**Reviewer’s Comments**

****

**Seroprevalence of Viral Marker (Hepatitis B and C, HIV) among Medical Waste Handlers in some Hospitals at Sana'a City- Yemen**

**Abstract**

**Background and Objective:** The hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) are highly contagious pathogens that threaten the medical waste handlers who are highly vulnerable to these viruses due to the nature of their job. Up to now, no data is available about the prevalence of viral markers (HBV, HCV, and HIV) among medical waste handlers in Sana'a city, Yemen. Consequently, this work was conducted to find out the prevalence of viral markers among medical waste handlers working in some hospitals in Sana'a capital of Yemen.

**Methods:** A cross-sectional prospective study was conducted among 120 randomly selected medical waste handlers from January to June 2022. A pretested and designed questionnaire was used to gather the required data. About 5-mL of venous blood was collected and centrifuged. The hepatitis B surface antigen and anti-HCV, as well as HIV antibody, were detected using a qualitative by rapid test cassette and the positive results were confirmed by the ELIZA technique.

**Results:** The overall rate of HBsAg, anti-HCV, and HIV positivity were detected in 9.17%, 5.0%, and 0.0%, respectively, rapid test. No significant differences were detected between socio-demographic characteristics and HBV and HCV infections. High rates of hepatitis B and C infection were found in the age group of ≥41 years (9.17%) and 21-30 years (8.77%), respectively. Also, both of these viruses were detected among married participants and who had a history of sharp injured between 7-9 times. There was a significant association between HBsAg positivity and history of blood transfusion as well as between HBsAg and anti-HCV positivity and history of vaccinated for hepatitis B. The ELISA technique revealed that the HBsAg was detected in 4.17% and anti-HCVin2.5%.

**Conclusion:** Appropriate training, immunization against HBV, and regular motivation of medical waste handlers on the practices of universal standard precautions are recommended to reduce HBV, HCV, and HIV transmission.

**Keywords:** ELISA, HBsAg, HCV, HIV, Hospitals, Medical Waste Handlers, Sana'a, Yemen

**INTRODUCTION**

Medical waste handlers are high exposure to infectious agents throughout the waste collection, segregation, transportation, storage, and final disposal of all types of waste that carry a high potential for infection 1. Exposure of medical waste handlers to infectious agents is the most common problem worldwide that occurs as a result of poor medical waste management practices in developing countries2,3. Medical waste which is generated during hospitals activities carries a varied range of pathogens such as hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) which account for most cases of occupational infection documented in the literature4,5. Transmission of these viruses are resulting from exposure to infectious blood or body fluids containing blood,blood transfusions or their products, and sexual contact. Also, in hospitals, the re-use of contaminated needles and syringes, multiple-use medication vials; infusion bags; and improperly sterilized surgical equipment are the factors contributing tothe transmission of these viruses6,7. The transmission of HBV is 50 to 100 times more infectious than HIV 8. In the year 2010, it was documented that the new cases were 33,800, 1.7 million, and 315,000, respectively, reported for HIV, HBV, and HCV resulting from the use of unsafe injections in hospitals 9. Hepatitis B and C viruses are the most common causes of chronic hepatitis, cirrhosis of the liver, liver failure, and hepatocellular carcinoma resulting worldwide in high morbidity and mortality 10,11.

Globally, the World Health Organization estimated that more than 500 million people are chronically infected with either of these two viruses that were responsible for an estimated 1.34 million deaths in the year 2015 12,13. Also, HBV and HCV together are presenting a major worldwide health problem and in 2013 viral hepatitis infection was the seventh foremost cause of global mortality14.

Commonly, medical waste handlers who are working in the collection, transportation, cleaning, and disposal of medical wastes are vulnerable to HBV, HCV, and HIV infection particularly in developing countries15. According to previous reports, the medical waste handlers were infected by HBsAg(20.4%)in Ethiopia1,HBsAg(1.3%) and HCV (0.7%) in southern Ethiopia16,HBsAg(2.3%)and HCV (2.7%) in Tripoli, Libya 15, 1.59% for HBsAgin Palestine17, 6.3% for HBV and 1% for HCV in Bangladesh18, and HIV (5%) in Africa 19.

Yemen is one of the developing countries where the infectious pathogenic microorganisms are easily spread among the population due to the lack of an effective health system, unsafe drinking water, poor environmental sensation, and uncontrolled disease transmission20-25. The prevalence rate of positive HBsAg among the population was between 8-50% in 2000 by Al-Shamahy26 and between 20% by Sallam*et al.* 26. The previous studies focused on the prevalence of viral viruses among adult Up to now, there no information about the prevalence of viral markers (HBV, HCV, and HIV) among medical waste handlers is available in Yemen. So, the present work aimed to identify the magnitude of HBV, HCV, and HIV infection and their associated risk factors among medical waste handlers working in some hospitals in Sana'a city –Yemen.

**MATERIALS AND METHODS**

**Study design and period**

This is a cross-sectional prospective study in which blood specimens were collected from waste medical handlers working in three public and three private hospitals located in Sana’a city, Yemen during a period from January 2022 to June 2022

**Study population**

This study was conducted among 120 medical waste handlers working in six hospitals including; Al-Gimhori, Al-Sabeen Maternal, Al-Thoawra general, University of Science and Technology,Modern European, Abdulkader Al-Mutawakel which is located at Sana’a City, Yemen.

**Sample size**

One hundred and twenty (120) blood specimens were randomly collected from medical waste handlers aged between 16-60 years old working in six hospitals in Sana’a city.

