

EPIDEMIOLOGICAL ASSESSMENT OF HEPATITIS C VIRUS PREVALENCE AMONG JANITORIAL STAFF IN FAISALABAD, PAKISTAN: A CROSS-SECTIONAL STUDY (2025)

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Abstract

The Hepatitis C Virus (HCV) is a public health problem, particularly to high-risk occupational populations. The purpose of the study was to establish the prevalence rate of the HCV infection and the factors that contribute to it in the area of janitorial employees in Faisalabad, Pakistan. In the year 2025, a structured questionnaire study was conducted on 170 janitorial employees of different government and non-governmental institutions in Faisalabad. The data gathered consisted of demographic factors, education level, previous blood transfusion, training on how to handle waste, and the diagnosis of HCV. Where laboratory data were available, these were checked. Data analysis was done by System Package for Social Scientists, version 26, and the chi-square test was used to determine any relationship between HCV infection and the estimated risk factors. There were more individuals who participated in the 18–44-year age bracket, where 86.5% of the respondents were married. They received a high-level education (50%) or no education (32.9 per cent). Of all the respondents, 37.1 percent had tested by using an anti-HCV antibody panel, whereas 45.9 percent were uncertain of the test they had taken. Formal training in waste collection was indicated by only 20 per cent. In general, HCV was diagnosed at the rate of 18.8 percent ($n = 32$) among participants. Chi-square revealed no significant relation between HCV status and both education level ($2 = 4.698$; $df = 3$; $p = 0.195$) and history of blood transfusion ($2 = 0.074$; $df = 1$, $p = 0.786$). Even though a calculating percentage of HCV-positive results were identified to be more in those with the lower level of education and people who have undergone the process of blood transfusion, it was not considered statistically significant. The paper emphasizes a high rate of janitorial personnel who are infected with HCV in Faisalabad. Although the results have shown no statistically significant relationships, it would be prudent to implement more health education, screening, and occupational training programs to reduce the risk of HCV in susceptible working persons.

INTRODUCTION

The Hepatitis C virus (HCV) is a global health challenge, contributing to both acute and chronic

liver diseases, including cirrhosis and hepatocellular cancer. It is a positive-sense, single-stranded RNA

virus, enveloped, belonging to the genus *Hepacivirus* of the family *Flaviviridae*, which may induce severe systemic inflammation in humans (Sallam and Khalil, 2024). Globally, around 58 million individuals are estimated to be living with chronic HCV at any moment, with around 1.5 million new cases diagnosed each year, resulting in nearly 290,000 fatalities annually owing to HCV-related comorbidities (Phoswa and Khaliq, 2021). Nevertheless, HCV is a significant public health issue in low- and middle-income countries, where access to diagnostic and therapeutic facilities is markedly limited. Pakistan bears the second-highest prevalence of HCV globally, making it a focal point in the elimination initiative (Qureshi, 2025).

Parenteral exposure to infected blood is regarded as a primary route of HCV transmission. Unsafe blood transfusions, the use of contaminated needles, inadequate sterilisation of medical instruments, and vertical transmission from mother to child must be eradicated. Another well-documented concern is occupational contamination, particularly for patients who frequently handle biomedical or municipal trash and may unknowingly be exposed to contaminated sharp instruments such as scalpels (Stroffolini and Stroffolini, 2024). Waste handlers, especially those who are unprotected or inadequately trained, are susceptible to infections due to their frequent handling of poorly disposed needles, blades, and other sharp waste materials (Ketema *et al.*, 2023).

The primary factors contributing to the increased frequency of HCV among municipal waste collectors are a lack of information and inadequate occupational safety measures. Studies indicate that occupational blood exposure presents a significant risk to janitorial and waste collection personnel, the majority of whom are inadequately educated about the dangers of bloodborne infections and the preventive measures, such as gloves, puncture-resistant containers, or established infection control protocols (Ippoliti *et al.*, 2025). Moreover, the minimal skill requirements characteristic of janitorial employment in developing nations exacerbate the scarcity of health education, protective gear, and post-exposure treatment, hence increasing the risk of infection. The global production of municipal garbage is anticipated to increase, with projections indicating that the average urban resident will generate approximately 500 kg of municipal waste

annually. A significant portion of this undergoes recycling, which poses health risks when recyclable materials include contaminated sharps or biohazardous waste (Cook *et al.*, 2022). In this context, municipal waste collectors represent a crucial yet overlooked demographic involved in public health research. The information from Pakistan reveals a concerning trend: the prevalence of HCV among waste collectors in the municipality is 3.3 percent, compared to 5 percent nationwide (Cook *et al.*, 2022). However, when stratification occurs along behavioural and occupational dimensions, more profound risks emerge. For instance, the prevalence is 8 percent among workers who do not consistently wear protective gear, compared to 2 percent among those who routinely utilise such equipment (Zaman *et al.*, 2022).

Marital status, educational attainment, and health literacy are significant variables to infection, with married individuals exhibiting a disproportionately higher prevalence of HCV positive compared to their unmarried counterparts. Socioeconomic disadvantages, coupled with inadequate institutional assistance, intensify occupational health risks for janitorial staff. The role of caretaker has been undervalued, lacking adequate formal training and insufficient attention to public health safety protocols (Egbe *et al.*, 2023).

Targeted health education, proper disposal techniques, and mandatory personal protective equipment (PPE) are urgently needed solutions. The World Health Organization has recommended the implementation of personal protective equipment and occupational health training to mitigate transmission, although adherence is minimal in many developing regions, including Pakistan (Halota *et al.*, 2020).

In this context, it is essential to assess the prevalence of HCV infection among municipal garbage collectors in Pakistan, particularly in densely populated urban areas such as Faisalabad. Identifying the principal risk variables and their prevalence will elucidate the dynamics of HCV transmission in the occupational environment and facilitate the development of targeted therapies to mitigate the infection's spread within this demographic.

MATERIAL AND METHODS

2.1. Study Design and Setting

It was a cross-sectional data-driven survey study carried out to determine the prevalence rate of Hepatitis C Virus (HCV) infection of janitorial workers in different public and private organizations within the City of Faisalabad in the Pakistani province of Punjab. The research mainly aimed at analyzing the possible risk factors such as education level, history of blood transfusion, and occupational exposure.

