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Original Article

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Prevalence and Risk Factors of Hepatitis C Virus Infection Among Garbage Collectors in Tehran, Iran

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Abstract

Background: Garbage collectors face a heightened risk of exposure to blood borne viruses like Hepatitis C Virus (HCV) infection. Accurate statistics on HCV prevalence and risk factors among garbage collectors, particularly in Tehran, are lacking. This study aims to determine the prevalence of hepatitis C infection among garbage collectors in Tehran and identify associated risk factors, contributing to a better understanding of their health risks.

Methods: A cross-sectional study was conducted involving 132 unauthorized garbage collectors across 22 districts in Tehran. Participants were selected using cluster sampling, and data were collected through interviews and rapid hepatitis C infection testing. Statistical analyses were performed using univariate and multivariate logistic regression models to identify independent risk factors for hepatitis C infection.

Results: The study found that 7.6% of participants tested positive for hepatitis C infection. The mean age was 29.8 years, and approximately 48.5% of those with HCV had no history of addiction, indicating that other exposures such as tattooing in prison and unsafe practices also contributed to infection risk. Significant risk factors identified included a history of tattooing in prison (OR: 10.58, 95%CI: 1.77-63.26, p=0.01). Compared to similar studies, the results of this showed a lower hepatitis C infection prevalence, but higher than that in the general population of Tehran.

Conclusion: The high prevalence of hepatitis C infection among Tehran's garbage collectors underscores the critical need for targeted public health interventions. Efforts should focus on reducing risk behaviors, improving health education, and enhancing disease management. Systemic reforms and better data collection are essential for safeguarding the health of garbage collectors.

Keywords: Hepatitis C, Infection, Prevalence, Prisons, Public health, Risk factors, Tattooing

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Introduction

Garbage collection is a vital global activity involving the removal of municipal solid garbage. However, this task exposes garbage collectors to various hazards, including biological, chemical, mechanical, physical, and psychosocial risks. Notably, garbage collectors encounter biological hazards such as contaminated needles, syringes, and hospital garbage (1,2).

Despite the importance of garbage collection, accurate statistics on the number of garbage collectors remain elusive due to factors like hidden activity and illegal immigrants. According to an official report from Tehran Municipality (2019), approximately 14,000 garbage collectors work nationwide, of whom about 4,700 are active in Tehran (3).

According to the Welfare Organization of Tehran (2023), children and adolescents make up a large proportion of the garbage collector population. Many of these individuals collect recyclables within designated areas, participating in an informal system that sustains their livelihood (4). These solid garbage workers face occupational hazards, including the risk of hepatitis A, B, and C virus infection (5).

Hepatitis C Virus (HCV) displays significant genetic diversity and complexity and is classified into seven genotypes, with 67 confirmed and 20 provisional subtypes. The geographic distribution of HCV genotypes and subtypes varies globally. Generally, genotypes 1a, 1b, 2a, 2b, and 3b are found worldwide, while most other genotypes are limited to specific regions (6). The virus leads to liver inflammation and causes both acute and chronic hepatitis. Globally, it is estimated that around 58 million people are infected with the virus, with around 1.5 million new infections occurring yearly. According to the World Health Organization (WHO), almost 290,000 individuals died of HCV in 2019; most of them died from cirrhosis and hepatocellular carcinoma (7).

Recyclable garbage collectors, often independent workers, handle paper, cardboard, glass, and metals. Despite their economic and environmental contributions, studies reveal that garbage collection is associated with poor health and increased morbidity (8,9). Additionally, recyclable garbage collectors face lifestyle challenges related to social, cultural, and environmental factors (10).

Due to their work, garbage collectors face a heightened risk of exposure to blood borne viruses like HCV. However, little research has been done on the prevalence of HCV in this group, particularly in Tehran. This study aimed to determine the prevalence of hepatitis C infection among garbage collectors in Tehran and to assess its association with specific demographic and behavioral factors, including age, nationality, education, marital status, history of addiction, risky sexual behaviors, and tattooing.