**Data collection**

The required data were collected from a subject study by using a designed questionnaire. The gender, age, marital state, educational level, working area, years of service (years), and frequency of sharp injury were asked. Also, history of blood transfusion or donation, surgical operations, dental procedures, needle prick, cupping, china acupuncture, history of liver disease, their family history of liver disease, and vaccinated for HBV were gathered by interview face-face.

**Inclusion and exclusion criteria**

All medical waste handlers who were working at hospitals and signed informed consent were included in this study. Also, the excluded participants refused to fill the questionnaire and sign the informed consent.

**Sample collection**

About 5-ml of venous blood samples were collected in a plain vacutainer tube under aseptic procedures and allowed to stand for about 20 min for clotting blood before centrifuging.

**Serological assay**

In the rapid test, about 3 drops of the serum were transferred separately by a sterile micropipette to the wells of the test kit to detect HBsAg (LUNGENE Rapid test Cassette HBsAg, China) and HCV (LUNGENE Rapid test Cassette Anti-HCV, China) as well as HIV antibody by rapid test Cassette (LUNGENE, China). The test was conducted after 10-15 minutes. The appearance of 2 distinctive red lines on the control and the test regions of the kit represented a positive reaction. Then, the positive results for HBsAg detection were confirmed by using an enzyme-linked immunosorbent assay (ELISA) (Labsystem Reader) using a commercially available kit (Biokit, Spain) at the AULAQI Specialized Med. Lab.

**Ethical consideration**

The ethical approval for this study was approved by the Al-Razi University Ethics and Review Committee and also permitted by the responsible subjected hospitals' administrations. The concept and purpose of this study were explained to study participants.

**Statistical analysis**

The obtained data were statistically analyzed by using the SPSS program (version 20.0). A significant difference between the proportions and the variables associated with HBV infections was determined. A *P*-value (< 0.05) was considered statistically significant.

**RESULTS**

**Socio-demographic**

Most blood specimens were sampled from medical waste handlers aged between 21-30 years (47.5%), male (100%), married (61.67%),uneducated (31.67%), working in the laboratory department (25%), and had a history of diagnosed for hepatitis test before work attending (74.17%), no one of them checked every 5-6 month (100%),every one year (19.17%), and every four years (0.83%). Also, 54.17% of study subjects had work experiences between 1-4 years and 33.33% of them said they had history of sharp injury between 1-3 times **(Table 1).**

**Table 1:** Socio-demographic of participated medical waste handlers

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Examined No.(%)** | **Variables** | **Examined No.(%)** |
| **Age group****(in years)** | **≤ 20** | 25 (20.83) | **Educational level** | **Illiterate** | 38(31.67) |
| **21-30** | 57(47.5) | **Primary**  | 19(15.83) |
| **31-40** | 29(24.17) | **Junior-high**  | 29(24.17) |
| **≥41** | 9(7.5) | **Secondary**  | 34(28.33) |
| **Gender** | **Male** | 120(100) | **Work****location** | **Laboratory** | 30(25.0) |
| **Female** | 0(0) | **Operating Room** | 18(15.0) |
| **Marital state** | **Married** | 74(61.67) | **ICU** | 18(15.0) |
| **Single** | 46(38.33) | **Emergency** | 6(5.0) |
| **History of hepatitis diagnosis:** | **Patients room** | 10(8.33) |
| **Before work**  | **Yes**  | 89(74.17) | **Laundry** | 3(2.5) |
| **No**  | 31(25.83) | **Outpatient** | 6(5.0) |
| **Periodically** | **Yes**  | 95(79.17) | **Movement** | 29(24.17) |
| **No**  | 25(20.83) | **Work experience (years)** | **1-4** | 65(54.17) |
| **Every 5-6 month** | **Yes**  | 0(0) | **5-10** | 43(35.83) |
| **No**  | 120(100) | **≥11** | 12(10) |
| **Every one year** | **Yes**  | 23(19.17) | **Frequency of sharp injury (times)** | **1-3**  | 40 (33.33) |
| **No** | 97(80.83) | **4-6** | 38 (31.67) |
| **Every four year** | **Yes**  | 1(0.83) | **7-9** | 6 (5) |
| **No**  | 119(99.17) | **≥ 10** | 36 (30) |

Table 2 shows that most of participated respondents said that they didn't have a history of blood transfusion, blood donation, surgical operation, dental procedure, cupping, china acupuncture, having liver disease, and their family had liver disease with HBV. While most of them were exposed to needle prick and vaccinated for HBV.

**Table 2.** Clinically risk factors associated with prevalence of viral markers

|  |  |  |
| --- | --- | --- |
| **Variables** | **Yes response****No. examined (%)** | **No response** **No. examined (%)** |
| Received blood transfusion | 32 (26.67) | 88 (73.33) |
| Blood donation | 31(25.83) | 89 (74.17) |
| Surgical operations | 39(32.5) | 81(67.5) |
| Dental procedures | 4(3.33) | 116(96.67) |
| Needle prick | 99(82.5) | 21(17.5) |
| Cupping | 27(22.5) | 93(77.5) |
| China acupuncture  | 20(16.67) | 100(38.33) |
| History of liver disease | 5(4.17) | 115(95.83) |
| Any family member with hepatitis  | 14(11.67) | 106(88.33) |
| Vaccinated for hepatitis B | 61(50.83) | 59(49.17) |

**Sero-prevalence result of viral markers**

The present study revealed that the seroprevalence of HBsAg and anti-HCV among medical waste handlers was 11(9.17%) and 6(5.0%), respectively. While all study subjects were free from HIV antibodies as figured in Fig. (1).