2.2. Study Population

The recommended population included janitorial staff such as cleaners, sweepers, and sanitary workers who are 18 years old and above, employed by the hospitals, municipal services, educational establishments, and companies. The participants who were not willing to participate and those who could not give informed consent were excused.

2.3. Sampling Technique and Sample Size

Participants were recruited by a purposive sampling technique. One hundred and seventy janitors were involved in the study. The sample itself was set up accordingly to the accessibility and willingness to cooperate in the course of the research.

2.4. Data Collection Tool and Procedure

The respondents were also sampled by a structured and pre-tested questionnaire of this cross-sectional study that was targeting specifically the janitorial staff. The survey instrument was written in Urdu and also in Punjabi so that the level of understanding would be easy for the respondents with different educational backgrounds. It consisted of closed ended questions that were grouped into different categories: demographic data (age, marital status, educational level), occupational exposure (workplace, number of years of employment, personal protective equipment usage), history of medical problems (including previous blood transfusion), Hepatitis C Virus awareness and testing (the type of test to be conducted and the outcome of the test), training on how to handle waste safely. To its content validity and reliability, the questionnaire was checked with a panel of experts in the field of public health and infectious diseases. Three trained data collectors interviewed the

respondents in a confidential environment using face-to-face interviews to help obtain the information. The informed consent of the study participants was obtained and they were recruited at their places of work. Each participant was made to understand clearly what the research was all about, how participation in it is voluntary, and also that they will not be fired due to their refusal to participate in the study or in any way hindered them in getting medical attention. Interviews have been done without any intrusion and with respect, and no biological samples were taken. Data analysis involved anonymizing all the data to ensure that the identity of the participants is not revealed during the analysis process.

2.5. Statistical Analysis

The demographic variables, HCV status were calculated using descriptive statistics. Chi-square test was employed to determine whether the level of education and history of blood transfusion were potential risk factors for HCV diagnosis, or not. Values with a p-value less than 0.05 were found as statistically significant. The Placement Bureau of the University of Faisalabad provided ethical approval to the study. All participants were asked to sign an informed consent written after they had been told about the purpose of the study, its benefits, and confidentiality.

RESULTS

The purpose of conducting this cross-sectional research was to expose the occurrence of Hepatitis C Virus (HCV) infection among janitors in Faisalabad, Pakistan, and identify the possible socio-demographic and occupational risks in the spread of HCV infection. With the help of a structured questionnaire, the data was sourced from 170 respondents. The descriptive and inferential statistical analysis in terms of variables like age distribution, marital status, educational attainment, training in waste collection, use of personal protective equipment (PPE) and history of blood transfusion are given as results. Moreover, the Chi-square test was used to check statistical relationships between these factors and the diagnosis of HCV to identify the risk factors. These results are presented in tabular and bar forms as shown below.

3.1. Age Distribution Study Population

Table 1. Age Distribution Study Population

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-24 years	45	26.5	26.5	26.5
	25-34 years	39	22.9	22.9	49.4
	35-44 years	46	27.1	27.1	76.5
	45-54 years	24	14.1	14.1	90.6
	Above 55 Years	16	9.4	9.4	100.0
	Total	170	100.0	100.0	

The table shows frequency distribution of age groups of 170 janitorial labourers sampled. The majority of the participants were in the age category of 35 to 44 years of age, which forms 27.1 percent of the entire sample ($n = 46$). This was trailed closely by the 18-24 years group comprising 26.5% ($n = 45$) and the 25-34 years group of 22.9% ($n = 39$). The participants in the 45-54 age bracket were 14.1 ($n = 24$), and the oldest age group of above 55 years was the lowest at 9.4 ($n = 16$). The cumulative percentage shows that 76.5 percent of the study population was younger than 45

years of age, which means that the workforce is relatively young to middle-aged. The age distribution of the janitor personnel can give useful information with regards to the susceptibility to work related health hazards such as exposure to the Hepatitis C Virus (HCV), among the janitor personnel due to this age vulnerable stage; and indicates that major proportion of the workers are in their economic active years, which is the important age stage that should be under focus in terms of interventions and health promotion and awareness as shown in table 1.

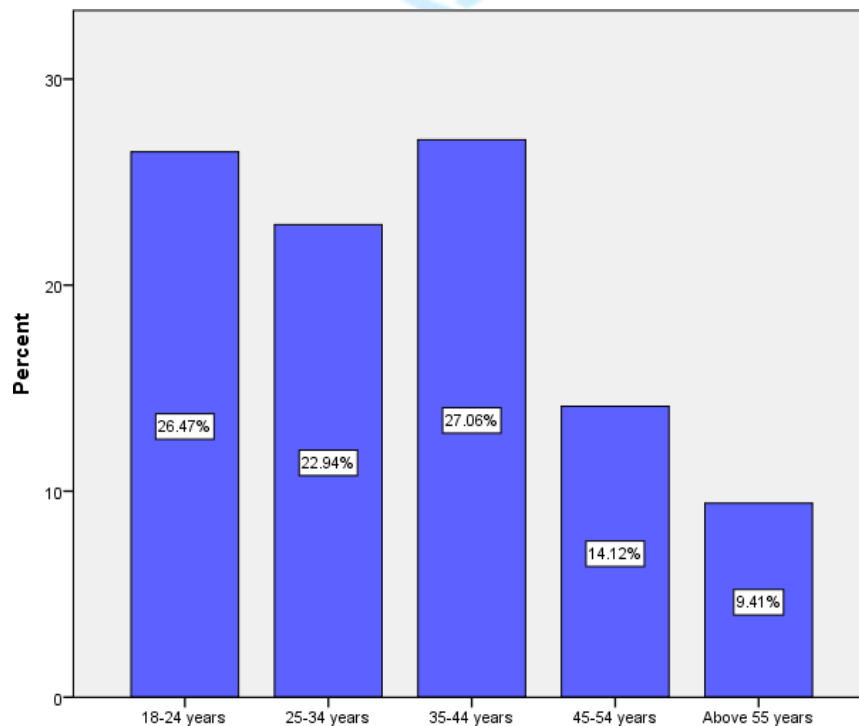


Fig 1. Age Distribution Study Population

This bar graph shows the proportion of the participants of the cross-sectional study 2025, which was conducted in Faisalabad, Pakistan, by the age group of janitorial staff. The largest representation was 3544 years, showing a percentage sample of 27.06, followed by 1824 years that had a sample of 26.47. Members in the 25-34 years age group formed 22.94,

and 14.12 were in the 45-54 years age bracket. The smallest percentage of respondents was in the above 55 years category, denoting nine-point four one percent. The kind of workforce presented by this distribution is relatively young and is involved in janitorial services; more of them are less than 45 years of oldness, as shown in Fig. 1.

