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Occupational Burden of Hepatitis Viruses in Municipal Solid Waste Workers in Attica, Greece: A Cross-Sectional Study

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Abstract

Background: Municipal solid waste workers (MSWW) are exposed to occupational hazards such as the infection from hepatitis A, B or C viruses (HAV, HBV or HCV). Our study aims to determine the prevalence of various types of hepatitis infection in a sample of municipal workers in Attica, Greece and to identify the risk factors associated with job exposure.

Methods: A total of 307 employees were examined in 2011 and 2012. Data retrieved from the occupational physician's medical files: socio-demographic information, exact job position, previous working experience, education level, medical and family history, previous diseases, use of medication, smoking, use of alcohol and hepatitis testing for the presence of A,B and C types.

Results: A total of 124 workers were found positive to any of the three hepatitis viruses (A, B, or C) in 2011 and 127 in 2012. In 2011, only 25 workers (8.1 % of the total study sample) reported being immunized for HBV and 59 employees (19.2% of the total sample) in 2012. No information on immunization for HAV was available. There was a positive correlation between high risk habits and being positive for HAV and HBV and/or HCV, 40% for alcohol consumption and 50% for smoking. In the multivariate analysis high hepatitis risk occupational exposure was independently associated with increasing age, marital status, alcohol consumption and smoking.

Conclusions: The prevalence of hepatitis A, B and/or C differs between municipal workers in high risk compared to low risk exposure job positions. Immunization status for hepatitis B was very low with no information on any protective measures during work. Closer monitoring of hepatitis infection at the workplace by job exposure status as well as the enforcement of prevention practices such as obligatory immunization, monitoring of practices during work and the use of protective personal equipment are needed. Regular occupational health monitoring must be emphasized.

Keywords: Municpal Solid Waste Workers, Hepatitis A, Hepatitis B, Hepatitis C, Occupational Exposure

Abbreviations: MSWW: Municipal Solid Waste Workers; HAV: Hepatitis A Virus; HBV: Hepatitis B Virus; HCV: Hepatitis C virus

Introduction

Municipal solid waste workers (MSWW) are exposed to an extended variety of occupational hazards [1-5]. Among these hazards is the infection from hepatitis A, B or C viruses (HAV, HBV or HCV). This relationship has been the study subject of many researchers around the world, given that the infection of hepatitis viruses is a significant cause of morbidity and a socio-economic burden. Even though in Greece there has been a decline in both HAV and HBV infection rates in recent years [6-10], infection from Hepatitis B Virus (HBV) or C (HCV) virus is still associated with high morbidity, as it can lead to chronic hepatitis, cirrhosis and hepatocellular carcinoma. Infection from hepatitis A virus (HAV), on the other hand, is associated with lower morbidity but is easier to occur as the virus is transmitted through the faecal-oral route.

Occupational employment with urban waste collection among others, poses risks of infection from blood-borne viruses (such as HBV and HCV), as municipal workers are exposed to biological agents through direct contact of skin or mucous membranes with blood, infected needles, syringes or condoms as well as by accidental pricks from infected needles, syringes or other sharp objects [5]. As far as hepatitis A is concerned, waste contaminated with HAV infected fecal matter, could facilitate the transmission of the virus. Hence practices, such as smoking, drinking or eating during work without adherence to safety precautions, could contribute to a higher HAV prevalence among the group of MSWW [6, 7, 11]. The possibility of infection is not negligible if we consider that hepatitis viruses can survive on infected objects for, at least, seven days [2-4]. Thus it is very important to have a clear idea on the possible

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correlation between high workplace risk such as urban waste collection or garden keeping and infection with the various hepatitis infections, taking into account several risk factors in order to enable measures that minimize occupational exposure.

The majority of studies published to date, only provide a fragmental view of the risks of MSWW associated with hepatitis infection. In order to provide effective occupational health prevention and to reduce occupational risk it is necessary to assess the prevalence of hepatitis virus infections in MSWW taking into account possible co-morbidities and providing comparisons with control groups in similar working environments. The objective of the present study is to determine the prevalence of 3 types of hepatitis infection in municipal workers in a sample from municipalities in the Attica area and to identify the risk factors that are associated with the various job positions (high and low risk exposure).

