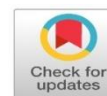


Research Article

Infectious diseases among waste handlers and its relation to their workability, Minia city, Egypt



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DOI: 10.21608/mjmr.2024.261623.1616

Abstract

Background: Waste handlers serve a crucial role in ensuring community health and hygiene. Their occupation, however, exposes them to a variety of hazards, while little or no attention is devoted to their health situation. **The aim of this study:** is to detect the prevalence of certain infectious diseases among Minia waste collectors and explore its relation to their work ability. **Methods:** A cross-sectional study design was employed to gather information about the demographics, occupational characteristics, work ability index and collecting blood samples for detection of multiple blood borne and food borne diseases of 310 waste collectors who participated in face-to-face interviews. **Results:** the prevalence of HCV, HBV, HAV, HIV and typhoid were 13%, 0.9%, 0%, 0% and 0.43% respectively. HCV positive tests were significantly associated with lower educational levels (17.3%), longer work duration (19.6%) and frequent exposure to medical waste (15.9%) and sharp injury (25.5%). Work ability scores in positive HCV workers wasn't significantly decreased (41.8 ± 4.5) and absenteeism (13.5%) and hindrance (11.3%) weren't affected too. **Conclusion:** the study highlighted multiple infectious diseases and their possible risk factors and consequences thus emphasizing the role of educating and informing workers about the appropriate protective equipment to be used, as well as how to prevent infection and reinfection by various pathogens.

Keywords: waste collectors, work ability, HCV prevalence, HBV prevalence, salmonellosis prevalence

Introduction

Hepatitis B virus (HBV) and hepatitis C virus (HCV) infections are significant global health issues with a high morbidity and death rate ⁽¹⁾.

Human immunodeficiency virus (HIV) too continues to be a serious global public health concern and according to the WHO, 34,000 (29,000-39,000) Egyptians were predicted to be HIV positive in 2023—roughly 0.3 per 1000 individuals. Of these,

74% knew their status, 47% received antiretroviral therapy and 39% reached viral load suppression ⁽²⁾.

Among those susceptible occupations to contracting blood borne diseases, municipal solid waste (MSW) handlers would be considered an important group. Particularly in underdeveloped nations, it is indisputable that MSW handlers are more susceptible to both fatal and non-fatal

occupational incidents due to work exposures, social vulnerability, low education, and limited access to health care services⁽³⁾. Garbage is frequently combined with high-risk waste, such as medical waste, and is disposed of as general waste in a lot of these nations where there is a lack of protective equipment. Medical waste handlers who handle instruments like razors, needles, and other discarded equipment might contract blood borne diseases as HBV, HCV and HIV^(3,4).

MSW handlers frequently encounter other biological workplace dangers too. They may become infected with the Hepatitis A Virus (HAV) and salmonellosis through contact with garbage that has been contaminated with infectious faeces. The activation of the fecal-oral pathway by poor sanitation and improper work practices like smoking or eating while working without following proper hygienic precautions may increase the risk of HAV virus and salmonella transmission^(5,6)

Aim of the study:

This study aims to identify the frequency of some infectious diseases among Minia waste collectors which are HCV, HBV, HAV, HIV and salmonellosis. Investigating the relationship between these diseases and the workers' work ability was another aim for this study.

Subjects and methods

Study design and population:

This is a cross-sectional study conducted among municipal solid waste workers in Minia city between January 2022 till January 2023.

Approximately 383 workers serve the entire Minia city. All workers were invited to take part in the study, however 73 declined; as a result, 310 employees with an 80.9% response rate were included in the research. The studied workers were street sweepers and waste collectors, drivers, as well as inspectors. Every participant completed the study questionnaire and was interviewed. Furthermore, because of resource constraints, 230 workers (74.19%) of the studied population were selected at

random as a subsample to participate in specific laboratory tests.

Data collection:

Data was collected through an interview questionnaire including their demographic and occupational data, Work Ability Index -WAI- questionnaire and health hazard assessment questions.

The Work Ability Index (WAI) questionnaire: Consists of seven items, considering the worker's health, both physical and mental demands of the job. The final score is categorized into four levels: poor (7–27), moderate (28–36), good (37–43), and optimal (44–49) work ability. The score range from 7 to 49⁽⁷⁾.

