ratio; AOR, adjusted odds ratio.

**Table 5** Bivariable and Multivariable Logistic Regression of Factors of HCV Among Waste Handlers in Dessie Town, Northeast Ethiopia, 2021

Characteristics		HCV Infection		COR (95% CI)	P-Value	AOR (95% CI)	P-Value
		Positive, N (%)	Negative, N (%)				
Sex	Male	2 (8.0)	23 (92)	10.82 (1.456–80.47)	0.002	11.15 (0.968–128.5)	0.053
	Female	2 (0.8)	249 (99.2)				
Waste handler type	Municipal	1 (0.5)	205 (99.5)		0.057		0.051
	Health Institute	3 (4.3)	67 (95.7)	9.179 (0.939–89.7)		17.71 (0.99–35.1)	
Length of service	≤10 years	2 (1.6)	123 (98.4)		0.678		
	>10 years	2 (1.3)	149 (98.7)	0.659 (0.09–4.748)			
Utilization of PPE	Yes	1 (0.5)	201 (99.5)		0.066		0.016*
	No	3 (4.1)	71 (95.9)	8.493 (0.869–82.97)		34.28 (1.915–61.39)	
Technical training	Yes	3 (2.3)	128 (97.7)		0.295		0.054
	No	1 (0.7)	144 (99.3)	0.296 (0.03–2.884)		0.45 (0.09–0.917)	

Note: \*Significant association ( $P < 0.05$ ).

Abbreviations: HCV, hepatitis C virus; PPE, personal protective equipment; COR, crude odds ratio; AOR, adjusted odds ratio.

The present study was carried out in a place where a high burden of HBV and HCV infection has been reported<sup>22,23,34</sup> and a considerable number of needle stick and sharp material injuries has been demonstrated.<sup>35</sup> In the present study, the overall seroprevalence of hepatitis virus among medical and domestic waste handlers was 5.1%. The seroprevalence of hepatitis infection (both HBV and HCV) was 12.85% among MWHs and 2.43% among DWHs. The overall prevalence of the two viral hepatitis types was lower among all study participants than in a previous study among pregnant women in Dessie town, but the infection prevalence among MWHs in the current study was consistent with the overall magnitude of viral hepatitis in different studies.<sup>23,36</sup>

HBV vaccine coverage in Africa is low, particularly among healthcare workers and waste handlers who have inadequate training and no HBV immunization history.<sup>20,37</sup> MWHs and DWHs in this study had a frequency of HBV infection of 8.6% and 1.9%, respectively. Unlike the present study, the proportion of HBV among MWHs and DWHs was found to be comparable in a similar study, which was conducted in Tripoli, Libya.<sup>38</sup> The seroprevalence of the virus in the current research demonstrates the high endemicity of HBV infection in our population, according to the WHO classification.<sup>39</sup> While a lower rate of HBsAg (1.3%) was found in Southern Ethiopia,<sup>40</sup> the seroprevalence of HBV among MWHs in Northwest Ethiopia revealed incomparable findings with the current research.<sup>15</sup> In comparison to the current research, a study conducted in Belo Horizonte, Brazil, revealed that MWHs had a similar percentage of HBV infection but DWHs had a higher prevalence of the virus.<sup>14</sup> This variation may be due to differences in laboratory methods, study period, demographic circumstances of the source population, and so on.

The HBV infection rate among MWHs in this study roughly corresponds to the combined prevalence of the virus in Africa's general population and healthcare workers.<sup>41,42</sup> It was higher than the results of a systematic research study conducted among the general public and clinical population in Germany, where a high vaccination rate was achieved.<sup>43</sup> A study carried out in Jimma, Ethiopia, showed a significantly lower prevalence of HBV among healthcare workers compared to the present study.<sup>44</sup> This may be due to the fact that the study participants in Jimma had a good level of knowledge and good attitudes about the standard precautionary measures. Another study, conducted in Nigeria, showed a concordant (2.6%) prevalence of HBV infection among municipal waste handlers.<sup>45</sup> In contrast to the result of the present study, DWHs had a huge prevalence of HBV in a study conducted in Greece.<sup>46</sup> The differences in the prevalence of HBV may be related to the laboratory method used, the study period, and variations in the population.