Methods

A total of 307 employees from several municipalities in Attica Greece were included in the study. The study participants were examined and assessed by the serving occupational physician (E.P) in the corresponding municipalities in 2011 and were re-assessed in 2012 (as part of their annual medical examination). Data for each worker were extracted from the occupational physician's medical files that contain socio-demographic information, exact job position, previous working experience, education level, medical and family history, previous diseases, use of medication, smoking, use of alcohol and routine medical test results (general biochemical tests), hepatitis testing for the presence of A,B and C types, chest X-ray, PAP smear test and mammogram (women over 40 years of age) and PSA (men over 45 years of age). All employees with complete medical files in 2011 were included in the study. Employees with incomplete socio-demographic characteristics, exact job position record and hepatitis test results were excluded from the study sample.

All information in the present study is treated according to the international medical confidentiality standards, enacted by the Council for International Organizations of Medical Sciences and the World Health Organization (WMA, 2008), by using unique code numbers with non-identifiable patient information. The study protocol was approved by the Ethical Committee of the University of Athens.

The study participants held various job positions and for reasons of statistical comparison, all workers were categorized according to the risk of exposure to infection with the 3 hepatitis viruses A, B and C. A total of 171 (55.7%) workers were categorized as low/medium and 136 (44.3%) as high hepatitis infection risk exposure.

Based on the job description the job positions were categorized as follows:

Low exposure: Van drivers, Machine operators, School road traffic controllers, Security guards, ICT technicians,

High exposure: Cleaning service workers, Gardeners, Park workers, Waste collection workers, Cooks, Nursery teachers and nurses.

Individuals who were found positive in carrying any of the hepatitis viruses are for the purposes of the analysis considered as "exposed" and those who were not infected by any hepatitis virus type are considered as "non-exposed".

Descriptive analysis was conducted to assess the distribution of the variables in the study sample. Chi square testing was performed to test the association of the hepatitis infection (dependent variable) with a series of independent variables: age, gender, body mass index, marital status, job position and years of education. The effect of smoking status, alcohol consumption and several medical conditions was also considered.

Multivariate analysis using logistic regression modeling was also performed to assess the associations between the high risk hepatitis infection profiles ("exposed group") with the independent variables. The level of statistical significance was set at 95%. Statistical analysis was conducted using the SPSS v.22 statistical software package.

Results

Out of the total sample of 307 municipal workers, 124 (75 men and 49 women) were found positive ("cases") to any of the three hepatitis viruses (A, B, or C) and 183 (77 men and 106 women) were free of any hepatitis infection ("controls") in 2011. For the year 2012, 127 (77 men and 50 women) were positive for any of the hepatitis viruses ("cases") and 180 (75 men and 105 women) were free of any hepatitis infection ("controls").

The mean age of the total sample in both years was 44.2 years. Hepatitis infection was determined by testing serum samples for the presence of total antibodies against HAV, anti-HBs, anti-HBc, HBsAg and HCV using molecular techniques. Table 1 shows the distribution of the socio-demographic characteristics of the study sample by case/control status (age, gender, Body Mass Index, marital status, job position, level of education).

The two hepatitis exposure groups differed statistically significant in age, Body Mass Index, job position exposure and level of education.

For the year 2011, 115 (66+49) municipal workers with high/medium risk exposure job position (48.5+41.2% of the total high/medium risk job exposure group) were positive for any of the three hepatitis virus infections (A, B or C). A total of 70 workers had completed the compulsory education (up to 9 years) of which the majority (52 persons) had only completed 6 years of education (41.9% of the total hepatitis virus carriers). The mean duration of employment in the current job position was 12.1 years.

In 2012, 118 (69+49) high/medium risk exposure municipal workers were positive for any of the three hepatitis viruses (50.7+41.2% of the total high/medium risk job exposure group).

