

*Research Article***Screening of Cases of Chronic hepatitis C viral infection among municipal solid waste collectors in Minia city, Egypt**

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Abstract

Introduction: Waste collectors have a potential risk of infectious diseases, where more than one third of exposures to blood-borne pathogens occurring among garbage collectors. Egypt became one of the highest hepatitis C virus (HCV) infection prevalent countries in the world, which increased the concern regarding the risk for disease transmission among municipal solid waste (MSW) collectors. Lack of education and awareness are the corner stones for a failure to appreciate safety and preventive measures during waste handling. **Aim of the study:** Detection of municipal solid waste collectors in Minia city, Egypt, who probably have HCV infection and identifying associated risk factors of HCV infection among waste workers. **Subjects and methods:** Descriptive cross-sectional study was conducted in El-Minia city on 171 municipal solid waste collectors aged 29 to 61 years old. An interview administered questionnaire was used and included occupational data, socio demographic data and different risk factors for HCV infection. Blood samples were collected for ELISA screening test for HCV antibodies. **Results:** laboratory results confirmed that 21.6 % of the municipal solid waste collectors were anti-HCV antibodies sero-positive. MSW collectors who experienced sharp injuries during the last 12 months of work and those who had history of dental procedures have 9.5 and 2.91 times more chance to be anti-HCV antibodies seropositive respectively. **Conclusion and Recommendations:** Municipal solid waste collectors are exposed to sharp injuries and are at risk to acquiring HCV infection worker health surveillance should be applied, including baseline and periodic medical examinations. Health education and providing personal protective equipment should also be offered.

Keywords: Waste collectors, HCV screening, Occupational risk and Risk factors.

Introduction

Waste collector workers are at an increased risk for fatal and non-fatal occupational episodes specially in developing countries (Eskezia et al., 2016). In many of these countries, the waste is handled by limited protective gear where it is often mixed with high risk waste such as medical waste specially small objects which being disposed as general waste (Ziraba et al., 2016). Instruments like blades, needles, razor and other discarded medical equipment may transmit HCV to workers handling the waste (Nakhla et al., 2015).

Recently, the number of subjects with acute or chronic diseases receiving home care has increased steadily. In addition to teams of health care workers (HCWs) providing home care and individuals in family members are frequently responsible for injections and other

invasive procedures at home. (Marcellus et al., 2017). Many pharmacies still providing services of administration the injectable medication and so that, most of the generated waste (including needles and other hazardous waste) was disposed away from dangerous waste (Gyawali et al., 2014).

During the disposal of wastes, infection can occur when syringe needles or other sharps have not been collected in rigid, tight puncture proof containers (El-Gilany, et al., 2013). In Egypt, 93% of HCWs in private healthcare facilities disposed of used needles in regular waste baskets. Items such as razor blades, needles and other discarded medical equipment may lead to HCV infection to people handling the waste (Nakhla et al., 2015). Being directly exposed to solid waste, MSW collectors are three times more at risk to needle stick injury

compared by a group of low exposure potential (El-Wahab, et al., 2014) carrying the danger of blood borne viral infections (Eassa et al., 2016). HCV has been known by WHO as a major health problem (Abdel-aty et al., 2017). Egypt has one of the world's highest prevalence of HCV infection (Elgharably et al., 2016).

A high prevalence (43.3%) of HCV antibodies was found among MSW collectors in Mansoura (El-Gilany et al., 2013). A research done in Cairo at a slum area, in comparison with non-working individuals, the garbage collectors, sorters or recyclers and those who had ever worked in relation to garbage at any time during their lives and manual laborers had the highest HCV sero-prevalence. HCV infection is an occupational hazard of waste collectors and who work in this environment. It was found that 25% of garbage collectors, sorter and recycler were positive to HCV and 46% among those who ever sort garbage (Nakhla et al., 2015).

Antiviral medicines can treat most of persons with HCV infection, thereby decreasing the risk of death from complication as liver cirrhosis and cancer, but access to diagnosis and treatment is low (WHO, 2016).