**Figure 1:**Seroprevalence of viral markers among medical waste handlers

This result showed that the higher rate of HBsAg and anti- HCV positivity were recorded among the age group of ≥41 years and31-40 years, respectively, and both among married participants who hold junior-high school education and work in ICU. Also, the study subjects who had work experience between 5 to 10 years and ≥11yearswere more infected by HBsAg (16.28%) and anti-HCV (8.33%). (Table 3).

**Table 3:** Seroprevalence of viral markers associated with socio-demographic

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Examined No. (%)** | **HBsAg No. (%)** | **P-value** | **Anti-HCV No. (%)** | **P-value** | **Anti-HIV No.(%)** |
| **Age group****(in years)** | **≤ 20** | **25 (20.83)** | 1(4.0) | 0.628 | 0(0) | 0.286 | 0(0) |
| **21-30** | **57(47.5)** | 5(8.77) | 5(8.77) | 0(0) |
| **31-40** | **29(24.17)** | 4(13.79) | 1(3.44) | 0(0) |
| **≥41** | **9(7.5)** | 1(16.67) | 0(0) | 0(0) |
| **Gender** | **Male** | **120(100)** | 11(9.17) | 0 | 6(5) | 0 | 0(0) |
| **Female** | **0(0)** | 0(0) | 0(0) | 0(0) |
| **Marital state** | **Married** | **74(61.67)** | 9(12.16) | 0.152 | 4(5.41) | 0.798 | 0(0) |
| **Single** | **46(38.33)** | 2(4.35) | 2(4.35) | 0(0) |
|  **Educational level** | **Illiterate** | **38(31.67)** | 4(10.53) | 0.198 | 2(5.26) | 0.057 | 0(0) |
| **Primary**  | **19(15.83)** | 0(0) | 0(0) | 0(0) |
| **Junior high**  | **29(24.17)** | 5(17.24) | 4(13.79) | 0(0) |
| **Secondary**  | **34(28.33)** | 2(5.88) | 0(0) | 0(0) |
| **Work location** | **Laboratory** | **30(25.0)** | 2(6.67) | 0.140 | 1(3.33) | 0.325 | 0(0) |
| **Operating Room** | **18(15.0)** | 3(16.67) | 1(5.55) | 0(0) |
| **ICU** | **18(15.0)** | 4(22.22) | 3(16.67) | 0(0) |
| **Emergency** | **6(5.0)** | 0(0) | 0(0) | 0(0) |
| **Patients room** | **10(8.33)** | 2(20.0) | 1(10.0) | 0(0) |
| **Laundry** | **3(2.5)** | 0(0) | 0(0) | 0(0) |
| **Outpatient** | **6(5.0)** | 0(0) | 0(0) | 0(0) |
| **Movement** | **29(24.17)** | 0(0) | 0(0) | 0(0) |
| **Work experience (years)** | **1-4** | **65(54.17)** | 4(6.15) | 0.456 | 2(3.08) | 0.582 | 0(0) |
| **5-10** | **43(35.83)** | 7(16.28) | 3(6.98) | 0(0) |
| **≥11** | **12(10)** | 0(0) | 1(8.33) | 0(0) |

\*Significant statistics at *p*-value <0.05.

In the current finding, it was noticed that the study respondents who did not periodically diagnose with hepatitis had a higher rate of HBsAg (44%) and anti-HCV (24%) while a lower rate was detected among study respondents who had hepatitis diagnosed before work attending (Table 4).

**Table 4:**Frequency of HBsAg, anti-HCV, and HIV antibody according to hepatitis testing

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Examined****No. (%)** | **HBsAg No. (%)** | **P-value** | **Anti-HCV No. (%)** | **P-value** | **Anti-HIV No.(%)** |
| **Before work attending** | **Yes**  | **89(74.17)** | 11(12.36) | 0.040 | 6(6.74) | 0.140 | 0(0) |
| **No**  | **31(25.83)** | 0(0) | 0(0) | 0(0) |
| **Periodically** | **Yes**  | **95(79.17)** | 0(0) | 0.075 | 0(0) | 0.200 | 0(0) |
| **No**  | **25(20.83)** | 11(44.0) | 6(24.0) | 0(0) |
| **Every 5-6 month** | **Yes**  | **0(0)** | 0(0) | N  | 0(0) | N  | 0(0) |
| **No**  | **120(100)** | 0(0) | 0(0) | 0(0) |
| **Every one year** | **Yes**  | **23(19.17)** | 0(0) | N | 0(0) | N | 0(0) |
| **No**  | **97(80.83)** | 0(0) | 0(0) | 0(0) |
| **Every four year** | **Yes**  | **1(0.83)** | 0(0) | N | 0(0) | N | 0(0) |
| **No**  | **119(99.17)** | 0(0) | 0(0) | 0(0) |

\*Significant statistics at *p*-value <0.05. **N**= Not Applicable

Table 5 shows the study subjects who had a history of sharp injured between 7-9 times were found to be more exposed to both HBsAg and anti-HCV infection.