In 2011, only 25 workers (8.1 % of the total study sample) reported being immunized for HBV, whereas in the year 2012, 59 employees (19.2% of the total sample) were immunized

Table 1: Correlation of hepatitis infection (A, B or C) with demographics: sex, age, body mass index, family status, level of education and job position for 2011 and 2012, respectively

		2011				2012			
		Cases= 124	Controls= 183	p-value	O.R. (95% CI)	Cases= 127	Controls= 180	p-value	O.R. (95% CI)
Sex	Male	75 (49.3%)	77 (50.7%)	0.002	2.11 (1.32-3.35)	77 (50.7%)	75 (49.3%)	0.001	2.16 (1.36-3.43)
	Female	49 (31.6%)	106 (68.4%)			50(32.3%)	105 (67.7%)		
Age (years)	<34	7 (21.9%)	25 (78.1%)	<0.001		7 (21.9%)	25 (78.1%)	<0.001	
	35-39	7 (14.0%)	43 (86.0%)			8 (16.0%)	42 (84.0%)		
	40-44	33 (33.0%)	67 (67.0%)			35 (35.0%)	65 (65.0%)		
	45-49	19 (44.2%)	24 (55.8%)			19 (44.2%)	24 (55.8%)		
	50-54	31 (67.4%)	15 (32.6%)			31 (67.4%)	15 (32.6%)		
	>55	27 (75.0%)	9 (25.0%)			27 (75.0%)	9 (25.0%)		
Body Mass Index (BMI kg/m2)	Normal Weight <24.9	24 (24.0%)	76 (76.0%)	0.001		25 (25.0%)	75 (75.0%)	0.002	
	Over weight 25 29.9	53 (47.3%)	59 (52.7%)			53 (47.3%)	59 (52.7%)		
	Obese >30	20 (45.5%)	24 (54.5%)			20 (45.5%)	24 (54.5%)		
Family Status	Single	15 (40.5%)	22 (59.5%)	0.693		15 (40.5%)	22 (59.5%)	0.716	
	Married	74 (36.8%)	127 (63.2%)			75 (37.3%)	126 (62.7%)		
	Divorced	6 (37.5%)	10 (62.5%)			6 (37.5%)	10 (62.5%)		
	Widowed	1 (100.0%)	0			1 (100.0%)	-		
Family State (never/ ever)	Has never been married	15 (40.5%)	22 (59.5%)	0.694	1.15 (0.57-2.35)	15 (40.5%)	22 (59.5%)	0.735	1.13 (0.55-2.30)
	Has been married	81 (37.2%)	137 (62.8%)			82 (37.6%)	136 (62.4%)		
Job position	Low exposure	9 (17.3%)	43 (82.7%)	<0.001		9 (17.3%)	43 (82.7%)	<0.001	
	Moderate exposure	49 (41.2%)	70 (58.8%)			49 (41.2%)	70 (58.8%)		
	High exposure	66 (48.5%)	70 (51.5%)			69 (50.7%)	67 (49.3%)		
Level of education	Primary school <6 yrs.	52 (54.7%)	43 (45.3%)	0.002		53 (55.8%)	42 (44.2%)	0.001	
	Junior high school 7-9yr	18 (41.9%)	25 (58.1%)			18 (41.9%)	25 (58.1%)		
	High school 10-12 yrs.	35 (37.6%)	58 (62.4%)			37 (39.8%)	56 (60.2%)		
	Inst Vocl Train 13-14 yrs.	5 (26.3%)	14 (73.7%)			5 (26.3%)	14 (73.7%)		
	Technol Edu Ins >15yr	3 (12.0%)	22 (88.0%)			3 (12.0%)	22 (88.0%)		
	University>15 yrs	8 (30.8%)	18 (69.2%)			8 (30.8%)	18 (69.2%)		

for HBV. No information on immunizations for HAV was available in the medical files.

Table 2 shows the prevalence of hepatitis virus types in the study participants in various combinations, i.e. hepatitis A, or B or C only or co-infection with HAV and HBV and/or HCV. The latter is considered the "highest" risk profile. This group consisting of 24 employees in 2011 (11.62%) and 25 employees in 2012 (12.1%) was positive of infection with HAV and HBV and/or HCV.

The correlation between high risk habits such as alcohol consumption and smoking shows that there is a positive association with being positive for HAV and HBV and/or HCV by 40% for alcohol consumption and by 50% for smoking with the corresponding odds ratios of 1.52 (95% Confidence Interval 0.56-4.15) and 1.40 (95% CI 0.50-3.88) respectively (Table 3).