3.2. Marital Demographics

Table 2. Marital Demographics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	147	86.5	86.5	86.5
	Unmarried	23	13.5	13.5	100.0
	Total	170	100.0	100.0	

Statistics indicate that out of all the 170 janitorial workers who participated in the survey, 147 of them (86.5 percent) were married and 23 (13.5 percent) were not. The valid percent and cumulative percent values are the same as the raw percentages, which means that there was absolutely no missing data in the category. This large percentage of married persons implies that most of the workforce is burdened with family stresses, which is likely to affect their health-

seeking behaviours, risk perceptions, and exposures to possible infections, e.g., Hepatitis C Virus (HCV). According to the public health point of view, this demographic description is necessary to design awareness campaigns and preventive measures, especially because the subject can be more open to health education to protect their own and household health as shown in Table 2.

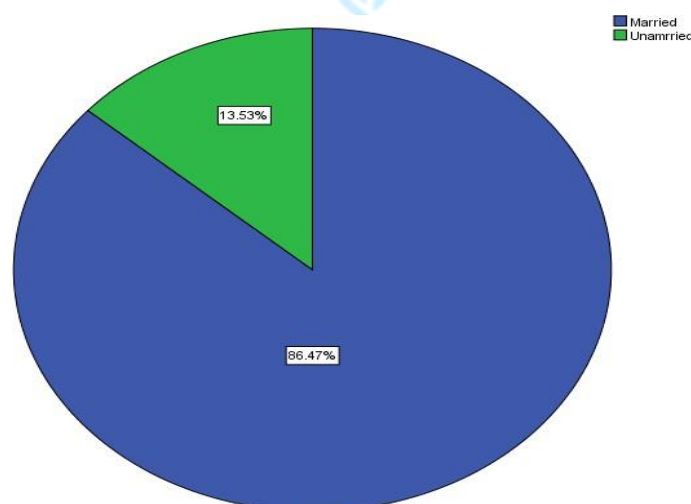


Fig 2. Pie Chart of Marital Demographics

The pie chart is a representation of the marital status of janitors who took part in the cross-sectional study of 2025, undertaken in Faisalabad, Pakistan. The

majority of respondents were married (86.47), and only 13.53 were unmarried. This is the distribution that means that in the occupation of janitors, a high

percentage of workers are married, and it can affect the health awareness, family responsibility, and health

opportunities in this occupation group as shown in Fig 2.

3.3. Distribution of Educational Levels among Janitorial Workers

Table 3. Distribution of Educational Levels among Janitorial Workers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	INTERMEDIATE	5	2.9	2.9	2.9
	MATRIC	24	14.1	14.1	17.1
	NONE	56	32.9	32.9	50.0
	PRIMARY	85	50.0	50.0	100.0
	Total	170	100.0	100.0	

The table is a summary of the education level of the 170 janitor workers who participated in the survey held in Faisalabad, Pakistan. Fifty percent (n = 85) of them were primary school graduates, and 32.9 percent (n = 56) had no formal education. Fewer had completed matriculation (secondary school), 14.1 percent (n = 24), and a mere 2.9 percent (n = 5) had had an intermediate level of education. These data show that most (82.9%) of the respondents have low or no educational levels, and hence this means that

literacy levels are low in this occupation group overall. This is valuable in terms of public health solutions: the poor level of education is usually linked with low health literacy, less awareness of the mechanisms of the disease spread, and less seeking health prevention options. Education level thus, could be a very important determinant of awareness level, risk behaviour, and susceptibility to infection by Hepatitis C Virus (HCV) in janitorial employees as shown in Table 3.

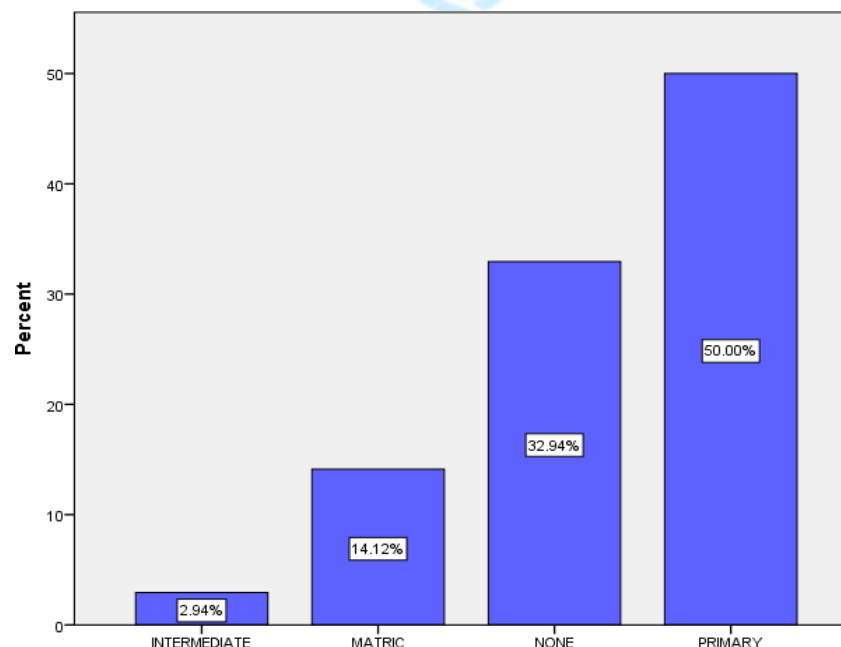


Fig 3. Bar graph of the Distribution of Educational Levels among Janitorial Workers

The bar chart shows the percentage breakdown of the level of education of the janitorial members surveyed

in the 2025 cross-sectional study organized in Faisalabad, Pakistan. Most of the study participants

were highly literate with the primary level of education only (50.00%), and the rest of the participants had no education (32.94%). Some had attained intermediate education (2.94) and matriculated in a smaller proportion (14.12%). This is in keeping with an overall low level of educational attainment among the

janitorial workforce and can be seen as having implications for job awareness of occupational hazards and health-related behaviours such as the prevention of infectious diseases, like hepatitis C, as shown in Fig. 3.