Materials and Methods

Study design and setting

A cross-sectional study was conducted in Tehran, Iran, in 2023. The study participants were recruited from the 22 districts of Tehran, targeting unauthorized solid garbage collectors. In this study, the term unauthorized garbage collectors refers to individuals who collect waste and recyclables informally for personal income, without any formal employment or authorization from municipal services. Inclusion criteria included cooperation and written consent, while municipal employees, those who withdrew, and minors without guardian consent were excluded. Data collection involved interviews to assess demographic details, HCV infection awareness, antibody status, and rapid testing.

Research tools

The research team, composed of pairs trained in counseling and HCV infection testing protocols, used safety gear, rapid test kits, and a custom questionnaire. The purpose of designing the questionnaire in this study was to collect data related to demographics and important risk behaviors. Therefore, the questions were based on a researcher-made questionnaire that the researchers themselves completed from the study participants. Participants were interviewed individually, and after signing a written consent form, they were included in the study. Each participant was given a pair of safety gloves as an incentive. HCV infection testing was performed using SD Bioline Hepatitis C rapid test kits (Standard Diagnostics, Republic of Korea), which have a reported sensitivity of 99.4% and specificity of 99.7% according to the manufacturer, and were administered directly at the waste collection sites. Used test kits were disposed of in safety boxes to ensure proper handling. Data

collected during the interviews were initially recorded on paper questionnaires and later entered into SPSS software for analysis. Participants received counseling and education on HCV transmission and prevention after the testing. Those who tested positive were referred to the nearest hepatitis clinic for a Polymerase Chain Reaction (PCR) test and subsequent treatment. In contrast, those who tested negative received additional education on HCV infection prevention.

Statistical analysis

This study used a cluster sampling approach to ensure that participants were selected from all geographic areas of Tehran and that the diversity of illegal garbage collectors was recorded throughout the city. Each of the 22 municipal districts of Tehran was defined as a separate cluster, reflecting both administrative boundaries and potential variations in working and living conditions.

Within each district (cluster), the research team visited known garbage collection points and informal recycling sites where unauthorized garbage collectors typically work. From each cluster, approximately six participants were selected using a convenience approach within the cluster boundaries, resulting in a total of 132 participants (22 clusters × 6 individuals). This method allowed for feasible data collection across the entire area while maintaining adequate geographic representation.

Data analysis was conducted using SPSS version 26. Descriptive statistics included means and standard deviations for continuous variables and absolute (n) and relative frequencies (%) for categorical variables. Univariate logistic regression was employed to explore associations between HCV infection prevalence and various determinants (age, nationality, education, marital status, addiction status, and tattooing in prison), with Odds Ratios (OR) and 95% Confidence Intervals (95%CI) calculated. All covariates with a p-value <0.20 in univariate analyses were included simultaneously in the final model. Multivariate logistic regression was then used to adjust for potential confounding factors and identify independent risk factors associated with HCV positivity using the "Enter" method. The level of statistical significance was set at 0.05 for all analyses. Model adequacy was evaluated using the Hosmer–Lemeshow goodness-of-fit test and Nagelkerke R^2. Multicollinearity was assessed through the Variance Inflation Factor (VIF).

Ethical approval

The study was approved by the Ethical Research Committee of Tehran University of Medical Sciences (ethics code: IR.TUMS.IKHC.REC.1402.144). All garbage collectors were informed about the study and assured of the confidentiality, protection, and anonymity of their data. Participation was entirely voluntary, with informed written consent obtained from all participants. Testing was provided at no cost, and individuals who tested positive for HCV infection were notified. Additionally, participants received on-site verbal training on medical waste collection to minimize their risk of infection.

Results

Socio-demographics

A total of 132 male garbage collectors participated in the study, with a mean age of 29.8 years (range: 12-60, SD=13.1). The nationality distribution was evenly split between Iranians and Afghans. Most participants were single and had not completed high school. Nearly half reported a history of addiction, while 16% reported a history of tattooing. Additional socio-demographic and behavioral characteristics are presented in table 1.