The correlation between hepatitis infection and other morbidities was examined for both years. Among the examined morbidities, a statistically significant correlation emerged indicating positive association between hepatitis infection and the presence of Diabetes Mellitus, Hypertriglyceridemia as well as Hypercholesterolemia both in 2011 and in 2012 (Table 4).

In the multivariate analysis (logistic regression) high hepatitis risk occupational exposure was independently associated with a number of risk factors (Table 5). As such the high risk profile for hepatitis infection in municipal workers is linked to increasing age, marital status (never married vs. ever married), alcohol consumption and smoking.

Table 2: Prevalence of Hepatitis in the study sample

2011	HAV or HBV or HCV	HAV only	HBV only	HCV only	HAV and HBV and/or HCV	2012	HAV or HBV or HCV	HAV only	HBV only* *Disease diagnosis	HAV and HBV and/ or HCV
Yes (cases)	124 (40.4%)	120 (39.1%)	28 (9.1%)	2 (0.7%)	24 (11.6%)	**Yes (cases)**	127 (41.4%)	99 (32.2%)	4 (1.3%)	25 (12.1%)
No (controls)	183 (59.6%)	187 (60.9%)	279 (90.9%)	305 (99.3%)	183 (88.4%)	**No (controls)**	180 (58.6%)	208 (67.8%)	303 (98.7%)	180 (86.9%)
Total	307 (100%)	307 (100%)	307 (100%)	307 (100%)	207 (100%)	**Total**	307 (100%)	307 (100%)	307 (100%)	207 (100%)

Table 3: Correlation between hepatitis (A and B or/and C) prevalence and smoking/alcohol consumption habits, years 2011 and 2012.

		2011				2012			
		Cases= 24	**Controls=183**	**p-value**	**O.R. (95% CI)**	**Cases= 25**	**Controls=180**	**p-value**	**O.R. (95% CI)**
		HAV and HBV and/or HCV	**No hepatitis Infection**			**HAV and HBV and/ or HCV**	**No hepatitis Infection**		
Smoking	Yes	9 (11.7%)	68 (88.3%)	0.409	1.52 (0.56-4.15)	10 (13.2%)	66 (86.8%)	0.254	1.76 (0.66-4.70)
	No (former smokers included)	8 (8.0%)	92 (92.0%)			8 (7.9%)	93 (92.1%)		
Alcohol consumption	Yes	7 (11.7%)	53 (88.3%)	0.517	1.40 (0.50-3.88)	8 (13.1%)	53 (86.9)	0.357	1.58 (0.59-4.25)
	No	10 (8.6%)	106 (91.4%)			10 (8.7%)	105 (91.3%)		

Table 4: Correlation between hepatitis (A and B or/and C) prevalence and other comorbidities, years 2011 and 2012

		2011				2012			
		Cases= 24	**Controls= 183**	**p-value**	**O.R. (95% CI)**	**Cases= 25**	**Controls= 180**	**p-value**	**O.R. (95% CI)**
		HAV and HBV and/ or HCV	**No hepatitis infection**			**HAV and HBV and/ or HCV**	**No hepatitis infection**		
Diabetes Mellitus	Yes	2 (28.6%)	5 (71.4%)	0.182	3.34 (0.61-18.36)	3 (37.5%)	5 (37.5%)	0.057*	4.92 (1.09-22.15)
	No	20 (10.7%)	167 (89.3%)			20 (10.9%)	164 (89.1%)		
Hypertriglyceridemia	Yes	2 (66.7%)	1 (33.3%)	0.034	17.10 (1.48-197.12)	2 (66.7%)	1 (33.3%)	0.038	16.0 (1.39-184.11)
	No	20 (10.5%)	171 (89.5%)			21 (11.1%)	168 (88.9%)		
Hypercholesterolemia	Yes	10 (17.9%)	46 (82.1%)	0.068*	2.28 (0.92-5.64)	11 (19.0%)	47 (81.0%)	0.05	2.38 (0.98-5.76)
	No	12 (8.7%)	126 (91.3%)			12 (9.0%)	122 (91.0%)		
*Marginally non-statistically significant at the 5% level									

Discussion

Only few studies have jointly examined the occupational exposure of municipal solid waste workers to the various types of the hepatitis virus and very few use control groups.