3.4. Occupational Waste Management Training Status among Janitorial Workers

Table 4. Occupational Waste Management Training Status among Janitorial Workers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	34	20.0	20.0	20.0
	NO	136	80.0	80.0	100.0
	Total	170	100.0	100.0	

Only 34 (20.0 percent) out of a total of 170 participants indicated having undergone some formal waste collecting and handling training. On the contrary, 136 persons (80.0%), which is a large majority, had never been trained in the occupational process of waste management. Such statistics demonstrate a real gap in training in this occupational group at risk. The unstructured nature of training of most janitorial workers can result in irresponsible

handling, which in turn exposes them to blood pathogens, such as Hepatitis C Virus (HCV). The low figure of trained personnel indicates a desperate need to adopt and carry out thorough occupational health and safety initiatives in order to diminish threats of infection and to promote proper behaviour regarding safe waste disposal within janitorial contexts as shown in Table 4.

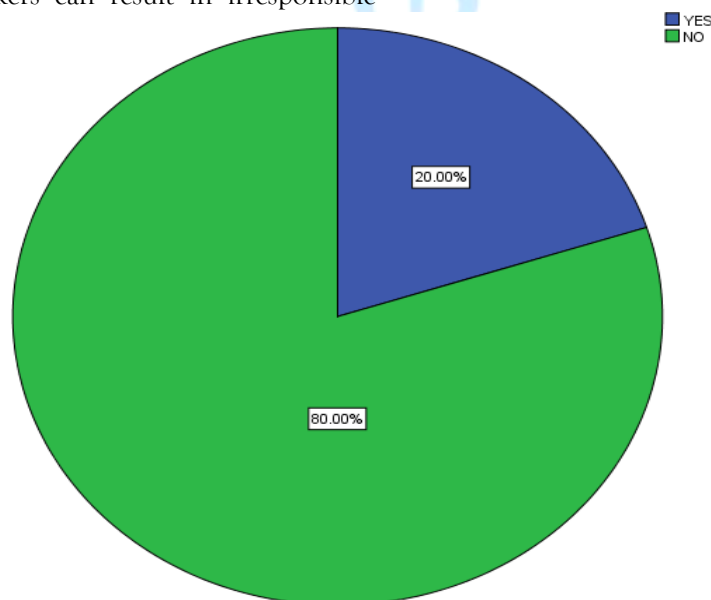


Fig 3. Pie Chart of Occupational Waste Management Training Status among Janitorial Workers

A pie chart is a representation of a yes-or-no query. The majority (80 percent) of the respondents answered in the negative, with the green portion of the chart as shown in the chart. As compared to this,

20 percent of the respondents responded YES as shown by the blue section. In this figure, there is an apparent leaning or agreement among the

respondents, and most have voted on the statement or question asked, as shown in Fig. 3.

3.5. Association of HCV Prevalence with age distribution:

Table 5. Association of HCV Prevalence with age distribution

		Diagnosis of Hepatitis C infection among municipal waste collector workers		Total
		YES	NO	
Age of participants	18-24 years	7	38	45
	25-34 years	7	32	39
	35-44 years	9	37	46
	45-54 years	4	20	24
	Above 55 years	5	11	16
Total		32	138	170

Of the 170 janitorial personnel that were surveyed, 32 (18.8%) were positive for Hepatitis C virus (HCV). There was a higher infection rate of 31.3 in participants aged more than 55 years of age indicating a risk with an increase in the age factor. The middle-aged populations showed higher cases overall, with lower percentages than the younger populations, which registered lower rates of infections. Though the data shows the potential age-related difference in HCV prevalence, statistical testing is necessary to provide any significant relation based on the data, as shown in Table 5.

Table 6. Chi-Square of HCV Prevalence with age distribution

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.041 ^a	4	.728
Likelihood Ratio	1.855	4	.762
Linear-by-Linear Association	1.073	1	.300
N of Valid Cases	170		

The tables below show the results of the Chi-square test that measures the statistical relationship between the levels of age and the incidence of the Hepatitis C Virus (HCV) infection among 170 members of the janitorial staff. There is a Pearson Chi-Square value of 2.041 and 4 degrees of freedom with a p-value of 0.728, which shows that the relationship between the age of the participants and their HCV presents no statistically significant results. On the same note, the Likelihood Ratio of 1.855 and the p-value of 0.762 also prove association does not exist significantly. Also, the Linear-by-Linear Association test was

chosen, which gives the value of 1.073 and a P-value of 0.300, indicating no significant linear pattern in the relationship between age and HCV infection.

Such results mean that in this group of the studying population, age was not an important factor in the probability of getting diagnosed with Hepatitis C.

Hence, some other occupational or environmental risk factors could be more applicable to the spread of the HCV among janitorial workers shown in Table 6.