Assessment of health hazards: eleven inquiries were carefully picked addressing exposure to medical wastes, human and animal excreta, masks, pesticides, carrying heavy objects, work accidents, stress, and underestimation from both family and the surrounding community⁽⁸⁾.

Blood samples were requested from the participants. Serum samples were collected in typical vacutainer tubes. A unique study code was assigned to each participant and this code was noted on both the corresponding questionnaire and the label on the blood sample. The following tests were performed in a private laboratory: Hepatitis A virus IgM antibody (HAV Ab) rapid test, Hepatitis B surface antigen (HbsAg) rapid test, Hepatitis C virus antibody (HCV Ab) rapid test, Human immunodeficiency virus (HIV) rapid test and S. Typhi antigen using Widal test⁽⁹⁻¹²⁾

Ethical consideration:

Prior to data collection, the study was carried out with the consent of the Institutional Review Board (IRB), Faculty of medicine, Minia University with approval number (7592021), the Minia City governorate and council. After informing each participant of the study's goal and guaranteeing that their data would remain anonymous and not be used for anything but scientific research, the researcher obtained their informed consent.

Statistical analysis:

The statistical package for social sciences (SPSS, version 26) was used to analyze the data that had been gathered. The figures were created using Microsoft Office Excel 365. The frequency distribution and its percentage were used to show the qualitative data, while the mean and standard deviation of the descriptive statistics were computed for the quantitative data. Student's t-test and Chi-square test were employed. P-values less than 0.05 were regarded as significant. Figures were done using Microsoft Excel 365.

Results

Table 1 revealed that the age range of the waste collectors, who were all men, was 15 to 67 with 76.1% of them above the age of forty. Around 60% were illiterate, and the vast majority (94.2%) came from rural areas. The study showed that 50.3% of the workers were current smokers, with cigarettes accounting for most of these cases. About 70% of the workforce works morning hours, and more than half of them (55.8%) have permanent contracts. Their average period of work was 17.4 years.

The prevalence of HCV and HBV was 13% and 0.9% respectively, as shown in figure 1. Widal test was positive for only 1 case (0.43%) while HAV and HIV testing revealed negative in all workers who underwent the laboratory investigations. Figure 2 demonstrates that the percentage of MSW workers with excellent and good work ability scores were 56.8% and 33.5% respectively. The mean score for work

ability index was 42.9 ± 4.5 with a minimum of 26 and a maximum of 49.

Table 2 shows that while there were no significant differences detected in terms of age, workplace, housing, marital status, or smoking status, the prevalence of HCV was substantially associated with lower educational levels (17.3% versus 5.7%).

Table 3 shows that increased exposure to medical wastes (15.9% versus 3.7%), higher rates of exposure to sharp injuries (25.5% versus 1.7%), and longer work duration (19.6% versus 6%) were all significantly correlated with the presence of HCV. However, no significant differences were found when considering the type of occupation, contract, shift time, PPE usage, presence of additional jobs, work ability, or salary.

It is worth mentioning that the two workers who had positive HBV tests were permanent sweepers and collectors aged about 48 years, worked for about 23 years in the southern district, used PPE, both done surgeries (cataract and hernioplasty), often or always exposed to medical waste and needle stick injury and had work ability score of about 42.5 (good work ability).

Table 4 showed that the presence of positive HCV tests didn't affect the workers' work ability as the positive workers had insignificantly lower scores (41.8 ± 4.5) than the negative ones (42.8 ± 4.7). While table 5 showed that presence of HCV doesn't affect the absenteeism (13.5%) and the hindrance (11.3%) of the studied workers.

Table (1): Demographic and occupational characteristics of Minia Municipal solid waste workers (n=310).

Variables	Mean \pm SD	Range
Age (in years)	46.8 \pm 9.7	22-67
Working years	17.4 \pm 8.9	1-42
	Number	Percentage
Age groups		
Below 40 years	74	23.9
Above 40 years	236	76.1
Minia city districts		
North	69	22.3
West	105	33.9
South	86	27.7
Central	50	16.1
Marital status		
Single	17	5.5
Married	293	94.5
Educational level		
Illiterate	186	60
Read and write	90	27.4
Secondary education	39	12.6
Residence		
Rural	292	94.2
Urban	18	5.8
Smoking status		
Smoker	156	50.3
Ex-smoker	12	3.9
Nonsmoker	142	45.8
Type of smoking		
Cigarettes	100	59.5
Shisha	65	38.7
Both	3	1.8
Occupation		
Sweepers and collectors	254	81.9
Drivers	23	7.4
Inspectors	33	10.6
Contract		
Permanent contract	173	55.8
Temporary contract	137	44.2
Time of shift		
Morning	218	70.3
Afternoon	39	12.6
Night	52	16.8