Our results show high prevalence of infection with any type of hepatitis virus 48.5% in high risk jobs in 2011 and 50.7% in 2012. Of the workers found positive for HAV and HBV and/ or HCV, 18.6% (16 workers) were employed in high risk jobs in 2011, OR=4.19, p=0.019, 95% CI 1.26-13.92 and 6.7% (5 workers) were employed in medium risk jobs, OR=3.89, p=0.023, 95% CI 1.21-12.54, with similar results in 2012.

Table 5: Logistic regression model with Dependent variable high vs low hepatitis exposure risk (exposed vs non-exposed) and Independent variables: Sex, Age, Marital status, BMI, Occupation, Employment years, Grams of alcohol, Smoking.

	B(beta)	p-value	Odds Ratio	95% C.I.for EXP(B)	
				Lower	Upper
Sex (Males/Females)	0,441	0,233	1,55	0,75	3,21
Age (years)	0,131	**0,000**	**1,14**	1,08	1,20
BMI (overweight-obese/normal)	0,598	0,086	1,82	0,92	3,60
Marital status (never married/married)	1,113	**0,019**	**3,04**	1,20	7,73
Occupation (baseline the low exposure occupation)	-	0,054	-	-	-
Occupation with medium exposure	1,359	**0,023**	**3,89**	1,21	12,54
Occupation with high exposure	1,432	**0,019**	**4,19**	1,26	13,92
Employment years (in this specific occupation)	0,027	0,326	1,03	0,97	1,08
Grams of alcohol (daily consumption)	0,020	0,261	1,02	0,99	1,05
Smoking	0,317	0,331	1,37	0,72	2,60
Constant	-8,983	0,000	0,00		

The majority of them had received up to 6 years of education: 23.2% (13 workers) in 2011 and 25.0% (14 workers) in 2012. Age was also a risk factor associated with increased prevalence of hepatitis infection, OR=1.4, p<0.001, 95% CI 1.08-1.20. Smoking and alcohol consumption also showed a positive association, but without reaching statistical significance.

A higher prevalence of anti-HBc antibody among MSWWs and non-exposed to waste persons was highlighted in the study of Tsovili et al (Attica, Greece, 2008), 15%, 2,5% respectively [OR=5.91 (95% CI:1.58-73.3)]. Additionally, a possible HBV transmission mechanism via needle prick was pointed out, since positive anti-HBc results were found in the 28,6% of the MSWWs, who referred accidents with needles and just 3,4% of those that did not report any accident (RR=8.28; 95% CI=1.076-63,79; p=0.033). For hepatitis C, unlike hepatitis B, prevalence was 2%, as in the general population in Greece and no correlation with needle pricks was found [2].

Moreover, in the prospective study of Luksamijarulhul et al [3] with a sample of 354 people from Thailand, HBV sero-positivity was higher for waste collectors than cleaners, 57.4% versus 42.2%. According to the data from the participants interview, a statistically significant relationship between the presence of HBV infection serum markers and occupational employment as waste collector (adjusted OR: 1.76, p<0.0027), history of contact with used condoms, syringes, needles (adjusted OR: 3.02, p<0, 0001) and history of sharp object injury or needle prick (adjusted OR: 4.21, p<0, 0001) was reported [3].

In a study of 208 workers (100 MSWWs and 108 gardeners) in Larisa, Central Greece by Rachiotis et al. in the period 2007-2008, the HBV infection prevalence (anti-HBc+) in MSWWs was estimated at 23%, while in gardeners at 5,5% (OR: 4,05;95%CI: 1,23–13,33). This difference was statistically significant (P < 0,001). In particular, 4/100 (4%) of the MSWWs was HBsAg+ versus 2/107 (1.9%) in the control group. Furthermore, the MSWWs who reported needle pricks were at a higher risk to be infected (RR: 2.64; 95% CI: 1.01–6.96; P < 0.005). The more experienced MSWWs reported less accidents during waste collection in comparison with their less experienced colleagues (employment duration: 20.3 years versus 14.2; Students t-test < 0,001) [4].