**Table 5:**Frequency of HBsAg, anti-HCV, and HIV antibody according to frequency of sharp injury

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Frequency of sharp injury (times)** | **Examined****No. (%)** | **HBsAg****No.(%)** | **P-value** | **Anti-HCV No. (%)** | **P-value** | **Anti-HIV No.(%)** |
| **1-3**  | **40 (33.33)** | 2(5.0) | 0.447 | 2(5.0) | 0.164 | 0(0) |
| **4-6** | **38 (31.67)** | 6(15.79) | 0(0) | 0(0) |
| **7-9** | **6 (5)** | **1(16.67)** | **1(16.67)** | 0(0) |
| **≥ 10** | **36 (30)** | 2(5.55) | 1(2.78) | 0(0) |
| **Total**  | **120 (100)** | **11 (9.17)** |  | **6 (5.0)** |  | **0(0)** |

\*Significant statistics at *p*-value <0.05.

Table 6 reveals that the highest sero-positivity rate of HBsAg and anti-HCV were recorded among participants who received a blood transfusion, donate blood, and were exposed to needle prick. Also, the study subjects who didn't have and their family history of liver disease with hepatitis were more infected for HBsAg and anti-HCV. The respondent vaccinated with hepatitis were free from both HBV and HCV infection.

**Table 6.** Frequency of HBsAg and anti-HCV associated with clinical risk factors of medical waste handlers

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **No. (%)** | **HBsAg No. (%)** | ***P*-value** | **No. (%)** | **Anti-HCV****No. (%)** | ***P*-value** |
| **Received blood transfusion** | **Yes**  | 32 (26.67) | 8(25.0) | 0.000 | 32 (26.67) | 2(6.25) | 0.188 |
| **No**  | 88 (73.33) | 3(3.41) | 88 (73.33) | 4(4.54) |
| **Blood donation** | **Yes**  | 31(25.83) | 4(12.90) | 0.407 | 31(25.83) | 3(9.68) | 0.168 |
| **No**  | 89(74.17) | 7(7.86) | 89(74.17) | 3(3.37) |
| **Surgical operations** | **Yes**  | 39(32.5) | 2(5.13) | 0.291 | 39(32.5) | 2(5.13) | 0.965 |
| **No**  | 81(67.5) | 9(11.11) | 81(67.5) | 4(4.94) |
| **Dental procedures** | **Yes**  | 4(3.33) | 0(0) | 0.522 | 4(3.33) | 0(0) | 0.644 |
| **No**  | 116(96.67) | 11(9.48) | 116(96.67) | 6(5.17) |
| **Needle prick** | **Yes**  | 99(82.5) | 11(11.11) | 0.111 | 99(82.5) | 6(6.06) | 0.251 |
| **No**  | 21(17.5) | 0(0) | 21(17.5) | 0(0) |
| **Cupping** | **Yes**  | 27(22.5) | 4(14.84) | 0.252 | 27(22.5) | 1(3.70) | 0.728 |
| **No**  | 93(77.5) | 7(7.53) | 93(77.5) | 5(5.37) |
| **China acupuncture**  | **Yes**  | 20(16.67) | 1(5.0) | 0.483 | 20(16.67) | 1(5.0) | 1.00 |
| **No**  | 100(83.33) | 10(10.0) | 100(83.33) | 5(5.0) |
| **History of liver disease** | **Yes**  | 5(4.17) | 0(0) | 0.472 | 5(4.17) | 0(0) | 0.604 |
| **No**  | 115(95.83) | 11(9.56) | 115(95.83) | 6(5.22) |
| **Any family member with hepatitis** | **Yes**  | 14(11.67) | 1(7.14) | 0.782 | 14(11.67) | 0(0) | 0.365 |
| **No**  | 106(88.33) | 10(9.43) | 106(88.33) | 6(5.66) |
| **Vaccinated for hepatitis B** | **Yes**  | **61(50.83)** | 0(0) | 0.000 | 61(50.83) | 0(0) | 0.010 |
| **No**  | 59(49.17) | 11(18.64) | 59(49.17) | 6(10.17) |

\*Significant statistics at *p*-value <0.05.

Table 7 shows the comparison between the Cassatt and ELISA techniques. It was observed that the Cassatt technique detected the HBsAg at 9.17% and anti-HCV at 5%. While the ELISA technique revealed that theHBsAg and anti-HCV were detected at 4.17% and 2.5%, respectively.

**Table 7.** Frequency of HBsAg and anti-HCV infection

|  |  |  |
| --- | --- | --- |
| **Viral markers** | **Cassatt technique**  | **ELISA technique** |
|  **No. of positive (%)** | **No. of negative (%)** |  **No. of positive (%)** | **No. of negative (%)** |
| **HBs Ag** | 11 (9.17) | 109 (90.83) | 5 (4.17) | 115 (95.83) |
| **Anti-HCV** | 6(5.0) | 114 (95.0) | 3 (2.50) | 117 (97.50) |

**DISCUSSION**

The prevalence of hepatitis viruses that consider a serious problem for Yemen health system were documented in several studies28,29,30.In the current result, it was found that the seroprevalence of HBsAg was 9.17% and anti-HCV was 5% recorded among medical waste handlers. While all study subjects were free from HIV antibodies. Similar study by Mengiste*et al*. 1documented that the HBsAg was 20.4% reported in eastern Ethiopia. Also, the HBsAg and anti-HCV, respectively, were detected at 1.3% and 0.7% in southern Ethiopia16.

However, in several reports, the seroprevalence has been reported at 2.3% for HBsAg and 2.7% for anti-HCV in Tripoli, Libya15,1.59% for HBsAg in Palestine17, 6.3% for HBsAg in Addis Ababa, central Ethiopia 31, and 6.3% for HBV and 1% for HCV in Bangladesh18.