HCV prevalence

Of the 132 participants, 10 tested positive for HCV antibodies, yielding a prevalence of 7.6% (95% CI: 3.1–12.1%). The remaining 122 participants (92.4%) tested negative.

Regression analysis

Univariate logistic regression identified several potential risk factors for HCV infection, including age, education, nationality, current addiction, and tattooing in prison. In the multivariate model, only tattooing in prison remained significantly associated with HCV infection (OR: 10.58, 95% CI: 1.77-63.26, p=0.01). Other covariates such as age, nationality, education, marital status, and addiction status were not statistically significant. Detailed results of univariate

Table 1. Socio-demographic profile of the participants

Characteristics	No. (%)
Age (*yr*), mean±SD	29.8±13.1
Nationality	
Iranian	66(50)
Afghan	66(50)
Education	
Illiterate	37(28)
High school graduates	33(25)
Middle school graduates	26(19.7)
No formal education	24(18.2)
Elementary school graduates	9(6.8)
University-educated	3(2.27)
Previous occupation	
Employed	74(56)
Unemployed	58(44)
Marital status	
Single	68(51.8)
Married	29(22)
Divorced	20(15)
Separated	12(9)
Addiction history	67(51)
Non-injecting	57(43)
Injecting & non-Injecting	10(8)
None	63(48)
Current addiction	58(44)
Injecting	0(0)
Non-injecting	58(44)
None	74(56)
Risky sexual behavior	
Any	13(10)
Past Year	3(2.27)
Tattooing history	
Any	21(16)
Within prison	9(6.82)

and multivariate analyses are shown in table 2.

Discussion

This study found an HCV antibody prevalence of 7.6% among unauthorized garbage collectors in Tehran, notably higher than the estimated prevalence in the general population of Iran (0.6%) (14,15). Comparable occupational studies in the region have reported similar findings, including an 8.5% prevalence among waste workers in Karachi, Pakistan (11).

Furthermore, a 2008 study by Rozman *et al* reported a high prevalence of infections among garbage collectors in Santos, Brazil: 8.9% for HCV, 34.4% for hepatitis B, and 18.4% for syphilis (12). Overall, the infection rates for HIV, hepatitis, and syphilis were 10 to 12 times higher than in the general population. In comparison, the HCV prevalence in our study was somewhat lower than in Rozman's cohort. The present study findings also differ from those of Marinho *et al*, who reported HCV prevalence among Brazilian garbage collectors comparable to the general population (13).

Interestingly, the study by Sarvari *et al* in municipal waste collectors in southwestern Iran found no sero-positive cases of anti-HCV antibodies using ELISA (16). These discrepancies may arise from differences in study design, population characteristics, or testing methods. Sarvari *et al* relied on ELISA tests for anti-HCV antibodies, our study used a rapid HCV tests.

This variation in findings highlights the potential influence of geographical, behavioral, and occupational factors on HCV prevalence. Mohammadi *et al* reported an overall prevalence of 18.6% (95% confidence interval: 12.4% to 27.1%) among Iranian prisoners between 2001 and 2016 (17). Most of the present study participants had a history of tattooing within a prison, emphasizing a strong and direct association between risky behaviors inside a prison and HCV infection transmission.

Additionally, a recent study by SeyedAlinaghi and colleagues in 2023 investigated the prevalence of HCV infection among 179 inmates in Tehran's correctional facilities. Nine individuals (5%) tested positive for HCV infection, and a significant correlation was observed between tattooing history and injection drug use with HCV infection (18). However, HCV infection did not correlate significantly with age, marital status, education, prior incarceration, duration of imprisonment, ear piercing, or risky sexual behaviors.