Garbage treatment in Egypt has been largely focused on the issues of collection and disposal with little or no attention paid to the health status of waste collectors (Ewis et al., 2013). MSW workers must be provided with education, personal protective equipment (PPE), training programs, and periodic medical examination to keep them safe from HCV (El-Gilany, et al., 2013).

Screening for HCV infection could determine persons at earlier stages of infection, before they develop dangerous or irreversible liver damage, and may lead to improve clinical outcomes and reduces transmission risk for HCV. Prevalence of HCV-infected persons who are unaware of their status reaches up to 75 % (Chou et al., 2013). Ignorant workers may be unaware of the important link between sources of infection and hazardous health effects. It is possible that this lack of awareness is the basis for a failure to appreciate such safety and preventive measures like use of PPE during waste handling (Eassa et al., 2016).

Aim of the work:

To detect HCV infection among solid waste collectors in Minia city, Egypt and to identify the associated risk factors of HCV infection among them

Subjects and methods:

- **Study design:** Descriptive cross sectional study.
- **Place and duration of study:** El-Minia city during the period from November 2016 to April 2017.
- **Study sample:** 171 workers among municipal solid waste collectors from many sectors selected randomly.

Study methods: The number of workers engaged with waste collection is 410 workers, we randomly recruited 171 workers.

1- Data were collected through a self-administrated structured questionnaire that included socio demographic characteristics, occupational history, previous test for HCV, availability of PPE and exposure to sharp injuries.

2- Laboratory Investigation:

All participants were requested to offer blood samples for HCV antibodies testing.

- **Consent:** The researcher explained the purpose of the study to all participants with confirming confidentiality of their information that will never be used for purposes other than scientific research and informed consent was taken.
- **Ethical approval:** The study was conducted after obtaining approvals of the Ethical Committee of Faculty of Medicine, Minia University and that of the Minia city municipality and the private sector prior to data collection.
- **Data management:** The collected data were analyzed by using the statistical package for social sciences software (SPSS- version 20). Graphics were done by Excel Microsoft office 2010. Qualitative data were presented as frequency distribution with its percent-tage; and for quantitative data, descriptive statistics with mean and standard deviation were calculated. Appropriate significant tests such as Student's t-test, Chi-square test, Fisher's Exact and Z (test of proportion) test were used. P-values of <0.05 were considered significant. Significant risk

factors in the bivariate analysis were entered into the regression model. Odds ratios and their 95% confidence intervals were calculated.

- **Limitations of the study:** Shifting system at work make difficult accessibility to some workers.

Results

This study is the first to provide not only HCV antibodies sero-prevalence data, but also information regarding risk factors associated with acquiring HCV infection among MSW collectors in Minia city, Egypt.

The age of the participated subjects ranged between 29- 61 (mean age 44.7±8.02 years) with 69% of them above the age of forty.

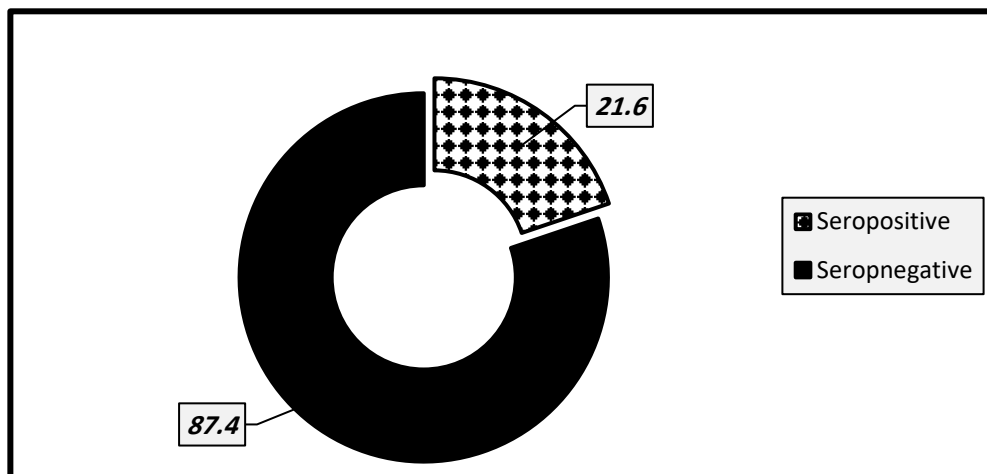


Figure (1): Frequency distribution of HCV antibodies sero-positivity among the studied MSW collectors.