The current result revealed that the high rate of HBsAg and anti-HCV were found among the age group of ≥41 and 21-30 years, respectively. These results are consistent with some studies conducted in different countries16,18,31. The high rate of hepatitis viruses observed in this study among older than 30 years of age may be due to the increased risk of exposure to hepatitis virus infection with time and might be more susceptible.

The high prevalence of infectious diseases in later years in Yemen resulted from the war since 2015 and so on. Also, these conflicts have been contributing significantly in increase poverty among the population, increasing costs the live requirements, and most families immigrating to other areas that are safe for them to live 32-40.

The present finding revealed that the married participants had the highest rate of HBsAg and anti-HCV when compared to single participants. This result is in agreement with a study conducted in Northwest Ethiopia 41, Bangladesh18, and southern Ethiopia 16.

The majority of enrollment in the present study who were educated in junior high-primary were more positive for HBsAg and anti-HCV. Comparable reports were obtained in Ethiopia 41, Libya15, and Bangladesh18.Moreover, medical waste handlers working in hospital ICU had the highest rate of HBsAg and anti-HCV compared to others working in hospital areas and this is a similar finding by Amsalu*et al*. 16.

The highest rate of hepatitis B surface antigen in our study was detected among study subjects who had work experience between 5 to 10 years and anti-HCV was equal or more than 11 years. This finding is supported by some studies that documented that the prevalence of HBsAg was higher among study subjects who have working experience between 5-10 years16,18,31.

The current result showed that 44% of HBsAg and 24% of anti-HCV were detected among study subjects who said that they did not periodically diagnose with hepatitis and there are no previous studies to compare with this study.

The high rate of HbsAg and anti-HCV was noticed among study participants who had a history of receiving a blood transfusion and blood donation. This result is similar with finding in Ethiopia1, Spain 42, and Japan 43. Therefore, the infected individuals in this study are remaining high risk and threaten the community if they donate their blood to other people.For that reason, it is preferable to exclude individuals who had previously worked in medical waste collection in hospitals by donating blood to other people.

This study showed that there was no significant association between HBsAg and anti-HCV positivity and history of frequency of sharp injury. This result is consistent with a study by Amsalu *et al*. 16. The causes of frequency of sharp injury resulting to improperly discarded needle and sharps, overfilled sharps containers, and improper handling of sharps during transportation16.

These incidents may be prevented by use the PPE such as puncture-resistant gloves, poly cotton trousers, penetration-proof masks, and protective glasses. In addition, the following the precaution guideline on the correct use of waste containers and appropriate segregation of wastes at source will be minimized potential risk for medical waste handlers.

This result showed that there was no significant association between HBsAg and anti-HCV positivity and history of blood donation, surgical operations, dental procedures, chronic disease, china acupuncture, cupping, and their family had a history of HBV. Positive results for HBsAg (11.11%) and anti-HCV (6.06%) in the present work were found among the participants who were exposed to needle prick while there was no one of the participants who didn't expose to needle prick was infected. The present finding was consistent with the studies that documented that needle-stick injuries among medical waste handlers and healthcare workers were the most frequent forms of exposure to HBV infections18,44. This finding indicates that the participants might be the acquisition of the hepatitis B and C virus infection through working in hospitals.

Furthermore, the study subjects, in this work, who didn't have and their family history of liver disease with hepatitis were found to be more infected by HBsAg and anti-HCV. This result was supported by a report performed by Amsalu*et al*. 16.

It was found in this study that 11(18.64%) and 6(10.17%) of non-vaccinated participated medical waste handlers were positive for HBsAg and ant-HCV, respectively with statistically significant differences (*P*˂ 0.05). This finding is in agreement with similar studies1,31,45. The decrease in the prevalence of HBsAg among vaccinated individuals in Yemen has well been noticed in previous studies 46,47.

HBV vaccine is considered the sole protective method which is required to immunize all medical waste handlers as well as healthcare workers against HBV infection. Hence receiving immunization not only decrease medical waste handlers' chance of being infected and prevent thoughtful disease but also contributes to community protection and reduces the likelihood of virus transmission 47.

Rendering a comparison between the cassette and ELISA techniques, the present result showed that the ELISA technique had more sensitivity and specificity for HBsAg detection. This result was supported by some reports 47, 48. Yemen is one of the countries that use non-advance technique such as rapid test cassettes, for hepatitis virus screening among blood donors. This technique giving more false-positive results is better for the diagnosis than those giving more false-negative results49. A false-positive can be followed by more accurate and advanced method to confirm the infection (presence) unlike the false negative results which may jeopardize human safety 50.

**CONCLUSION**

In this study, it can be concluded that a low rate of hepatitis B and C viruses observed among medical waste handlers represents a serious health problem for their life and family. The inadequate of knowledge, training, practices, and unvaccinated against hepatitis B are some factors that contributed to the prevalence of hepatitis B and C viruses among subjects studied. Therefore, health promotion, adequate immunization against hepatitis B, training on universal precaution guideline, and effective medical waste management are crucial in the prevention of HBV and HCV infection. Also, the ELISA technique is preferable for confirming the hepatitis B and C diagnosis.

**CONFLICT OF INTEREST**

The authors declare that they have no competing interests.

**ACKNOWLEDGMENT**

The authors would like to thank staff members of Al-Gimhori, Al-Sabeen Maternal, Al-Thoawra general, University of Science and Technology, Modern European, and Abdulkader Al-Mutawakel hospitals for their help during the study and specimens collection.