In another study in Keratsini [5] according to the data collected from 71 MSWWs and 88 people that were used as the control group during the period 9/1999-12/2001, an increased anti-HBc antibody incidence among MSWWs was reported compared to that of the control group (24% versus 8%, p<0,007). Occupational exposure to waste was independently and statistically significant correlated with the anti-HBc presence (OR:4,66). A statistically significant relationship with the occupational employment in the field of waste management was also showcased for the anti-HBs antibody, but not for the HBs antigen [5].

In summary, the relative risk of infection with hepatitis B virus for workers in the waste collection field compared to the workers not exposed to waste ranges from 1,76 (p<0.0027) [3] to 9.36; 95% (CI = 2.01 – 43.7, P<0.05) [1]. All the above studies had statistically significant results [1-5]. The highest prevalence noted among the MSWWs was 57.4% [3] whilst the lowest 1% [12]. From the studies that estimated the hepatitis B prevalence without a control group [13-19], it is worth mentioning that in a study in Pakistan the prevalence was found to be 7.5 times higher than the respective one in the general population [14] and 2.4 times higher than the one of the population of the region in the city Goiânia in Brazil, in the study by Rozman et al [18], however without any comparison for the respective prevalence among general population. On the other hand, in a study by Jayakrishnan et al [17] in India, no case of hepatitis B among the 313 waste collectors that were studied was found [17].

The literature data for hepatitis C was very limited. However, in the studies found [2, 11, 13, 14, 16, 18, 20, 21], the prevalence ranges from 0% [11, 21] to 43.3% [13] in the MSWWs. In the study by Rauf et al [14] the prevalence was about 1.7 times higher than the respective one in the general population of Pakistan (8.5% versus 4.9%) [16]. Mol et al [20] discovered a borderline higher prevalence among Medical Waste Handlers (MWH) compared to Non MWH, 3.3% versus 0.9% [20].

Among the risk factors that are significantly related to increased

hepatitis B or C incidence among the waste collection workers are age (OR from 1,06 with p=0,008 to 10 with p=0,001) [1, 4, 5, 11, 13, 15, 16], employment duration (OR from 1.17 with p=0,006 to 24.02) [1, 2, 11], record of needle prick or injury from a sharp object (OR from 4.21 with p<0.0001 to 8.28 with p=0.033) [1-3] and record of contact with syringes, needles and used condoms (OR: 3.02 with p<0.0001) [3].

Municipal solid waste workers (MSWW) are exposed to a large variety of occupational hazards [22, 23]. Among these possible hazards is the infection from hepatitis A virus (HAV). Yet only few studies have investigated the HAV infection risk among MSWW worldwide [3, 7, 24, 25]. Contact with waste contaminated by infected faecal matter could perhaps enhance the viral transmission via the feacal-oral route. Hence practices, such as smoking, drinking or eating during work without adherence to safety precautions, could contribute to a higher value of HAV prevalence in the group of MSWW [7].

The present study has the limitation of its cross-sectional design; hence it is not possible to establish an aetiological relationship between the hepatitis infection status and the occupational exposure or other risk factors. Moreover, in this study we did not account for non-occupational risk factors with regards to the hepatitis infection status. In addition, the job exposure status did not account for high risk behaviours during work e.g. lack of use of protective equipment (gloves, mask etc.) and we did not have any specific information on workplace accidents such as needle pricks that may have put the workers into even higher risk of hepatitis virus infection. Under-reporting of such accidents may also be an issue. However, the strengths of the study include a variety of job positions and detailed recording of high risk behavioural patterns such as smoking and alcohol consumption.

Despite these limitations, our study points towards an association between high risk occupational exposure with increased prevalence of the various hepatitis viruses and that specific occupational health measures should be enforced in order to minimize the risk of hepatitis infection.

Conclusions

Our study indicates a statistically significant difference in the prevalence of hepatitis A, B and/or C between municipal workers in high risk exposure job positions compared to municipal workers in low exposure jobs. There is great variability in the job characteristics of high risk exposure across the various studies. Immunization status for hepatitis B was very low and there was no information on the use of any protective measures during work. These results indicate the need for closer monitoring of hepatitis infection at the workplace by exposure status and the enforcement of prevention practices such as obligatory immunization, monitoring of practices during work and the use of protective personal equipment. The importance of regular occupational health monitoring must be emphasized.

Conflict of Interest

The authors declared no conflicts of interest.

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