Articolo originale

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Municipal waste collectors and hepatitis B and C virus infection: a cross-sectional study

Studio cross-sezionale sull'infezione da HBV e HCV in addetti alla raccolta dei rifiuti solidi municipali

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INTRODUCTION

Solid waste management refers to a variety of activities related to the supervised handling of waste material from generation at the source through the recovery process to final disposal [1]. Municipal solid waste collectors are occupationally exposed to a broad spectrum of occupational hazards [2, 3]. However, it has been observed that waste collectors are characterized by higher level of labor accidents in comparison to the total workforce [4].
In addition, there are reports from different countries suggesting that injuries caused by sharp objects were much higher among municipal waste collectors from USA, Brazil and Taiwan than among their Danish colleagues [5-8].
Hepatitis B Virus (HBV) is resistant on environmental surfaces for a period of at least 7 days [9]. Consequently, municipal collectors could have a theoretical risk of acquiring HBV infection after exposure to contaminated sharp instruments which have been improperly discarded. This is also could be the case for Hepatitis C Virus infection (HCV). Up to day there are only two studies that reported a positive association between exposures to sharp instrument during waste collection process and the risk of HBV infection [10, 11]. Additionally, there is a scarcity of data on the prevalence and risk factors for HCV infection among municipal waste workers. The aim of present cross-sectional study is to investigate the prevalence and possible risk factors of HBV and HCV infections among waste collectors in a municipality of the broader region of Attica, Greece.

PATIENTS AND METHODS

A cross-sectional sero-prevalence study was conducted during the period January-August 2008 in a municipality of the broader region of Attica, Greece. Five out of 60 municipal waste collectors were vaccinated against HBV and all have recorded protective levels of anti-HbS (+). These 5 workers were excluded from the final sample. Finally, fifty waste collectors participated in the study (response rate: 95%). The group of municipal waste collectors was compared to a convenient sample of employees not exposed to waste (n=90). Finally, 83 out of 90 members of the control group participated in (response rate: 92%). This control group did not differ significantly in comparison to waste collectors in terms of sex, age and duration of employment. Educational status was different between study and control groups. In particular, waste collectors were less educated that mem-

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bers of the control group ($p<0.05$). At first, a questionnaire was used to obtain information on socio-economic variables (sex, age, education, occupation and duration of employment). All participants were asked to report previous vaccination history against HBV. In addition municipal waste collectors were asked to report previous experience (during the last 12 months) of exposure to sharp instruments/needle stick injuries during the municipal waste collection process (never/almost never/rarely/sometimes/frequently/always). Participants who selected the options: never/almost never/rarely/sometimes were classified as the "low" exposure group. On the contrary subjects who reported frequent/always exposure to sharp objects/needle sticks injuries were considered as the "high exposure" group. All collected serum samples were tested for HBsAg (antigen), anti-HBc, anti-HBs, and anti-HCV (antibodies) by enzyme linked immunosorbent assay. All participants have given their informed consent for participation in the survey. No monetary incentives for participation were offered. The study was conducted according to the principles of the Declaration of Helsinki.

STATISTICAL ANALYSIS

Qualitative data were presented as absolute (n) and relative frequencies (%) while quantitative data were presented as mean (Standard Deviation).The statistical analysis (univariate) of the qualitative data collected conducted by the use of Chi-square test, and the univariate analysis of quantitative data was performed by the use Student's t-test. A logistic regression model was used for the multivariate analysis of anti-HBc (+) with selected risk factors. Odds Ratio (OR) and 95% Confidence Intervals (95% CI) were calculated. The level of statistical significance was set at 0.05. Statistical analysis was performed by the use of Excel and Epi Info software.

RESULTS

Socio-demographics

Table 1 presents the socio-demographic profile of our study sample. The mean age of the participants was 43.5 years (SD=8.25; median=42). Males were 51.1% of the participants and 48.9% were females. Regarding educational status 48.1% of the study population reported ≤ 9 years of education and 51.9% reported >9 years of education. Regarding occupation 50 (38%) were municipal solid waste collectors while 83 (62%) worked in various occupations without exposure to municipal solid waste (*e.g.* office workers, and blue collar workers). The mean duration of employment was 12.3 years (SD=6.1).