**LIMITATIONS OF THE STUDY**

**REFERENCES**

1. Mengiste DA, Dirbsa AT, BehailuHawulteAyele BH, Hailegiyorgis TT. Hepatitis B virus infection and its associated factors among medical waste collectors at public health facilities in eastern Ethiopia: a facility-based cross-sectional study. BMC Infect Dis., (2021); 21:233. <https://doi.org/10.1186/s12879-021-05918-x>
2. Coker A, Sangodoyin A, Sridhar M, Booth C, Olomolaiye P, Hammond F: Medical waste management in Ibadan, Nigeria: Obstacles and prospects. Waste Manag 2009; 29:804-811.  DOI: [10.1016/j.wasman.2008.06.040](https://doi.org/10.1016/j.wasman.2008.06.040)
3. Le Pont F, Hatungimana V, Guiguet M. Assessment of occupational exposure to human immunodeficiency virus and hepatitis C virus in a referral hospital in Burundi, Central Africa. Infect Control HospEpidemiol. 2003; 24:717-718. DOI: <https://doi.org/10.1086/502908>
4. Gunn RA, Murray PJ, Ackers ML, Hardison WG, Margolis HS. Screening for chronic hepatitis B and C viruses infections in an urban sexually transmitted disease clinic-rationale for integrating services. Sex Transm Dis. 2001; 28:166-170. DOI: [10.1097/00007435-200103000-00008](https://doi.org/10.1097/00007435-200103000-00008)
5. Tarantola A, Abiteboul D, Rachline A: Infection risks accidental exposure to blood or body fluids in health care workers: a review of pathogens transmitted in published cases. Am J Infect Control 2006; 34:367-375.DOI: [10.1016/j.ajic.2004.11.011](https://doi.org/10.1016/j.ajic.2004.11.011)
6. Alter MJ (2007). Epidemiology of hepatitis C virus infection. World Journal of Gastroenterology. 13 (17): 2436–2441. [doi](https://en.wikipedia.org/wiki/Doi_%28identifier%29):[10.3748/wjg.v13.i17.2436](https://doi.org/10.3748/wjg.v13.i17.2436). [PMC](https://en.wikipedia.org/wiki/PMC_%28identifier%29) [4146761](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4146761).
7. Buddeberg F, Schimmer BB, Spahn DR. Transfusion-transmissible infections and transfusion-related immunomodulation (PDF). Best Practice & Research. Clinical Anaesthesiology. 2008; 22 (3): 503–517. doi:10.1016/j.bpa.2008.05.003.
8. Centers for Disease Control and Prevention (CDC). Hepatitis B FAQs for the public. Archived from the original on 20 August 2015. Retrieved 24 March 2022.
9. Pepin J, Abou Chakra CN, Pépin E, Nault V, Valiquette L. Evolution of the global burden of viral infections from unsafe medical injections, 2000-2010. PLoS ONE. 2014; 9: e99677.<https://doi.org/10.1371/journal.pone.0099677>
10. Westermann C, Peters C, Lisiak B, Lamberti M, Nienhaus A. The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. Occup Environ Med. 2015;72(12):880–888. <https://doi.org/10.1136/oemed-2015-102879>.
11. Budak GG, Gülenç N, Özkan E, Bülbül R, *et al*. Seroprevalences of hepatitis B and hepatitis C among healthcare workers in Tire State Hospital. Dicle Med J. 2017;44(3):267–270. DOI:  [10.5798/dicletip.339008](http://dx.doi.org/10.5798/dicletip.339008)
12. World Health Organization. Prevention and control of viral hepatitis infection: framework for global action; 2012 [cited 2022 May 25]. Available from: <http://www.who.int/hiv/pub/hepatitis/Framework/en/>
13. Aaron D, Nagu TJ, Rwegasha J, Komba E. Hepatitis B vaccination coverage among healthcare workers at national hospital in Tanzania: how much, who and why? BMC Infect Dis 2017;17(1):1–7. DOI: [10.1186/s12879-017-2893-8](https://doi.org/10.1186/s12879-017-2893-8)
14. Ishizaki A, Bouscaillou J, Luhmann N, Liu S, Chua R, Walsh N, *et al*. Survey of programmatic experiences and challenges in delivery of hepatitis B and C testing in low- and middle-income countries. BMC Infect Dis. 2017;17(1): 130–140. DOI: [10.1186/s12879-017-2767-0](https://doi.org/10.1186/s12879-017-2767-0)
15. Franka E, El-Zoka AH, Hussein AH, Elbakosh MM, Arafa AK, Ghenghesh KS. Hepatitis B virus and hepatitis C virus in medical waste handlers in Tripoli, Libya. J Hosp Infect 2009;72:258-261. DOI: [10.1016/j.jhin.2009.03.019](https://doi.org/10.1016/j.jhin.2009.03.019)
16. Amsalu A, Worku M, Tadesse E, Shimelis T. The exposure rate to hepatitis B and C viruses among medical waste handlers in three government hospitals, southern Ethiopia. Epidemiol Health. 2016;38:e2016001-e.<http://dx.doi.org/10.4178/epih/e2016001>