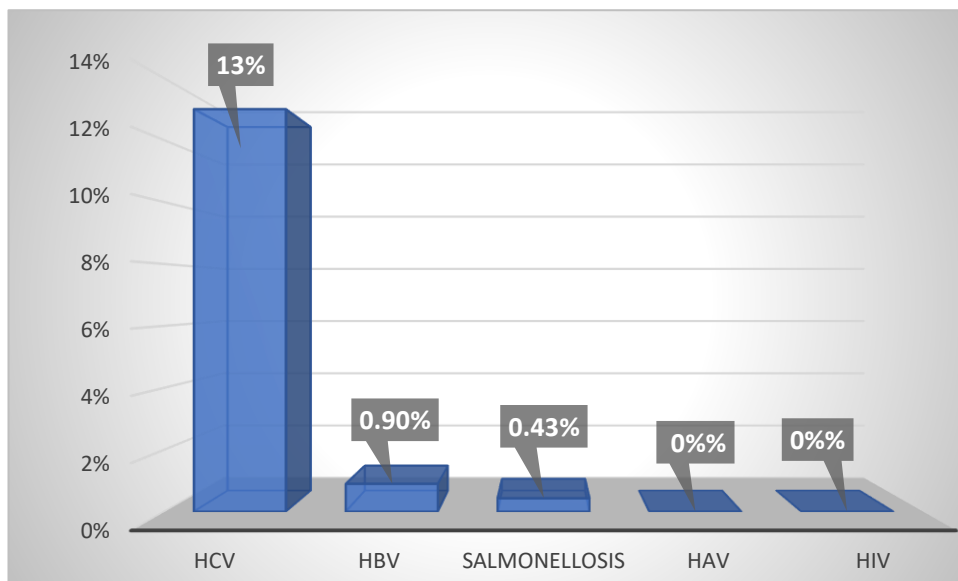


Figure (1): Distribution of studied workers according to their results in the five tested infectious diseases

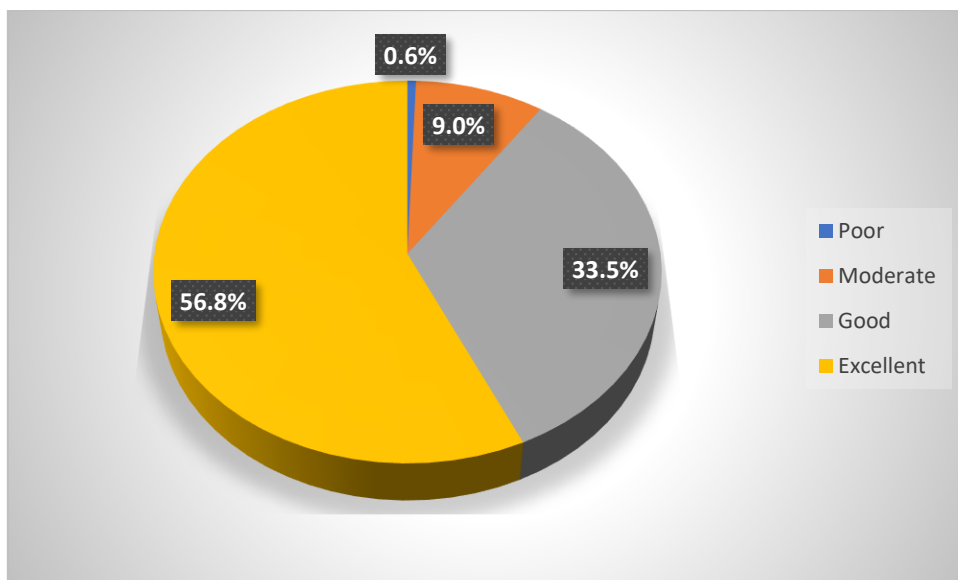


Figure (2): Work ability index scoring among the studied waste collectors

Table (2): The relation between Hepatitis C virus antibody laboratory results and sociodemographic factors among Minia waste workers