Table 1 - Sociodemographic profile of the participants

Characteristics	*N (%)*
Sex	
Male	68 (51%)
Female	65 (49%)
Age*	43.5 (8.25)
Duration of employment*	12.3 (6.1)
Education	
≤9 years	64 (48.1%)
>9 years	69 (51.9%)
Occupation	
Exposed to waste	83 (63%)
Non exposed	50 (37%)

*Mean, standard deviation

Univariate analysis (among all participants)

Table 2 shows the univariate association between several possible risk factors and anti-HBc positivity. Despite the fact that males recorded a higher prevalence (10.4%) of anti-HBc (+) than females (3.1%) the difference was not significant (p value=0.165). Age was found to be a significant risk factor in terms of anti-HBc status. In particular the mean age of participants with anti-HBc (+) was significantly higher in comparison to those with anti-HBc negative (50.89 vs. 42.93, respectively, $p<0.005$). Duration of employment also was a factor significantly associated with anti-HBc status in univariate analysis. Subjects with anti-HBc positivity did record a higher mean duration of employment that their counterparts with negative anti-HBc (19 years vs. 11.9, respectively, $p=0.001$). Lower education was a risk factor for anti-HBc positivity among participants. Especially, subjects with less than 9 years of education recorded a higher prevalence of anti- HBc (+) in comparison to their counterparts with 9 or more years of education (12.5% vs. 1.5%, respectively, $p=0.016$). Municipal solid waste collectors had a higher prevalence of anti-HBc positivity in comparison to subjects without oc-

Table 2 - Univariate analysis of anti-HBc (+).

Characteristic	*Anti-HBc (+)*	*Anti-HBc (-)*	*P value*
Sex	n, (%)	n, (%)	
Male	7/67 (10.4%)	60/67 (89.6%)	0.165[b]
Female	2/64 (3.1%)	62/64 (96.9%)	
Age (years)[a]	50.9 (9.1)	42.93 (7.9)	<0.05[c]
Duration of employment (years)[a]	19.0 (5.1)	11.9 (5.8)	<0.05[c]
Occupation			
Exposed	7/50 (16%)	42/50 (84%)	<0.001[b]
Non exposed	2/82 (2.4%)	80/82 (97.6%)	
Educational status			
≤9 years	8/64 (12.5%)	56/64 (87.5%)	0.016[b]
>9 years	1/67 (1.5%)	97/101 (98.5%)	

[a]Mean, standard deviation, [b]X^2 test, [c]Student's t-test.

cupational exposure to waste (15% vs. 2.4%, respectively, p=0.014). One solid waste collector was HBsAg positive (2%). No subject from the control group was HBsAg (+). Regarding Hepatitis C virus infection only one participant (municipal waste collector) was anti-HCV (+).

Multivariate analysis (among all participants)

Table 3 depicts the results of the multivariate analysis of anti-HBc (+). Occupation and duration of employment were independently associated with the likelihood of anti-HBc positivity. In particular municipal waste collectors recorded a 5.91 fold ratio of being anti-HBc (+) in comparison to the control group (OR=5.91; 95% CI=1.58-73.3). In addition subjects with more than 12 years duration of employment recorded a 5.68 fold ratio of anti-HBc positivity (OR=5.68; 95% CI=1.67-192.85) in comparison to participants with duration of employment less than 12 years.

Table 3 - Multivariate analysis of anti-HBc (+).

Risk factor	*Odds Ratio (OR)*	*Confidence Interval (CI)*
Age group		
≤42 years	1.0 (ref)	0.21-9.6
>42 years	1.42	
Occupation		
Non-exposed	1.0 (ref)	1.58-73.3
Exposed 5.9		
Education		
>9 years	1.00 (ref)	0.32-35.3
≤9 years	3.36	
Duration of employment		
>12 years	5.68	1.67-192.8
≤12 years	1.00 (ref)	

Univariate analysis (homogeneous exposure group of municipal cleaners)

Further analysis (Table 4) among the homogeneous exposure group of municipal waste collectors indicated that age and duration of exposure were significantly associated with anti-HBc (+). In particular the mean age of the anti-HBc (+) positive municipal waste collectors was 50.9 (SD=10.3) while the mean age of their anti-HBc (-) counterparts was 42.9 (8.8). The difference was statistically significant (p<0.05). The univariate analysis also revealed that anti-HBc (+) municipal waste collectors recorded higher duration of employment in comparison to their colleagues with an anti-HBc (-) status (19.9 vs.8.5 years, respectively, p<0.001). Sex and education were not significantly associated with anti-HBc status among municipal solid waste collectors (p=0.65 and 0.081, respectively). Additional univariate analysis showed that sharp and needle stick injuries among solid waste collectors were significantly associated with the risk of anti-HBc (+). In particular, 6 out of the 21 (28.6%) solid waste collectors that reported frequent sharp/needle stick injuries were anti-HBc (+) while only one (3.4%) out of the 29 collectors that didn't report sharp/needle stick injuries was anti-HBc positive (RR=8.28; 95% CI=1.076-63.79; p=0.033).