Figure 1 showed that 21.6% of the studied group was sero positive HCV antibodies

Table (1): Relation between serum HCV antibodies and possible risk factors among the studied MSW collectors.

Risk factors	Positive (No=37)	Negative (No=134)	Total (No=171)	p-value
Age group				
<40years	14(26.4%)	39(73.6%)	53 (31%)	0.309
>40 years	23(19.5%)	95(80.5%)	118 (69%)	
Residence				
Rural	32 (21.3%)	118 (78.7%)	150 (87.7%)	0.781
Urban	5 (23.8%)	16 (76.2%)	21 (12.3%)	
Use of personal protective equipment	4(23.5%)	13(76.5%)	17 (9.9%)	0.732
Affection by Sharp injury during last year.	35 (28.5%)	88(65.7%)	123 (71.9%)	0.001
Number of affection by sharp injury /year (No =123).				
One to five	18(26.1%)	12(73.9%)	69 (40.4%)	0.018
Six to ten	8(61.5%)	5(38.5%)	13 (7.6%)	
More than ten	9(21.9%)	32(78.1%)	41 (24%)	
+ve history of surgery	15(20.5%)	58 (79.5%)	73 (42.7%)	0.765
+ve history of dental procedure	29 (27.6%)	76(56.7%)	105 (61.4%)	0.017
+ve history of blood transfusion	1(7.7%)	12(92.3%)	13 (7.6%)	0.303

Table 1 showed that there was no statistically significant difference between workers with positive and their counterparts' negative HCV antibodies regarding age and residence.

Also the table showed that 9.9% of MSW collectors use PPE (gloves and/ or boots). About 94.5% of sero-positive workers had history of exposure to sharp injury during last year of work versus 65.47% of sero-negative workers (highly statistically significant difference (P= 0.001)).

There was statistically significant difference (P= 0.018) regarding number of sharp injuries where 61.5% of sero positive workers had history of number of affection with sharp injury for six to ten times versus 38.5% of sero negative workers.

Table (2): Bivariate Spearman's correlation analysis between HCV seropositivity and possible risk factors among MSW collectors in Minia city 2017

	Anti-HCV seropositivity	
	(r)	P-value
Exposure to sharp injury during last year	0.265	<0.001*
Having dental procedure before	0.183	0.016*
Family history	0.159	0.370
Age	0.112	0.145
History of blood transfusion	0.097	0.206
Educational level	0.092	0.231
Sharp injury number	0.090	0.330
Duration of employment	0.062	0.418
History of surgery	0.023	0.767
Residence	0.020	0.798
PPE use	0.015	0.843

Bivariate analysis revealed a significant weak and fair correlation between exposure to sharp injury during last year, having dental procedure before and the likelihood of HCV antibodies seropositivity (r= 0.265, 0.183 with P <0.001 and 0.016) respectively and insignificant weak correlation regarding family history as shown in (table 2).

Table (3): Logistic regression analysis of independent risk factors of HCV seropositivity among MSW collectors

Independent predictor	P-value	Odds ratio	95% C.I of OR	
			Lower	Upper
Exposure to sharp injury during last year:	0.003	9.5	2.169	41.697
- Exposed				
- Not exposed (ref)				
Having dental procedure before:	0.017	2.9	1.209	7.004
- Yes				
- NO (ref)				

MSW collectors who were exposed to sharp injuries during the last year of work and those who had history of dental procedures have 9.5 and 2.9 times more risk to be HCV seropositive antibodies respectively.

Discussion

The results of the present study revealed that, MSW collectors had a high prevalence (21.6%) of HCV antibodies as shown in (Figure 1) which was higher than the prevalence of the general population which was 10% in Egypt

(Kandeel et al., 2017) and 6-9% in Minia city (Mohamoud et al., 2013; Hassuna et al., 2015). Also, it was higher than what was found among the same group in Beni Suef which was 18.1% (Ewis, et al., 2013), and in Alexandria 8.4% (El-Wahab et al., 2015).