17. Al-Khatib IA, Al-Qaroot YS, Ali-Shtayeh MS. Management of healthcare waste in circumstances of limited resources: A case study in the hospitals of Nablus city, Palestine. Waste Manag Res 2009;27: 305-312. DOI: [10.1177/0734242X08094124](https://doi.org/10.1177/0734242x08094124)
18. Uddin MS, Islam MN, Khan MEU, Yeasmin S, Ahmed F, Amiruzzaman M. Frequency of hepatitis B and C viral infection among the medical waste handlers. Bangladesh J Infect Dis 2017;4(1):3-9. DOI: <http://dx.doi.org/10.3329/bjid.v4i1.37673>
19. Blenkharn I, Odd C. Sharps injuries in healthcare waste handlers. Ann OccupHyg 2008; 52:281-286. DOI: [10.1093/annhyg/men010](https://doi.org/10.1093/annhyg/men010)
20. Edrees HW, Al-Awar SM. Bacterial contamination of mobile phones of medical laboratory workers at Sana’a city, Yemen and their antimicrobial susceptibility. JPPRes 2020; 8 (6): 591-599.[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Phar+Pharmaco+Res&title=Bacterial+contamination+of+mobile+phones+of+medical+laboratory+workers+at+Sana%27a+city,+Yemen+and+their+antimicrobial+susceptibility&volume=8&publication_year=2020&pages=591-599&)
21. Abdullah QY, Al-Helali MF, Al-Mahbashi A, Qaaed ST, Edrees WH. Seroprevalence of dengue fever virus among suspected patients in Taizgovernorate-Yemen. UJPR 2020; 5(5):21-26.<https://doi.org/10.22270/ujpr.v5i5.482>
22. Edrees WH, Mogalli NM, Alabdaly KW. Assessment of some clinical and laboratory profiles among dengue fever patients in Hajjahgovernment, Yemen. UJPR 2021; 6(2):38-41.<https://doi.org/10.22270/ujpr.v6i2.571>
23. Gobara'a AA, Edrees WH, Al-Shehari WA, Al-Madhagi A, Al-Moyed K, AlmezgagiMM, Reem A. Prevalenceof rubella IgG antibodies among productive-age ‎women in Al-Mahweet Governorate, Yemen. UJPR 2020; 5(4):28-32.<https://doi.org/10.22270/ujpr.v5i3.413>
24. Al-Haik MW, Al-Haddad MA, Al-kaf GA, Edrees HW. Antimicrobial activities for hadhrami honey on growth of some pathogenic bacteria. UJPR 2017; 2(6): 7-12.<http://dx.doi.org/10.22270/ujpr.v2i6.R2>
25. Alhlale FM, Saleh HA, Alsweedi SK, Edrees HW. The inhibitory effect of *Euphorbiahirta* extracts against some wound bacteria isolated from Yemeni patients.COPS. 2019; 3(2): 780-786.
26. Al-Shamahy H. Prevalence of hepatitis B surface antigen and risk factors of HBV infection in a sample of healthy mothers and their infants in Sana'a, Yemen. Ann Saudi Med 2000; 20(5-6):464-466. DOI: [10.5144/0256-4947.2000.464](https://doi.org/10.5144/0256-4947.2000.464)
27. Sallam TA, Tong CY, Cuevas LE, Raja’a YA, Othman AM, Al-Kharsa KR. Prevalence of blood-borne viral hepatitis in different communities in Yemen. Epidemiol Infect 2003; 131:771—775. DOI: [10.1017/s0950268803008653](https://doi.org/10.1017/s0950268803008653)
28. Edrees WH, Banafa AM, Al-Awar MS. Risk factors and seroprevalence of hepatitis B virus antigen among university students in the Sana'a City, Yemen. Al-RaziUniv J Med Sci 2022; 6(1):8-16. DOI: <https://doi.org/10.51610/rujms6.1.2022.122>
29. Almezgagi MM, Edrees WH, Al-Shehari WA, Al-Moyed K, Al-Khwlany RS, Abbas AB. Prevalence of hepatitis B virus and hepatitis C virus and associated risk factors among hemodialysis patients in Ibb City-Yemen. PSM Microbiol2020; 5(2): 32-40.
30. Al-Shamahy HA, Rabbad IA, Al-Hababy A. Hepatitis B virus serum markers among pregnant women in Sana’a, Yemen. Ann Saudi Med., 2003; 23:87−89.DOI: [10.5144/0256-4947.2003.87](https://doi.org/10.5144/0256-4947.2003.87)
31. Shiferaw Y, Abebe T, Mihret A. Hepatitis B virus infection among medical aste handlers in Addis Ababa, Ethiopia. BMC Res Notes 2011;4:479.DOI <https://doi.org/10.1186/1756-0500-4-479>
32. Edrees WH, Al-Asbahi AA, Al-Shehari WA, Qasem EA. Vulvovaginal candidiasis prevalence among pregnant women in different hospitals in Ibb, Yemen. UJPR 2020; 5(4):1-5. DOI: <https://doi.org/10.22270/ujpr.v5i4.431>
33. Qasem EA, Edrees WH, Al-Shehari WA, Alshahethi MA. Frequency of intestinal parasitic infections among schoolchildren in Ibb city-Yemen. UJPR 2020; 5(2):42-46.<https://doi.org/10.22270/ujpr.v5i2.388>
34. Edrees HW, Alshwmi M, Al-Ofairi AB. Prevalence and antifungal susceptibility of *Candida* species causing vaginitis among pregnant women in Hajjah Governorate, Yemen. Al-RaziUniv J Med Sci 2021; 5;(1): 1-8.<https://doi.org/10.51610/rujms/2.5.1.202>