Variables	Negative	Positive	Total	χ^2 <i>p</i> value
Age				
Below 40	49 (89.1%)	6 (10.9%)	55 (23.9%)	0.29
Above 40	151 (86.3%)	24 (13.7%)	175 (76.1%)	0.655
District				
North	54 (78.3%)	15 (21.7%)	69 (30%)	7.209 0.063
West	52 (88.1%)	7 (11.9%)	59 (25.7%)	
South	64 (91.4)	6 (5.6%)	70 (30.4%)	
Central	30 (93.8%)	2 (6.3%)	32 (13.9%)	
Residence				
Rural	189 (87.5%)	27 (12.5%)	216 (93.9%)	0.924
Urban	11 (78.6%)	3 (21.4%)	14 (6.1%)	0.403
Educational level				
Illiterate	129 (82.7%)	27 (17.3%)	156 (57.8%)	8.142 0.013*
Read and write	50 (94.3%)	3 (5.7%)	53 (23%)	
Secondary education	21 (100%)	0	21 (9.1%)	
Marital status				
Single	10 (90.9%)	1 (9.1%)	11 (4.8%)	0.159
Married	190 (86.6%)	29 (13.2%)	219 (95.2%)	0.690
Smoking status				
Smokers	96 (85.5%)	15 (13.5%)	111 (48.3%)	1.204
Ex-smokers	11 (100%)	0	11 (4.8%)	0.566
Nonsmokers	93 (86.1%)	15 (13.9%)	108 (47%)	

Table 3: The relation between Hepatitis C virus antibody laboratory results and work-related factors among Minia waste workers

	Negative	Positive	Total	χ^2 p value
Occupation				
Sweeper and collector	157 (85.8%)	26 (14.2%)	183 (79.5%)	1.410
Drivers	14 (87.5%)	2 (12.5%)	16 (7%)	0.494
Inspectors	29 (93.5%)	2 (6.5%)	31 (13.5%)	
Contract				
Permanent	126 (86.3%)	20 (13.7%)	146 (63.5%)	0.151
Temporary	74 (88.1%)	10 (11.9%)	84 (36.5%)	0.697
Shift type				
Morning	148 (84.6%)	27 (15.4%)	175 (76.1%)	3.756
Afternoon	28 (93.3%)	2 (6.7%)	30 (13%)	0.153
Night	24 (96%)	1 (4%)	25 (10.9%)	
Work duration				
Less than 11 years	59 (89.4%)	7 (10.5%)	66 (28.7%)	6.964 0.031*
11-20 years	63 (94%)	4 (6%)	67 (29.1%)	
More than 20 years	78 (80.4%)	19 (19.6%)	97 (42.2%)	
Additional job				
No	149 (86.1%)	24 (13.9%)	173 (75.2%)	0.423
Yes	51 (89.5%)	6 (10.5%)	57 (24.8%)	0.515
PPE usage				
No	169 (87.1%)	25 (12.9%)	194 (84.3%)	0.027
Yes	31 (86.1%)	5 (13.9%)	36 (15.7%)	0.999
Salary (LE/month)				
Less than 2000	75 (88.2%)	10 (11.8%)	85 (37%)	0.194
More than 2000	125 (86.2%)	20 (13.8%)	145 (63%)	0.692
Exposure to sharp injury				
Never or rarely	118 (98.3%)	2 (1.7%)	120 (52.2%)	28.633 0.0001*
Often or always	82 (74.5%)	28 (25.5%)	110 (47.8%)	
Exposure to medical wastes				
Never or rarely	62 (96.3%)	2 (3.7%)	54 (23.5%)	5.427 0.02*
Often or always	148 (84.1%)	28 (15.9%)	176 (76.5%)	

Table (4): The difference in the mean of work ability score regarding the positive or negative hepatitis C virus lab findings

	WAI score Mean \pm SD	t value p value
Presence of positive hepatitis C antibody		
No (200)	42.8 \pm 4.7	1.066
Yes (30)	41.8 \pm 4.5	0.288

Table (5): the difference between HCV positive and negative workers regarding their absenteeism and work hindrance

	Negative	Positive	Total	χ^2 p value
Absence from work				
No	166 (86.9%)	25 (13.1%)	191 (83.8%)	0.005
Yes	32 (86.5%)	5 (13.5%)	37 (16.2%)	0.944
Hindrance during work				

No	137 (86.2%)	22 (13.8%)	159 (69.1%)	0.286
Yes	63 (88.7%)	8 (11.3%)	71 (30.9%)	0.593

Discussion

The majority of the studied solid waste handlers in Minia City are composed of middle-aged males. The studied waste handlers were less educated, coming from lower socioeconomic backgrounds, and live in poorer rural areas than in urban ones (4, 13-16).