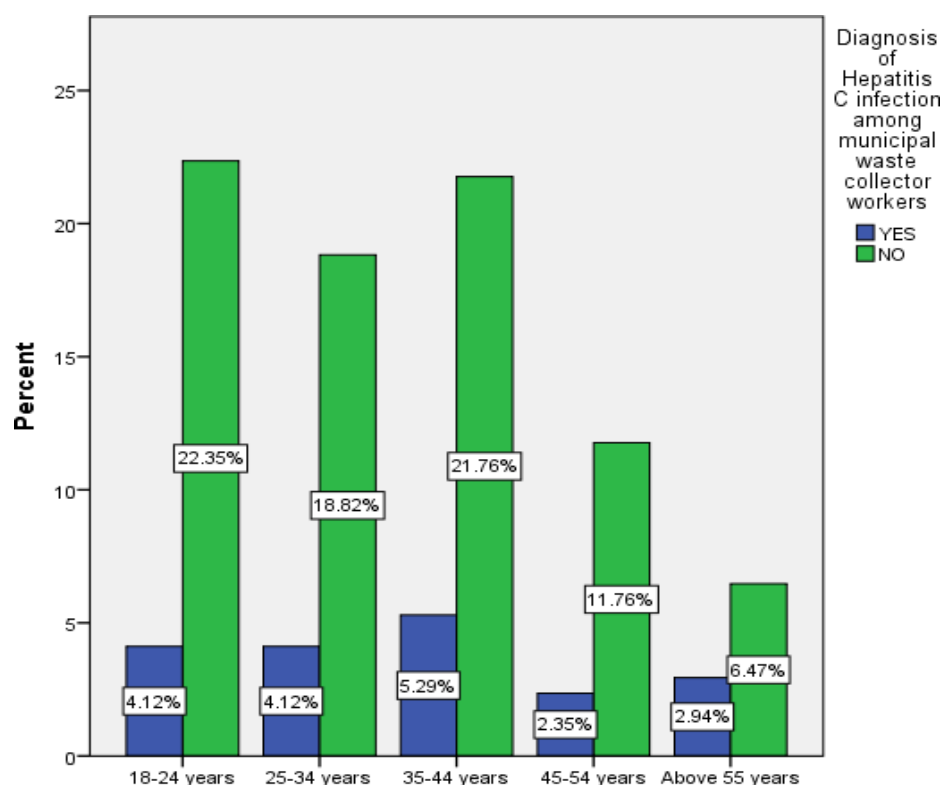


Fig 4. Bar graph of the association of HCV Prevalence with age distribution

The bar chart depicts the diagnosis of infection with Hepatitis C in the workers of the municipal waste collection servicing of varying ages. The numbers are illustrated in percentage with blue bars indicating the employees who have been diagnosed with Hepatitis C (YES) and the green bars indicating employees who have not been diagnosed (NO). The percentage of diagnosed cases in young people (35-44 years) is the highest, compared to the rest of the population (5.29%), and the second position is occupied by the ages (18-24 years) and (25-34 years) with the percentage of 4.12. The lowest rate of infection in the

total population is among the age bracket of 45-54 years, whose rate is 2.35% with a small percent increase among the workers above 55 years of 2.94%. The percentage of non-infected people is much greater in all age groups, which means that though the municipal workers have not been diagnosed with Hepatitis C, the cases are recorded in all age categories. It so implies that there is a possible occupational hazard, and the requirement of health interventionists and frequent screening of such workers, as shown in Fig. 4.

3.6. Association of HCV Prevalence with Education:

Table 7. Association of HCV Prevalence with Education

		Diagnosis of Hepatitis C infection among municipal waste collector workers		Total
		YES	NO	
Education of participants	INTERMEDIATE	2	3	5
	MATRIC	6	18	24
	NONE	13	43	56
	PRIMARY	11	74	85
Total		32	138	170

As seen on the statistical table, there is a correlation between the educational level of janitorial staff in relation to the issue of Hepatitis C Virus (HCV) infection. Out of a total sample of 170, 32 people were infected with HCV. In the analysis of educational status, 23.2 percent (13/56) of people who had never attained any form of education had HCV positive, and 12.9 percent (11/85) of those who had only primary school education had HCV positive. Out of the 24 respondents with matric education level, 6 respondents (25%) were HCV positive, whereas out of the 5 respondents with intermediate level of education, 2 showed a positive result of HCV positive. Even though there was a comparatively greater percentage of the HCV positive cases that occurred

among the individuals who had medium education, the sample among this group was very small, and thus the finding is less statistically. The highest cases of positive results were established among those who were educated to the lowest level, and to others with lower levels, indicating the possibility of prevalence of cases associated with lower levels of literacy. This can be blamed on little knowledge of the prevention of infections, risky behaviour, and access to information concerning health. Nevertheless, this association should be further analysed statistically to arrive at the strength of this association and whether it is significant, as shown in Table 7.

Table 8. Chi square of the association of HCV Prevalence with Education

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.698 ^a	3	.195
Likelihood Ratio	4.537	3	.209
N of Valid Cases	170		

The analysis of the association that exists between the level of education and Hepatitis C diagnosis infection among 170 janitorial employees is established in the statistical table with the assistance of the Pearson Chi-square test. The Chi-square calculated was 4.698 and

the Degrees of Freedom = 3, and the p-value = 0.195. In the same vein, the likelihood ratio was 4.537, and the p-value was 0.209. The results show that there is no significant correlation between the level of education among these participants and the infection

of HCV, based on the received p-values, both lower than 0.05 ($p = 0.8128$ and $p = 0.8408$). What is meant by this is that provision of differences in level of education among the workers did not contribute

significantly to the risk of becoming diagnosed with Hepatitis C in this population of the study, as shown in Table 8.