35. Alshahethi MA, Edrees WH, Mogalli NM, Al-Halani AA, Al-Shehari WA, Reem A. Distribution and risk factors for *Giardialamblia* among children at Amran Governorate, Yemen. UJPR., 2020; 5(3):34-37.<https://doi.org/10.22270/ujpr.v5i3.413>
36. Edrees WH. Antibacterial susceptibility and Sider honey activity against isolated bacteria from wound patients attending at Al-Gmohori hospital in Hajja City, Yemen. Al-RaziUniv J Med Sci 2021; 5 (2):1-8.<https://doi.org/10.51610/rujms5.2.2021.108>
37. Al-Shamahy HA, Jaadan BM, Al-Madhaji AG, *et al*. Prevalence and potential risk factors of hepatitis B virus in a sample of children in two selected areas in Yemen. UJPR 2019; 4(3): 17-21. DOI; [10.22270/ujpr.v4i3.269](https://doi.org/10.22270/ujpr.v4i3.269)
38. Edrees WH, Alshahethi MA, Alariqi RR, Khoailed AA, Saif WW, Al-Saqaf SB, Al-Awar MS. Detection of intestinal parasites of some fresh vegetables and their consumers in Sana'a City, Yemen. Al-RaziUniv J Med Sci 2021; 5 (2):19-25.<https://doi.org/10.51610/rujms5.2.2021.112>
39. Mogalli NM, EdreesWH, Al-Awar MS, Alshahethi MA, Al-Shehari WA. Prevalence of intestinal parasitic infections among primary schoolchildren in Kohlan district at Hajjah governorate, Yemen. Al-RaziUniv J Med Sci 2020; 4 (2):34-39.DOI: <https://doi.org/10.51610/rujms4.2.2020.75>
40. drees WH. Seroprevalence and risk factors for *Helicobacter pylori* infection among school students in Sana'a City, Yemen. UJPR 2022; 7(2):67-73. DOI: <https://doi.org/10.22270/ujpr.v7i2.747>
41. Anagaw B, Shiferaw Y, Anagaw B, Belyhun Y, Erku W, Biadgelegn F, *et al*. Seroprevalence of hepatitis B and C viruses among medical waste handlers at Gondar town health institutions, Northwest Ethiopia. BMC Res Notes 2012;5:55.doi:<https://doi.org/10.1186/1756-0500-5-55>
42. López-Menchero C, Alvarez M, Fernández P, Guzmán M, Ortiz-de-Salazar MI, Arbona C. Evolution of the residual risk of HBV, HCV and HIV transmission through blood transfusion in the region of Valencia, Spain, during a 15-year period (2003-2017). Blood Transfus 2019;17(6):418–427. DOI; [10.2450/2019.0058-19](https://doi.org/10.2450/2019.0058-19)
43. Matsumoto C, Tadokoro K, Fujimura K, Hirakawa S, Mitsunaga S, Juji T. Analysis of HBV infection after blood transfusion in Japan through investigation of a comprehensive donor specimen repository. Transfusion. 2001;41(7):878–884. DOI; [10.1046/j.1537-2995.2001.41070878.x](https://doi.org/10.1046/j.1537-2995.2001.41070878.x)
44. Ansa V, Udoma E, Umoh M, Anah M: Occupational risk of infection by human immunodeficiency and hepatitis B viruses among health workers in South-eastern, Nigeria. East Afr Med J 2002, 79:25-27. DOI; [10.4314/eamj.v79i5.8863](https://doi.org/10.4314/eamj.v79i5.8863)
45. Kangethe JM, Komu JG, Muturi DN, *et al*. Hepatitis B virus infections and associated risk factors among medical waste handlers at the Kenyatta National Hospital, Nairobi Kenya. JMSCR., 2019; 07(03):499-506.DOI: <https://dx.doi.org/10.18535/jmscr/v7i3.92>
46. Al-Shamahy HA, Hanash SH, Rabbad IA, Al-Madhaji NM, Naser SM. Hepatitis B vaccine coverage and the immune response in children under ten years old in Sana’a, Yemen. SQU Med J 2011; 11(1): 77-82.PMID: [21509212](https://pubmed.ncbi.nlm.nih.gov/21509212)
47. Banafa AM, Edrees WH, Al-Falahi GH, Al-Shehari WA. Prevalence of hepatitis B surface antigen among orphans children living in orphanage in Sana'a city, Yemen. PSM Microbiol 2022; 7(1): 19-26.
48. Navvabi N, Khadem Ansari MH, Navvabi A, Chalipa HR, Zitricky F. Comparative assessment of immunochromatography and ELISA diagnostic tests for HBsAg detection in PCR-conﬁrmed HBV infection. Rev GastroenterolMéx., 2021.RGMXEN-741.<https://doi.org/10.1016/j.rgmx.2020.12.003>
49. Sharma M, Golia S, Mehra SK, Jani MV. A comparative evaluation of rapid card test with enzyme-linked immunosorbent assay for the detection of HBsAg among pregnant women in a tertiary care hospital. Int Arch Bio Med Clin Res. 2019;5(1):31-33.DOI: <https://doi.org/10.21276/iabcr.2019.5.1.09>
50. Mishra RK, Tiwari YK, Pundir S, Saraf G, Pawan K, Dashora D, *et al*. A comparison of rapid card test with enzyme-linked immunosorbent assay for the detection of hepatitis B surface antigen [HBsAg] in tertiary care hospital. Research and reviews: A Journal of Microbiology and Virology. 2017;7(3):27-31.