Table 4 - Univariate analysis of anti-HBc among the homogeneous exposure group of municipal cleaners

Characteristic	*Anti- HBc (+) n, (%)*	*Anti- HBc (-) n, (%)*	*P value*
Sex			
Male	6/35 (17.1%)	29/35 (82.9%)	0.659[b]
Female	1/15 (6.7%)	14/15 (93.3%)	
Age (years)[a]	50.86 (10.3)	42.88 (8.82)	<0.05[c]
Duration of employment (years)[a]	19.9 (5.6)	8.5 (6.2)	<0.001[c]
Educational status			
≤9 years	7/34 (20.6%)	27/34 (79.4%)	0.08[b]
>9 years	0/16 (0%)	16/16 (100%)	

[a]Mean, standard deviation, bX^2 test, cStudent's-t- test.

Table 5 - Multivariate analysis of anti-HBc among the homogeneous exposure group of municipal cleaners (+).

Risk factor	*Odds Ratio (OR)*	*Confidence Interval (CI)*
Age group		
≤42 years	1.0 (ref)	0.21-9.6
>42 years	1.11	
Duration of employment		
>12 years	24.02	1.9-303.3
≤12 years	1.00 (ref)	

Multivariate analysis among municipal solid waste workers

Logistic regression analysis (Table 5) indicated that duration of employment was independently associated with the risk of anti-HBc positivity among the homogeneous exposure group of municipal solid waste collectors. Municipal solid waste collectors with more than 12 years duration of employment had a 24 fold increased risk of being anti-HBc (+) in comparison to their colleagues with duration of employment less than 12 years (OR=24; 95% CI=1.9-303.2).

DISCUSSION

Our results indicated that municipal solid waste collectors recorded a significantly higher prevalence of hepatitis B virus infection (anti-HBc positivity) in comparison to the reference group (15% vs. 2.5%, respectively). A recent systematic review and meta-analysis of the existing limited evidence showed that the pooled proportion of anti-HBc (+) was 24% [12]. Previous studies from various geographic parts of Greece recorded high prevalence of anti-HBc positivity among municipal solid waste collectors. In particular, Dounias et al. in a cross-sectional study of municipal workers at a municipality in the region of Piraeus found that the prevalence of anti-HBc (+) was estimated at 23.9% [13]. Similar results have been found by Mariolis and co-workers in a cross-sectional study among municipal solid waste collectors in a municipality of the Attica region. They reported a prevalence of anti-HBc positivity at 21.7% [14]. Rachiotis et al. in a seroprevalence study among municipal employees at a municipality based on Central Greece found that the prevalence of anti-HBc (+) was 23% [10]. In addition studies from Italy and Thailand do confirm a higher prevalence of Hepatitis B infection among municipal solid waste collectors. In particular, Squeri and colleagues in a study among municipal solid waste collectors in Italy found that 32.4% of the municipal solid waste workers showed serologic evidence of previous exposure to Hepatitis B virus infection [15]. Moreover, a study from Thailand indicated that the total prevalence for anti-HBc (+) was 42% and 57% for public garbage collectors and public cleaners, respectively [10]. Regarding prevalence of Hepatitis C Virus infection, our results demonstrated that the prevalence among municipal waste collectors was 2% which is similar to the general population prevalence of HCV in Greece [16]. In a previous study among waste collectors Mariolis and co-workers found all tested municipal workers sero-negative for antibodies against HCV [14]. Interestingly, a recent study from Egypt (a highly endemic country for Hepatitis C Virus infection) found a high preva-

lence (43%) of anti- HCV antibodies among municipal waste collectors [17]. Multivariate analysis confirmed an independent association between waste collection and the likelihood of Hepatitis B Virus infection. Further analysis among the homogeneous exposure group of waste collectors has shown an independent association between duration of employment as municipal waste collector and anti-HBc positivity. With respect to the possible route of Hepatitis B Virus transmission restricted analysis among the municipal collectors indicated that collectors who reported frequently accidents with sharp instrument/needle sticks were more likely to be infected (anti-HBc positive) with HBV virus in comparison to their colleagues with low or no exposure to such type of injuries (RR=8.28; 95% CI=1.076-63.79). This finding suggests that exposure to sharp instruments and needle stick injuries could represent a possible pathway for Hepatitis B Virus transmission among municipal waste collectors. This interesting finding corroborates the results of two previous studies in Central Greece and Thailand [10, 11]. In particular Rachiotis et al. in a study of municipal employees published in 2012 found that municipal waste workers who reported occupational injuries with needle sticks were at higher risk of hepatitis B infection. Additionally, a study conducted in Thailand found that exposure to needle stick or sharp puncture injuries was independently associated with HBV sero-positivity among public cleansing workers of Bangkok Metropolis. Our study showed that despite the needle stick injuries observed among waste collectors HCV infection was not a significant hazard among this occupational group. This finding could be partially explained taking into account the lower sero-convertion rate for HCV infection after a needle stick injury (1.8%) in comparison to the respective rate after exposure to HBV [18]. The limitations of our study include the cross-sectional design and the locally applicable results. In addition, the small number of the study population and in particular of waste collectors produced large 95% Confidence Intervals for the estimate of association. Consequently, extrapolation of the results should be made with care.