Approximately half of the workers in the present study were smokers. These figures were comparable to those of MSW workers in Mansoura and Menoufia, where the percentage of smokers was 55% and 42.9%, respectively (13, 15).

According to surveys conducted in Brazil and India, the percentage of smokers was lower, at 34% and 29.5%, respectively (17, 18). However, a research conducted in Malaysia revealed greater percentages (81.8%) of participants were smokers (19).

The present study's findings demonstrated that MSW collectors had a frequency of HCV antibodies of 13%. This was less than the 18.1% observed among the similar population in Beni Suef in 2013 (20), the 8.4% in Beni Suef in 2015 (21), the 43.3% in Mansoura workers who had much higher prevalence in 2013 (22) and the 21.6% in Minia workers in an earlier study done in 2017 (4). In contrast, the prevalence in the current study was greater than the prevalence found in Alexandria in 2015 which was 8.4% (21) and also higher than the overall population in Egypt which in 2017 was 10% (4) and in 2023 was 0.38% due to the currently employed 100 million healthy life national campaign (23).

Worldwide, the prevalence is lower than the figures of the current study. In Sanaa' Yemen, the reported prevalence was 5% by rapid test and 2.5% by ELISA among medical waste handlers (24). An Indian study reported that 10% of the waste handlers were reactive to HCV (25). In Pakistan the prevalence was 3.3% (26), in Ethiopia it was only 1.13% (27), while in Iran there were no reported cases of HCV (28).

HCV among other high-risk occupations was less than the figures reported in this study as the prevalence of HCV among health care workers (HCWs) (21) in Cairo university hospitals was 10% in 2007 (29), among Assiut university HCWs was 5.2% in 2015 (30) and among Kafr El-Sheikh general hospital personnel it was 9.3% (31).

Recent figures in Egypt are generally lower than older ones as addressed by the WHO (23). This study shows higher prevalence of HCV which could suggest the frequency of exposure and may be even reinfection by HCV both due to work conditions and sociodemographic and educational factors highlighting the necessity of educating these workers especially. Another suggested cause is the inaccuracy of rapid testing as false positive results may yield from this screening test.

The present study stated that people with low educational levels (17.3%), longer work duration (19.6%) and higher rate of exposure to sharp injury (25.5%) and medical wastes (15.9%) were having positive HCV antibodies more than other workers. These results were consistent with the study done among Minia waste collectors in 2019 where 28.5% of those exposed to sharp injury were seropositive. El-Wahab showed that workers exposed directly to solid waste had significantly more positive test results than non-exposed ones (16.9%) (21). About 73% of Mansoura workers who worked more than 15 years were seropositive (22). The study held in Pakistan showed that those with primary education had the highest HCV-positive infection rate (1.67%), followed by illiteracy (1.33%) and lastly among those having diploma and above (0.33%). It showed also that the two main risk factors for infected cases were sharp injuries (6%) and barehanded activities (2.67%) (26). The Ethiopian study addressed that handling medical wastes ($p=0.037$) and history of sharp injury ($p=0.003$) were significant

factors in predicting positive HCV results as well as the non-usage of PPE ($p= 0.019$)⁽²⁷⁾. The study done in Yemen showed that worker who worked more than 11 years had higher rates of HCV infection (8.3%)⁽²⁴⁾. Concerning HBV in waste collectors, the current study showed low prevalence (0.9%). MSW workers in Alexandria showed a prevalence of 36.1% in 2015⁽²¹⁾, 1.5% in 2018⁽¹⁴⁾ and in Beni Suef were 6.5% in 2013⁽²⁰⁾.

Other countries show higher number of workers who contracted HBV compared to those addressed in the present study. Yemen waste collectors revealed 9.17% prevalence by rapid test and 4.17% by ELISA⁽²⁴⁾, Ethiopia was 6.04%⁽²⁷⁾ and Iran was 1.5%⁽²⁸⁾.