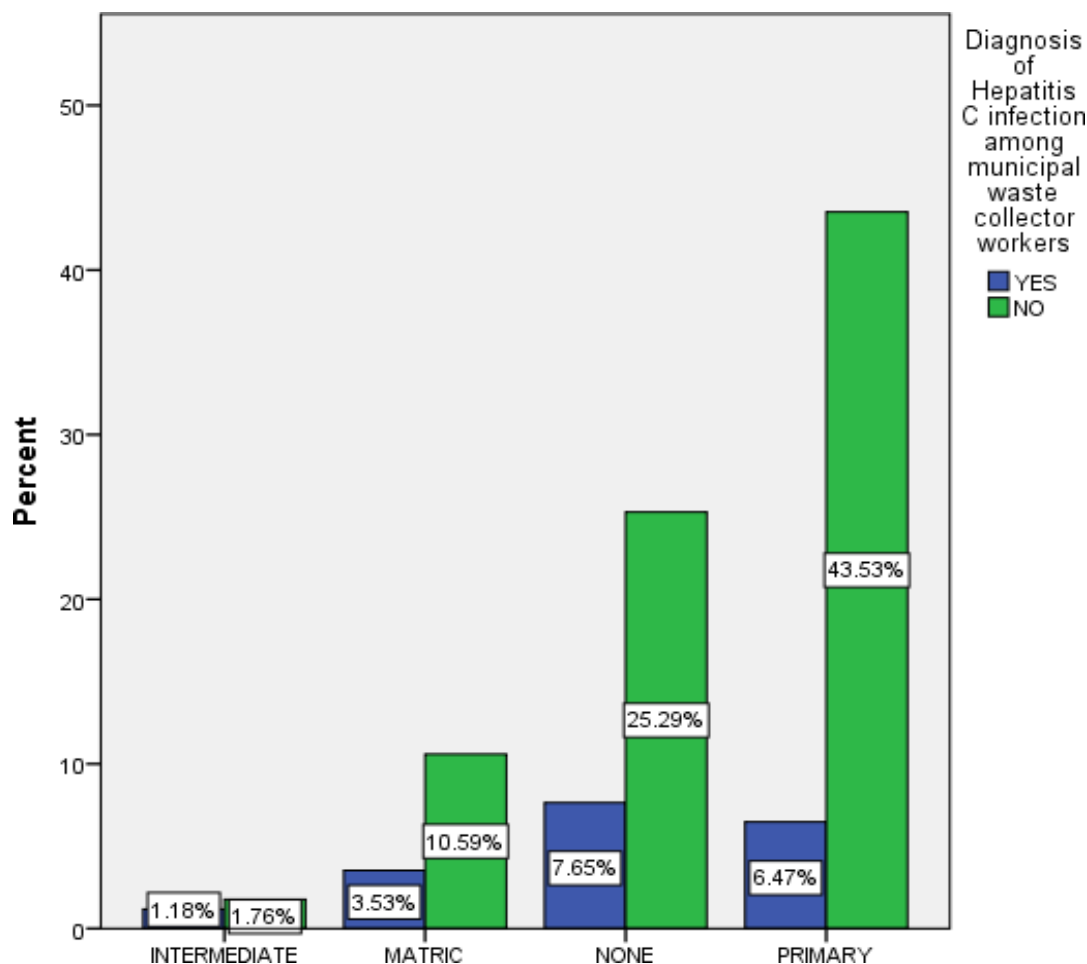


Fig 5. Bar graph of the association of HCV Prevalence with Education

The bar diagram shows how the Hepatitis C infection is diagnosed in the workers of municipal waste collectors, as per their education level. The statistics indicate that workers with no education and only primary education top with a percentage of 7.65 and 6.47 in diagnosed cases, respectively. Conversely, the rate of infections is significantly lower in workers who have a higher education level, 3.53 percent of workers who have completed matric were diagnosed compared to 1.18 percent of workers with intermediate education. Conversely, the proportion of employees

yet to be diagnosed with Hepatitis C is highest among employees in level of education which is primary education; 43.53 percent, no education: 25.29 percent, matriculation: 10.59 percent, and intermediate: 1.76 percent. These results indicate a possible connection between lower educational level and increased susceptibility to Hepatitis C infection, which can appear because people with low education have less awareness of health threats and maintain low hygiene standards and lack knowledge of occupational exposure prevention strategies, as shown in Fig. 5.

3.7. Association of HCV Prevalence with Use of PPE (Gloves)

Table 9. Association of HCV Prevalence with Use of PPE (Gloves)

		Diagnosis of Hepatitis C infection among municipal waste collector workers		Total
		YES	NO	
Gloves use during waste collect	YES	3	15	18
	NO	29	123	152
Total		32	138	170

The statistical evidence introduced in the table is an investigation into the relationship between the diagnosis of Hepatitis C Virus (HCV) and protective gloves during the collection of waste among the janitorial workers. Among the 170 workers surveyed, 32 (18.8) were certified to be infected with HCV. Out of 18 persons who had indicated that they had been wearing gloves during waste collection, only 3 (16.7) were HCV positive, as against 15 (83.3) who were HCV negative. On the other hand, 29 out of 152 (19.1 %) of those who failed to use gloves were HCV

positive, and 123 (80.9 %) were HCV negative. Although the percentage of HCV-positive cases seems to be a bit more when persons refrained not to using gloves, the margin is not high. This implies that the glove use has a defensive effect, but the data are not sufficient to create a statistically meaningful connection between the use of gloves and infection with HCV. Further statistical analysis will be necessary to reveal whether and how strong this relationship is, and it would be the Chi-square or the Fisher Exact test, as shown in Table 9.

Table 10. Chi-square of the association of HCV Prevalence with use of PPE (Gloves)

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.061 ^a	1	.804		
Continuity Correction ^b	.000	1	1.000		
Likelihood Ratio	.063	1	.802		
Fisher's Exact Test				1.000	.550
Linear-by-Linear Association	.061	1	.805		
N of Valid Cases	170				

The statistical analysis offered in the table sets the degree to which the application of gloves during the collection of wastes was related to diagnosing Hepatitis C Virus (HCV) infection among janitorial workers. The p-value of the Pearson Chi-Square test is 0.061, degree of freedom is 1, indicating that the connection is not statistically significant. On the same note, the Continuity Correction generated a p-value of 1.000, and the Likelihood Ratio test also pointed to a lack of significant relationship at a value of 0.063 and a p-value of 0.802. The Exact test used by Fisher,

which is accurate in small sample sizes, did not provide a significant association, a value of p p-value of two sides being 1.000, and a one-sided p-value being 0.550. These findings were also strengthened by the Linear-by-Linear Association that had a p-value of 0.805. On the whole, these statistical findings demonstrate without fail that the use of gloves in the process of waste collection is not related to HCV infection prevalence in the population of the participants of the study in a significant way, as shown in Table 10.