Another study by Kheirandish *et al* in 2009 explored HCV infection prevalence and its association with injection drug use among male addicts in detention centers in Tehran (19). Similar to the present study

Table 2. Results of univariate and multivariate logistic regression

Risk factor	Odds Ratio (OR)	95%(CI)	p-value	AOR	95%(CI)	Adjusted p-value
Age						
>30	14.8	1.82-121.20	0.01	7.28	0.71-75.3	0.09
≤30	Reference	Reference	Reference	Reference	Reference	Reference
Education	5.20	1.06-25.54	0.04	1.5	0.17-13-37	0.71
Nationality	10.26	1.26-83.51	0.03	1.5	0.08-27.63	0.78
Current addiction	13.41	1.65-109.21	0.01	2.52	0.22-29.2	0.46
Tattooing history within prison	15.6	3.31-73.48	0.01	10.58	1.77-63.26	0.01
Marital status						
Single	Reference	Reference	Reference			
Separated	2.31	0.14-38.21	0.56	-	-	-
Married	0.11	0.01-0.96	0.46	-	-	-

findings, they reported a significant relationship between tattooing history and HCV infection. It appears that having a history of tattooing in prison significantly increases the risk of blood borne infections, including HCV infection.

The notably higher prevalence of HCV infection among garbage collectors (around 8%) compared to the general population (1.8%) emphasizes the urgent need for targeted public health interventions (20). This population is particularly vulnerable due to their exposure to hazardous waste and lack of access to adequate healthcare. Preventive strategies should prioritize protective equipment, routine health assessments, and education on infection control. Importantly, undocumented migrants, who may be excluded from formal healthcare services, must also be included in such programs. These findings support our initial hypothesis that unauthorized garbage collectors represent a high-risk population for HCV infection, and tailored interventions are essential to mitigate their health risks and reduce further transmission.

Limitations

This study has important limitations to consider. First, the sample size was relatively small (132 participants), with only 10 HCV-positive cases, which may reduce statistical power and limit generalizability (21). Second, information on risk behaviors such as addiction history and sexual practices was obtained through self-report, which is subject to recall bias and social desirability bias. Third, although rapid diagnostic tests were used, positive rapid HCV antibody tests may yield false positives and cannot differentiate between past resolved infection and current active infection, which may influence prevalence estimates (22). Recent systematic reviews and meta-analyses report pooled anti-HCV seroprevalence in Iran ranging from approximately 0.3% to 0.6%, which underscores that the HCV antibody prevalence observed in this study (7.6%) remains substantially higher than population-based estimates (23,24). Finally, the researcher-made questionnaire employed for data collection was not subjected to validity and reliability assessments, which may have influenced the accuracy and consistency of the self-reported behavioral data.

Future studies

Future research should focus on larger, more representative samples to improve the generalizability of findings. Longitudinal studies are needed to assess the long-term health outcomes of garbage collectors and the effectiveness of targeted public health interventions. Particular attention should be given to undocumented workers, who are often excluded from formal health systems but are at high risk for infections like HCV.

Galley Proof

Conclusion

This study has shown a significant prevalence of HCV infection among garbage collectors in Tehran, highlighting the occupational health risks faced by this group. In particular, tattooing within prison emerged as a key risk factor, along with older age, lower education, non-Iranian nationality, and current addiction. These findings highlight the vulnerability of garbage collectors to HCV infection and the need for targeted preventive strategies. Rather than broad systemic reforms, practical measures are recommended, including hepatitis prevention education, free or low-cost health screenings, and improved provision of protective equipment. Collaboration between municipal authorities and community organizations to supply protective gear and expand access to healthcare services could help reduce the risks faced by this high-exposure group and mitigate the broader public health burden.

Ethics approval and consent to participate

Special attention was paid to protect undocumented and underage participants. Participation was strictly voluntary, with anonymity guaranteed. Informed consent was obtained from all participants or their guardians when available. When guardians were unavailable, assent was obtained directly from the minor after a clear explanation of the study objectives, as approved by the institutional ethics committee. All participants, regardless of legal status, received free testing, self-protective equipment, counseling, and referrals for follow-up care.

This study adhered to the Declaration of Helsinki in the context of research conducted on humans.

The study was approved by the Ethical Research Committee of Tehran University of Medical Sciences (ethics code: IR.TUMS.IKHC.REC.1402.144).

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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