Similarly, worldwide, among MSW collectors in Karachi, Pakistan (8.5%) (Rauf et al., 2013), in Greece (0-2%) (Mariolis, et al., 2006), in Brazil (12.4%) (Rozman et al., 2007) and in Italy (0.92%) (Squeri et al., 2006). This closely matched a finding by (El-Wahab et al., 2015).

El-Gilany, et al., 2013 found that about 43.8% versus 33.3% of sero-positive workers were from rural and urban areas respectively with respect of 95% involvement of rural residents from the whole study participants owed to the rural nature of study governorate (Mansoura).

El Gilany et al., 2013 reported sero-prevalence of 43.3% for anti-HCV among MSW collectors in El Mansoura governorate. However, the population composition in this region is mainly rural where HCV is highly prevalent. Also, 78% of the enrolled participants were above 40 years of age, suggesting exposure to parenteral anti-schistosomal therapy although this was denied by the participants.

The present study demonstrated that the sero-prevalence of HCV antibodies among MSW workers was higher than those of other occupational groups such as health care workers (5.2%, 16.6% and 0%) (Zayet et al., 2015 and Mohamoud et al., 2013).

Table (1) shows insignificant difference between workers with positive and their counterparts negative HCV antibodies regarding age and residence. This finding discarded the role of mass schistosomiasis treatment campaign with reused syringes (1960s through early 1980s) mentioned in a study by El-Gilany, et al., 2013.

In the present study it was found that 9.9% of MSW collectors use PPE (gloves and/ or boots). None of the waste collectors included in similar studies in Nagpur by Sabde & Zopde in 2008, Beni-Suef by Ewis et al., 2013 and Dhaka (Bangladesh) by Ahmed et al., 2017.

There was no significant difference ($p=0.732$) between positive and negative HCV antibodies MSW collectors regarding PPE use which was consistent with a finding that only 9.9% of their subjects were using PPE resembling a study by Rauf et al., 2013 where only 16% of study participants used PPE.

In the present study, 71.9% of the studied MSW collectors reported exposure to sharp injuries during their last 12 month of work (Table 1) compared to 94.9% detected by (Ewis et al., 2013) in their study on occupational health-related morbidities among street sweepers and waste collectors at Beni-suef, Egypt, 50.8% where (El-Gilany et al., 2013), 93% where (Nakhla et al., 2015), 65.4% (Ravindra et al., 2016), 73.2% (Jayakrishnan, et al., 2013), 47.9% (Marinho et al., 2014), 33.3% (El-Wahab et al., 2015), 11.5% (Ansari-Moghaddam, et al., 2016), 16% (Alavian et al., 2005), 52.3% (Eskezia, et al., 2016), 8.9% (Jeong et al., 2015) and 40% (Jerie S, 2016) referring the difference to the type of garbage and how they work.

There was a highly significant difference ($P=0.001$) between positive and negative HCV antibodies MSW collectors regarding sharp injury exposure; 94.5% of sero-positive workers with history of exposure to sharp injury during last year of work versus 65.47% of sero-negative workers. (Table 1)

A similar finding was detected by El-Wahab et al among MSW workers in Alexandria (El-Wahab, et al., 2015) and other studies (El-Gilany et al., 2013; Marinho, et al., 2014; Silva et al., 2005, Gutberlet & Baeder 2008, Rozman et al., 2007), nearly found the same.

As shown in (table 1), 24.3% of studied MSW collectors were injured more than or equal to ten times during the last year of work which was higher than the result (13%) reported by Ewis et al., 2013.

There was significant difference ($P=0.018$) regarding number of sharp injuries where 61.5% of workers with history of sharp injury six to ten times were seropositive versus 26.1% workers injured once to five times.