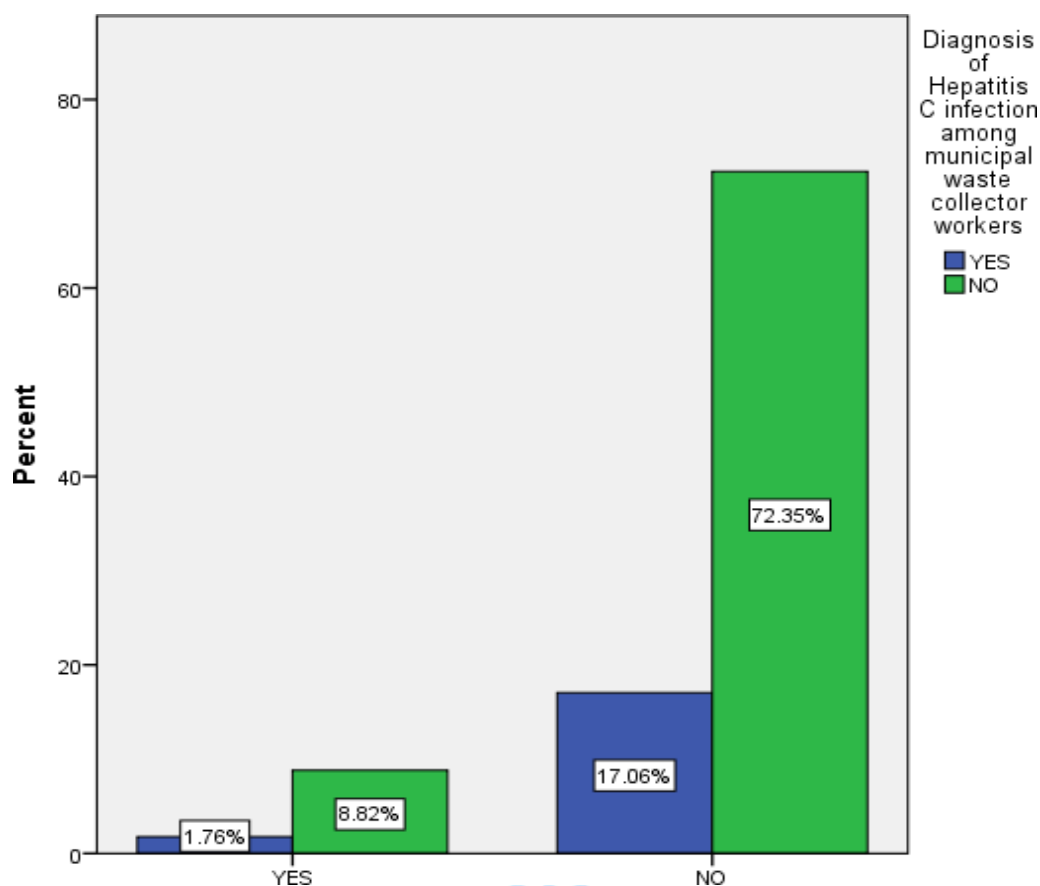


Fig 6. Bar graph of association of HCV Prevalence with use of PPE (Gloves)

The bar graph shows the diagnosis of the Hepatitis C infection among the workers of municipal waste collectors on the basis of whether they were tested before or not. Of those who had been tested (YES), 1.76 percent of them tested positive for Hepatitis C, and 8.82 percent of them were negative. Conversely, the percentage of never-tested workers (NO) that developed into positive significantly was considerably less, constituting 17.06, in which much more 72.35 turned out to be negative. Such data indicate a

problematic trend, the bulk of cases of infection were observed among non-tested people before the infection, thus portraying an absence of general screening. It means that there is an apparent necessity to introduce periodic and freely accessible programs on Hepatitis C screening in workers in the municipal waste industry, that is regarded as being at a higher risk since they have occupational exposure to this illness, as shown in Fig. 6.

3.8. Association of HCV infection with blood transfusion:

Table 11. Association of HCV infection with blood transfusion

		Diagnosis of Hepatitis C infection among municipal waste collector workers		Total
		YES	NO	
Receive blood transfusion	YES	27	119	146
	NO	5	19	24
Total		32	138	170

The cross-tabulated information (based on data provided in the table) refers to the association between the history of the blood transfusion and the status of the Hepatitis C Virus (HCV) infection of 170 employees working in municipal garbage collecting services. Of the 170 participants, 146 had received blood transfusions, whereas 24 had not. Of the individuals who had obtained a transfusion, 27 were (18.5%) positive, but only 5 (20.8) of the HCV-positive individuals were without no history of transfusion. Though the prevalence of HCV positivity showed more green numbers in people who had a

history of blood transfusion, the percentage of positive cases was somewhat higher compared to the other group (20.8% vs. 18.5%). Nevertheless, such a minor disparity is not statistically significant, and further statistical analysis (including but not confined to analyzing using chi-square) would be required to establish whether there is indeed any relationship between them. For this table and only on the basis of the distribution obtained, there does not seem to be a strong or a clear connection between history of blood transfusion and HCV positivity in this population, as shown in Table 11.

Table 12. Chi-square of the association of HCV infection with blood transfusion

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.074 ^a	1	.786		
Continuity Correction ^b	.000	1	1.000		
Likelihood Ratio	.072	1	.788		
Fisher's Exact Test				.781	.487
Linear-by-Linear Association	.073	1	.786		
N of Valid Cases	170				

The statistical findings in this table indicate the association between the occurrence of the blood transfusion process and the Hepatitis C Virus (HCV) infection diagnosis among the janitorial staff. Pearson Chi-Square values are 0.074 with degree of freedom equal to 1, and the associated p-value gives the value of 0.786, which denotes that there is no statistically significant relationship between history of blood transfusion and presence of infection by HCV. In the same manner, Continuity Correction (also known as

Correction of Yates) bears a value of 0.000 with a p-value of 1.000, which further proves that it is not significant. Likelihood Ratio test also confirms this result, it is 0.072 with a p-value of 0.788. Moreover, Fisher's Exact Test, which can be used with small data or data with uneven distributions, achieved two-sided and right-sided p-values that are 0.781 and 0.487, respectively, where p indicates no significant interaction. Finally, the value of the Linear-by-Linear Association of 0.073, p-value 0.786 indicates that it

does not depend on a trend, gradient presence between the two variables. Taken together, these observations show that the presence or absence of the

history of blood transfusion and the status of HCV infection in the study population are not statistically associated with each other, as shown in Table 12.