HBV prevalence among health care workers -HCWs had similar numbers as Cairo university hospital HCWs showed a prevalence of 0.93%⁽³²⁾, Assiut HCWs were 3.1%⁽³⁰⁾ and Suez canal HCWs were 0.4%⁽³³⁾

In WHO-MENA region, the pooled prevalence of HCV among general population was 2.4% with 95% CI (2.3-2.6) and among high-risk health care personnel was 30.1% with 95% CI (27.6-32.7)⁽³⁴⁾. A systematic review done in south America addressed that the prevalence of HBsAg varied from 4.3 to 33.4% while for HCV antibody varied from 1.6 to 12.4%⁽³⁵⁾.

None of the workers in the current study were positive for hepatitis A virus. In Greece it was 40%⁽³⁶⁾ and in Iran it reached 100%⁽³⁷⁾. This variation may be due to the difference in the used testing modalities across the studies.

A meta-analysis done in 2023 showed that the overall pooled seroprevalence of HAV infection among waste collectors across the world was 56.7%. While 22.6% and 22.8% for HBV and HCV respectively⁽⁵⁾.

There were no HIV positive personnel in the current study and that was consistent with Beni Suef MSW workers (0%)⁽²¹⁾, Sanaa', Yemen medical waste handlers in hospitals (0%)⁽²⁴⁾ and Brazil garbage recycling cooperatives workers 0.75%⁽³⁾.

Given that the estimated prevalence of HIV infection across Egypt is roughly 0.3 per 1000 individuals, this low prevalence is explained by the extremely small reservoir of HIV infection. The widespread practice of male circumcision in Egypt could be one reason for the low rate of HIV transmission. In reality, because medicalized male circumcision has been shown to reduce the incidence of HIV infection by as much as 60%, the WHO has advised it as a prophylactic step against the virus^(2, 21).

Prevalence of salmonellosis in the present study was 0.43%. a study in Ghana revealed 31.7% of the workers were salmonella typhi reactive cases⁽⁶⁾. Indian waste collectors showed typhoid prevalence of 10%⁽³⁸⁾. This variation may be due to the healthy worker effect that hinders the presence of sick workers in their workplaces.

The majority of workers reported having good (33.5%) and excellent (56.7%) job abilities. To our knowledge, no prior research has been done on the work ability of this working group in Egypt; nevertheless, a study carried out in Brazil looked at comparable numbers of workers who admitted to having good (44%) and excellent (43%) ability to work⁽¹⁷⁾.

Work ability in diverse Egyptian occupations, such as administrative, professional, and technical personnel, was found to be moderate, with a mean score of 35.2 ± 4.7 ⁽³⁹⁾ We can hypothesize that the high work ability in the current study is related to the workers' fear of losing their jobs, since temporary contract workers did not have the option of addressing their complaints or taking a sick leave when needed. This is because WAI scores were significantly ($t= -2.637$, $p= 0.009$) higher in temporary contract workers (43.7 ± 3.9) than permanent contract workers (42.4 ± 4.8).

HCV didn't yield significant negative impact on the work ability scores of the studied workers as those with negative results had a score of 42.8 ± 4.7 while positive ones scored 41.8 ± 4.5 .

Absenteeism in HCV positive workers was 13.5% and hindrance was 11.3% with no significant difference between positive and negative ones. On the other hand, American studies showed that HCV infection has a major negative impact on job productivity. Infected individuals report an average of 27% impairment at work and miss 9% of working hours during the work week. Additionally, a database analysis revealed that, in terms of work units per hour, HCV patients were 7.5% less productive^(40, 41). This difference may be due to the chronicity and endemicity of HCV in Egypt so workers become tolerant to their conditions and also may be due to the fear of the workers from losing their jobs and cutting of financial resources.

Conclusion and recommendations:

Among all the studied infectious diseases, the most prevalent one in the MSW workers was HCV which was significantly influenced by the workers' educational level, work duration, exposure to sharp injuries and medical wastes thus highlighting the importance of informing and education of the workers about the proper protective equipment to be used and how to protect themselves from infection and reinfection by HCV.

Limitations:

Some of the workers' supervisors weren't cooperative claiming that this study hindered the workers and got them late to their work while other supervisors didn't allow the workers to participate in the study as they feared that the workers could complain of having certain diseases and so ask for sick leave or mitigated work. Another limitation was the financial resources that hindered the application of more specific diagnostic techniques.

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