In this study, it was found that 42.7%, 61.4% and 7.6% of the MSW collectors had history of surgery, dental procedure and blood transfusion respectively. Compared to 7.7%, history of blood transfusion was identified in 24.3% of HCV-positive cases in a study from Egypt by El-Akel et al., 2017 and in 26.1% of anti HCV positive patients in a large study from China (Liu, et al., 2009).

Bivariate analysis of our results revealed a significant weak and fair correlation between

exposure to sharp injury during last year, having dental procedure before and the likelihood of HCV antibodies seropositivity ($r=0.265$, 0.183 with $P<0.001$ and 0.016) respectively and insignificant weak correlation regarding family history (table 2). A study done by Ozsoy et al., 2003, on health care workers and reported that 9.5% of HCWs were exposed to a needle stick injury in their history, but no significant correlation was found with seropositivity to HCV.

Table 3, shows MSW collectors who were exposed to sharp injuries during the last year of work and those who had history of dental procedures have 9.5 and 2.9 times more likely to be HCV antibodies seropositive, this finding was supported with other studies (El-Gilany, et al., 2013; Ewis, et al., 2013).

This finding suggests that exposure to sharp instruments and needle stick injuries could represent a possible pathway for Hepatitis C Virus transmission among municipal waste collectors. This interesting finding corroborates the results of previous studies in Egypt.

A study from Egypt, by Nakhla et al., 2015 conducted on a slum area in Cairo reported that garbage collection was significantly associated with higher risk of HCV infection (adjusted Prevalence Ratio= 1.5), and that HCV infection appears to be an occupational hazard of garbage collection and sorting in this environment giving the large reservoir of HCV infection in the population.

Conclusion and Recommendations

Municipal solid waste collectors are exposed to sharp injuries and acquiring HCV infection. It is important to value those workers and the work they do, periodic worker health surveillance, including baseline and follow-up medical examinations should be done. Health education and providing personal protective equipment should also be offered.

Conflicts of interest

The authors declare that there are no competing interests.

Funding

There was no source of funding.

Acknowledgment

The authors would like to thank all participant and the persons who helped us in conduction of the research.

References

1. Abdel-aty M, Fouad M, Sallam MM, Elgohary EA, Ismael A, Nawara A, Hawary B, Tag-Adeene M and Khaled S. (2017): Incidence of HCV induced esophageal varices in Egypt. *Medicine*; 96: 104
2. Ahmed SN, Sinha AM, Haider M and Craddock H. (2017): Community Perception of Solid Waste Management (SWM) in Dhaka, Bangladesh. *Annals of Global Health*; 83 (1): 1-6.
3. Alavian SM, Dezfoli NM, Asari S. (2005): Prevalence and needle stick risk factors in municipal personnel of Tehran in 2005. *J Infec Trop Dis*; 35: 19–24.
4. Ansari-Moghaddam A, Ansari H, Mohammadi M, Khosravi S, Sanei-Moghaddam E and Miri-Bonjar M. (2016): Predictors of High-Risk Behaviors in Municipal Workers and Staff in Zahedan, South-East of Iran. *International Journal of High Risk Behaviors and Addiction*; 5(4). DOI: <http://dx.doi.org/10.5812/ijhrba.27555>
5. Chou R., Hartung D., Rahman B., Wasson N., and Cottrell E. B. (2013): Screening for Hepatitis C Virus Infection in Adults: A Systematic Review for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*; 158 (2): 101-109.
6. Eassa, SM, El-wahab EWA, Lotfi, SE, Masry SA, El-Shatat HZ, and Kotkat AM. (2016): Risk factors associated with parasitic infection among municipality solid-waste workers in an Egyptian community. *J. Parasitol*; 102(2): 214–221.
7. Ebrahimzadeh P, Haghshenas M and Babamahmoodi F. (2017): The Prevalence of Hepatitis C Virus Genotypes in Mazandaran, Province, Iran. *Jundishapur J Microbiol. In press (In press):e40750*
8. El-Akel W, El-Sayed MH, El Kassas M, El-Serafy M, Khairy M, Elsaeed K, Kabil K, Hassany M, Shawky A, Yosry A, Shaker MK, ElShazly Y, Waked I, Esmat G and Doss W. (2017): National treatment programme of hepatitis C in Egypt: Hepatitis C virus model of care. *J Viral Hepat*; 24: 262–267.