Moreover, the prevalence of HCV infection among MWHs in the present study was 4.3%, whereas its prevalence among DWHs was 0.5%. This result was found to be comparable with a study conducted in Brazil.<sup>14</sup> A lower prevalence of HCV among MWHs and DWHs was reported in a study conducted in Gondor town, Ethiopia,<sup>13</sup> and another similar study also reported a lower prevalence of HCV among MWHs.<sup>47</sup> The rate of HCV among MWHs was found to be lower than a pooled prevalence of HCV among healthcare workers in Africa, but it was higher than the rate in East African healthcare workers and in Jimma town.<sup>41,44</sup> In the present study, HBV and HCV coinfection was not detected in either the MWH or the DWH group. Most of the studies on similar topics also found no coinfection of HBV and HCV.<sup>13,21,40</sup>

In the present study, MWHs were shown to have 5.35 times higher likelihood of acquiring HBV infection compared to DWHs. Similar results were found in studies conducted in Gondar and Addis Ababa, Ethiopia, which indicated the strong association between HBV infection and medical waste handling work type.<sup>13,20</sup> A meta-analysis on the association between HBV and medical waste handling demonstrated a strong statistical correlation between HBV infection and MWHs relative to DWHs. This study also showed that the association was particularly strong in African reports.<sup>12</sup> This may be the result of accepted medical waste management practices being disregarded and a lack of planning for work-related safety precautions.<sup>48</sup> Besides, various occupational risks and injuries that can occur in the medical setting can predispose MWHs to this problem.<sup>35</sup>

Waste workers are more susceptible to infectious agents as a result of sharp material injuries, inappropriate PPE use, and a lack of HBV vaccination.<sup>49</sup> A history of needle stick injury had a substantial association (AOR=15.293; 95% CI=2.59–90.22;  $P=0.003$ ) with HBV infection. In Greece, waste collectors who reported occupational injuries with needle sticks were found to be at a higher risk of HBV infection.<sup>46</sup> In contrast, similar research indicated that needle stick injury did not demonstrate any statistical association with HBV infection.<sup>15</sup> Owing to insufficient instruction on its use, technical issues, and the tolerability of PPE in the workplace, adhering to appropriate PPE use is challenging.<sup>50</sup> Study participants who did not utilize PPE had nearly seven times greater odds of developing HBV and 34 times higher likelihood of acquiring HCV infection in comparison with those who used it properly.

In this study, nearly half of the study participants revealed they had received technical training about infectious waste management. Having or not having received technical training did not show any statistical association with HBV or HCV infections. This is consistent with the results of studies conducted in Gondar<sup>13</sup> and Bahir Dar, Ethiopia,<sup>15</sup> and in Kenya.<sup>51</sup> A history of tattooing and blood transfusion demonstrated statistical associations in different research conducted in Ethiopia and elsewhere,<sup>21,40,45,52</sup> whereas these variables did not show any association with the infection rates of HBV and HCV among our study participants or in other similar research.<sup>53</sup>

## Limitations of the Study

In contrast to straightforward cross-sectional research, the comparative nature of the study was a crucial factor in enhancing its quality. To ensure the quality of the data, the study was also conducted under strict supervision and with regular follow-up. Despite these advantages, there are also some drawbacks to the study, such as the absence of quantitative real-time polymerase chain reaction (qRT-PCR). As a result, it was not possible to rule out occult HBV infection, which may have underestimated the prevalence of hepatitis virus infection in general and HBV infection specifically. The low percentage of MWHs may be another drawback of this research. Therefore, it is important to take these limitations into account when interpreting the results of this research.

## Conclusion

The overall seroprevalence of viral hepatitis in the current study was high. The prevalence of HBV infection among MWHs is in line with the high endemicity classification of the WHO, and there was a significant difference in the prevalence of HBV between DWHs and MWHs. The burden of HCV in the present study was in agreement with other similar studies in various study populations including waste handlers. The results of the current study did not indicate coinfection with HBV and HCV. A number of variables, such as working area, history of needle stick injury, and not using PPE, showed statistically significant associations with HBV infection. The seroprevalence of HCV was significantly higher among waste handlers with a history of not using PPE. Both groups of waste handlers should receive proper attention to protect them from any infectious agents, including HBV and HCV, that they can acquire during working hours. Healthcare administrators, municipal officers, and other stakeholders should work together to minimize the chances of infection due to viral hepatitis by ensuring access to PPE, arranging practical training, supplying informative guidelines, and providing free HBV vaccination schemes.

## Abbreviations

HBV, hepatitis B virus; HCV, hepatitis C virus; DWH, domestic waste handler; MWH, medical waste handler; ELISA, enzyme-linked immunosorbent assay.

## Data Sharing Statement

The original data used for this study are available from the corresponding author upon reasonable request.

## Acknowledgment

We would like to acknowledge the Research and Ethics Review Committee of Wollo University, College of Medicine and Health Sciences, who gave us permission to conduct this study. We are also grateful to our data collectors, and to the study participants who provided blood specimens for screening purposes and information about their socio-demographic and clinical characteristics.

## 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 report no conflicts of interest in this work.

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