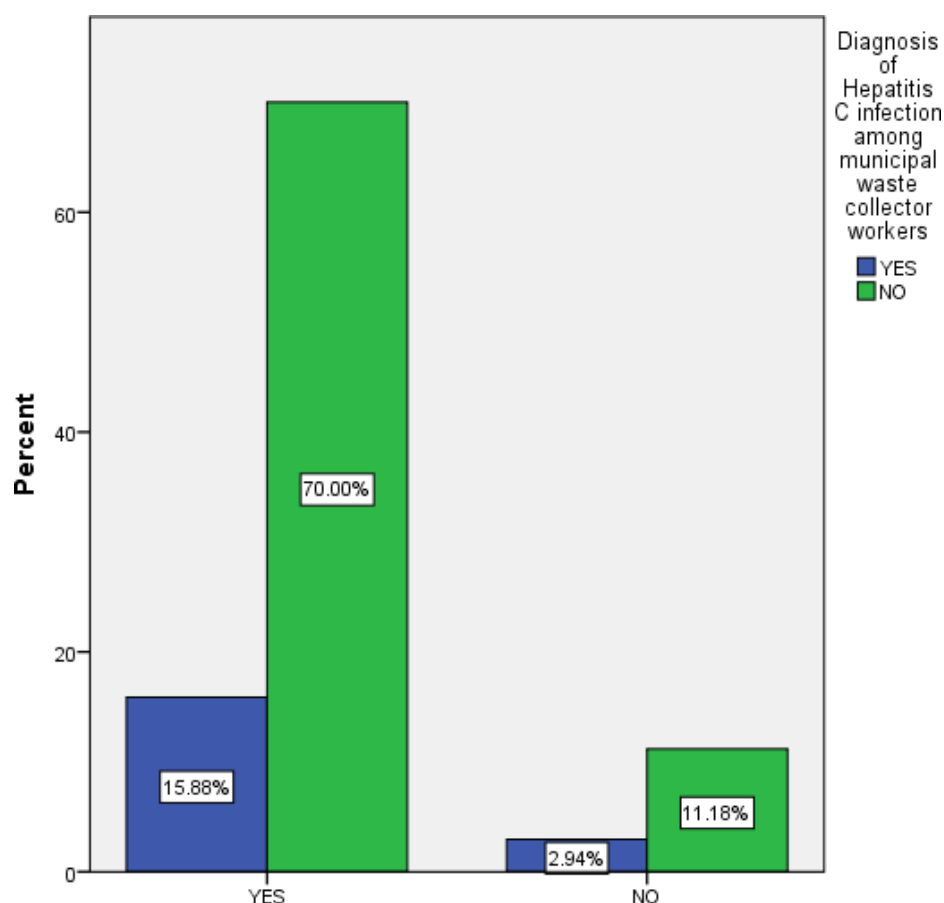


Fig 7. Bar graph of the association of HCV infection with blood transfusion

The bar chart shows the diagnosis of hepatitis C infection among the workers of the municipality's waste collector, two groups of which are in blue and green. Among the workers with Hepatitis C (YES), 15.88% were identified to be in the blue group, whereas the proportionately greater excess of workers was in the green group, with a percentage of 70.00. Conversely, among the subjects who were not diagnosed with Hepatitis C (NO), only 2.94 and 11.18 percent were of the blue and green groups, respectively. Based on this distribution, a larger percentage of the green group was diagnosed with Hepatitis C than that of the blue group. The data indicate the potential correlation of some factors defined by the green category, including the lack of awareness, exposure to risks, or insufficient protective measures, with the high risk of Hepatitis C infection

in case of municipal waste collectors, as shown in Fig. 7.

DISCUSSION

The goal of the current study was to determine the prevalence of Hepatitis C Virus (HCV) infection and associated risk factors among janitorial employees in the Faisalabad region of Pakistan. The general prevalence rate of 3.3 percent obtained in this occupational category is lower compared to the national prevalence, as estimated by the Pakistan Ministry of Health and the WHO report, at 5 percent (Noman *et al.*, 2021). It may be due to the relatively better awareness campaign, exposure to fewer working conditions, or the varied adoption of protective means by some of the workers. Nevertheless, the rate is high, and it highlights the exposure of waste

handlers to occupational risks of bloodborne infections. The prevalence has been found to be relatively lower than in other cases, and this may be a result of better awareness campaigns, less exposure to the hazards in work workplace, or a higher usage of protective measures by some of the workers. Nonetheless, the incidence rate is high and illustrates the professional risk of waste handlers against bloodborne infection (Girmay *et al.*, 2024). Our results' protective effect of PPE warrants a strong argument, complying with enforced provision and use of these pieces of equipment in waste management industries.

The connection between the HCV status and the socio-demographic characteristics also became a significant point of consideration. Married people had a greater rate of infection as compared to their unmarried counterparts, and this may be as a result of disparities in social exposure, living with family groups who have been or are infected, or occupational exposure, especially over more productive working years. Moreover, less educated workers had a higher impact of infections, that are in accordance with previous research, which indicates that little education is associated with low knowledge of workplace risks and control strategies related to infection risks and prevention (Egbe *et al.*, 2023). Such results would support the necessity of education and health literacy procedures in preventing the disease of vulnerable workforces.

It is found that occupational factors, including employment tenure, type of wastes to which an individual is exposed, and absence of formal training on waste management, are likely to contribute risk profile. In line with other research programs in the low- and mid-income economies, there is frequent incapability among the janitorial staff to model the proper qualification on safe collection and disposal of biomedical waste (Cook *et al.*, 2022). Lack of formalized procedures, as well as variable supervision, can continue to encourage unsafe work practices like manual processing of recyclable items and uncovering exposures to sharps.

Regardless of the national prevalence, being lower than observed in the study, the occupational risk of transmission of the infection cannot be disregarded due to a high rate of HCV prevalence within the Pakistani population. Single instances of exposure

may result in chronic infection that has serious implications for long-term health effects. Besides, since the forecast of the growth of municipal waste generation is not going to decrease but on the contrary, it is predicted to be more than 500 kg per capita per annum in the cities, the task of minimizing the effects caused by municipal waste generation on the environment becomes pivotal (Jaroszewicz *et al.*, 2020), exposure risk by the waste handlers is likely to increase unless they strengthen the protective measures.

Policy implications and implications on workplace practices relating to safety apply directly to the findings. Specific health education, obligatory usage of PPE, and procedures of waste segregation institutionalization should be given priority. The surveillance of occupational health, namely, the regular screening of HCV and the post-exposure prophylaxis pathways, should also be integrated with janitorial staff. Experiences of other countries that were able to lower occupational bloodborne infections imply that these measures are not only possible but also affordable in the case of incorporation into the health models in any municipality (Flisiak *et al.*, 2024).

In the end, although the study is valuable in terms of its insights, some limitations need to be acknowledged. The cross-sectional study design precludes causal inference, and the purposive sampling method can restrict the application to the population beyond that of the study population. Further, using any self-reporting methods of PPE use and workplace procedures might be exposed to recall or social desirability bias. However, consistency in the findings of this study, in addition to its reflection in international literature, gives credibility to the findings.

CONCLUSION

In summary, the work notes that although the prevalence of HCV among the janitorial workers in Faisalabad is a bit lower than in the rest of the country, the occupational risk of acquiring the virus is still high unless they wear PPE and utilize it in a consistent manner, as well as receive training. The burden of HCV in this high-risk population may be greatly mitigated by building upon the gaps using

structured occupational health programs, education, and implementation of policy.

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