9. Elgharably A, Gomaa AI, Crossey MM, Norsworthy PJ, Waked I and Taylor-Robinson SD. (2016): Hepatitis C in Egypt – past, present, and future. *International Journal of General Medicine*; 10: 1–6
10. El-Gilany AH, Abou-ElWafa HS, El-Bestar SF, El-Sayed ZM. (2013): Prevalence of Hepatitis C Virus Antibodies among Municipal Solid Waste Collectors in Mansoura, Egypt. *Occupational Med Health Affairs*; 1 (6):1-4.
11. El-Wahab EWA, Eassa SM, Lotfi SE, El Masry SA, Shatat HZ and Kotkat AM. (2014): Adverse health problems among municipality workers in Alexandria (Egypt): *Int J Prev Med*; 5(5):545-56.
12. El-Wahab EWA, Eassa SM, Lotfi SE, Kotkat AM, Shatat HZ and El Masry SA. (2015): Sero-prevalence, immuno-status and factors associated with blood borne viral infections among Egyptian municipal solid waste workers. *Journal of Virology & Antivirus Research*; 4 (1): 1-4.
13. Eskezia D, Aderaw Z, Ahmed KY and Tadese F. (2016): Prevalence and associated factors of occupational injuries among municipal solid waste collectors in four zones of Amhara region, Northwest Ethiopia. *BMC Public Health*, pp.1–7. Available at: <http://dx.doi.org/10.1186/s12889-016-3483-1>.
14. Ewis AA, Rahma MA, Mohamed ES, Hifnawy TM and Arafa EA. (2013): Occupational health-related morbidities among street sweepers and waste collectors at Beni-suef, Egypt. *Egyptian Journal of Occupational Medicine* 37: 79–94.
15. Gutberlet J and Baeder AM. (2008): Informal recycling and occupational health in Santo André, Brazil. *Int J Environ Health Res* 18: 1-15.
16. Gyawali IS, Rathore DS, Adhikari K, Shankar PR, Kumar V and Basnet S (2014): Pharmacy practice and injection use in community pharmacies in Pokhara city, Western Nepal. *BMC Health Services Research* 2014, 14:190
17. Hassuna NA, Mohamed ZM, Abo-Eluoon SM and Abdel-Hamid M. (2015): Prevalence of Hepatitis B Virus (HBV), Hepatitis C Virus (HCV) Infections and their Co-infection among Blood Donors in Minia Governorate, Egypt. *British Journal of Medicine & Medical Research*; 5(8): 987-993.
18. Jayakrishnan, T., Jeeja, M. C., and Bhaskar, R. (2013): Occupational health problems of municipal solid waste management workers in India. *International journal of environmental health engineering*; 2 (42): 1-9.
19. Jeong BY, Lee S and Lee JD. (2015): Workplace Accidents and Work-related Illnesses of Household Waste Collectors. *Safety and Health at Work*; (7): 138-142.
20. Jerie S. (2016): occupational risks associated with solid waste management in the informal sector of Gweru, Zimbabwe. *Journal of Environmental and Public Health*; (1); 1-14.
21. Kandeel A, Genedy M, El-Refai S, Funk AL, Fontanet A and Talaat M. (2017): The prevalence of hepatitis C virus infection in Egypt 2015: implications for future policy on prevention and treatment. *Liver Int*; 37: 45–53.
22. Liu F, Chen K, He Z, Ning T, Pan Y and Cai H. (2009): Hepatitis C sero-prevalence and associated risk factors, Anyang, China. *Emerg Infect Dis*; 15 (11): 1819–22.
23. Marcellus Dias Costa MD, Rapparini C, Schmaltz CAS, Tuyama M, Lauria L M, Saraceni V, Barroso PF. (2017): Danger in the streets: exposures to bloodborne pathogens after community sharp injuries in Rio de Janeiro, Brazil. *Brazilian Journal of Infectious Diseases*; 21 (3): 4-10
24. Marinho TA, Lopes CL, Teles SA, Matos MA, Matos MA and Kozlowski AG. (2014): Epidemiology of hepatitis B virus infection among recyclable waste collectors in central Brazil. *Rev Soc Bras Med Trop*; 47(1): 18–23.
25. Mariolis A, Michas C and Magaziotou I. (2006): Sero-epidemiological study of viral hepatitis among workers of the Cleaning Department of the Municipality of Vyronas: Preliminary results of a single centre study. *Public Health*; (120), 1088-1089.
26. Mohamoud Y, Mumtaz GR, Riome S, Miller D & Abu-Raddad LJ. (2013): The epidemiology of hepatitis C virus in Egypt: a systematic review and data synthesis. *BMC Infectious Diseases*, 13(1), 288.
27. Nakhla IA, Sanders JW, Mohareb EW, Samy S, Cosby MT, Mostafa MM, Riddle MS and Jr RWF. (2015): A cross-sectional household cluster sero-survey of hepatitis C virus antibodies in an urban

- slum of Cairo, Egypt in 2004. *Tropical Diseases, Travel Medicine and Vaccines*, 1–10. <https://doi.org/10.1186/s40794-015-0012-7>.
28. Ozsoy M F, Oncul O, Cavuslu S, Erdemoglu A, Emekdas G and Pahsa A (2003): Seroprevalences of hepatitis B and C among health care workers in Turkey. Department of Infectious Diseases, Gulhane Military Medical Academy, Haydarpasa Training Hospital, Istanbul, Turkey. *Journal of Viral Hepatitis*:10,150–156.
 29. Patel PH, Patel HK and Nerurkar AB. (2017): Study of Prevalence of Hepatitis C Virus (HCV) Infection in a Patients attending Tertiary Care Hospital Valsad, Gujarat, India. *Int.J. Curr. Microbiol. App. Sci*; 6(5): 2783-2787. <https://doi.org/10.20546/ijcmas.2017.605.312>.
 30. Rauf MU, Saleem MD, Anwer MO, Ahmed G, Aziz S and Memon MA. (2013): HIV, hepatitis B and hepatitis C in garbage scavengers of Karachi. *J Pak Med Assoc*; 63(6):798-802.
 31. Ravindra K, Kaur K and Mor S. (2016): Occupational exposure to the municipal solid waste workers in Chandigarh, India. *Waste Manag Res*; 34 (11): 1192-1195.
 32. Rozman MA, Alves IS, Porto MA, Gomes PO, Ribeiro NM, Nogueira LA, Caseiro MM, da Silva VA, Massad E and BurattiniMN. (2007): HIV and related infections in a sample of recyclable waste collectors of Brazil. *Int J STD AIDS* 18: 653-654.
 33. Sabde YD and Zodpey SP. (2008): A Study of Morbidity Pattern in Street Sweepers: A Cross-sectional Study. *Indian J Community Med*; 33(4):224-8.
 34. Silva MC, Fassa AG, Siqueira CE and Kriebel D. (2005): World at work: Brazilian ragpickers. *Occup Environ Med* 62: 736-740.
 35. Squeri R, La Fauci V, Sindoni L, Cannavò G, and Spagnolo VE. (2006): Study on hepatitis B and C serologic status among municipal solid waste workers in Messina (Italy). *J Prev Med Hyg* 47: 110-113.
 36. World Health Organization (2016). Country Cooperation Strategy for WHO and Kuwait 2012–2016. Available from: URL:http://apps.who.int/iris/bitstream/10665/113231/1/CCS_Kuwait_2014_EN_15234.Pdf
 37. Zayet HH, Ezz El-Din AM, Ahmed SM and El-Khayat MR. (2015): Hepatitis B and C Virus Infection among Health Care Workers In General Surgery Department, Assiut University Hospitals. *Egyptian Journal of Occupational Medicine*;39(1): 85-104
 38. Ziraba AK, Haregu TN and Mberu B. (2016): A review and framework for understanding the potential impact of poor solid waste management on health in developing countries. *Archives of Public Health*; 74:55. DOI: 10.1186/s13690-016-0166-4.