CONCLUSION

Our study corroborates previous results of an increased prevalence of Hepatitis B infection among municipal waste collectors. In addition we found that needle stick injuries were associated with the risk of HBV infection. On the contrary HCV infection does not seem to represent a significant occupational hazard among waste collectors. Vaccination against HBV among municipal solid waste and promotion and use of safer methods for the collection of non-hospital medical waste (*e.g.* from private health practitioners, patients and i.v. drug users) could be considered as potential measures for the prevention of Hepatitis B Virus infection among municipal solid waste workers.

Keywords: Hepatitis B, Hepatitis C, municipal, collectors, waste.

SUMMARY

There is some evidence that municipal waste collectors are at risk of Hepatitis B virus infection (HBV). Published information on risk of Hepatitis C Virus (HCV) infection among waste collectors is scant. We aimed to investigate the prevalence and possible risk factors of HBV and HCV infections among waste collectors in a municipality of the broader region of Attica, Greece. A cross-sectional sero-prevalence study was conducted in a municipality of the broader region of Attica, Greece. Fifty waste collectors participated in the study (response rate: 95%). The group of municipal waste collectors was compared to a convenient sample of white collar employees not exposed to waste (n=83). Waste collectors recorded a significantly higher prevalence of hepatitis B virus infection (anti-HBc positivity) in comparison to the reference group (15% vs. 2.5%, respectively; p<001). Waste collectors who reported frequent exposure to needle-stick injuries had higher risk of HBV infection (RR=8.28; 95% CI=1.076-63.79; p=0.033). Only one municipal waste collector was anti-HCV (+). Our study corroborates previous results of an increased prevalence of Hepatitis B infection among municipal waste collectors. In addition we found that needle stick injuries were associated with the risk of HBV infection. By contrast, HCV infection does not seem to represent a significant occupational hazard among waste collectors. Vaccination against HBV among municipal solid waste collectors and promotion and use of safer methods for the collection of non-hospital medical waste could represent potential measures for the prevention of Hepatitis B Virus infection among municipal waste collectors.

RIASSUNTO

Alcune evidenze scientifiche indicano che gli addetti alla raccolta dei rifiuti municipali sono a rischio di contrarre l'infezione da virus dell'epatite B (HBV); per contro, i dati relativi al rischio di infezione da virus dell'epatite C (HCV) sono ancora scarsi. Il presente studio è stato condotto al fine di indagare la prevalenza e i possibili fattori di rischio per le infezioni da HBV e HCV tra gli addetti alla raccolta dei rifiuti in un comune della regione dell'Attica (Grecia).

Allo studio, trasversale e di siero prevalenza, hanno partecipato cinquanta addetti alla raccolta dei rifiuti (tasso di risposta: 95%) che sono stati raffrontati a un campione adeguato di impiegati non esposti ai rifiuti (n=83). Negli addetti alla raccolta dei rifiuti si è registrata una prevalenza significativamente maggiore di infezione da virus dell'epatite B (positività anti HBc) in confronto al gruppo di riferimento (15% contro 2,5%, rispettivamente; p<0,01). Gli addetti alla raccolta dei rifiuti che denunciavano una frequente esposizione a lesioni da puntura con aghi presentavano un maggior rischio di infezione da HBV (RR=8,28; IC95%=1,076-63,79; p=0,033). Solo un addetto alla raccolta dei rifiuti del comune è risultato anti-HCV(+). Il nostro studio conferma i precedenti risultati che riportano una maggiore prevalenza di infezione da epatite B negli addetti alla raccolta dei rifiuti comunali. Inoltre, abbiamo riscontrato che le lesioni da puntura con aghi si associavano al rischio di infezione da HBV. Per contro, i risultati osservati indicano che l'infezione da HCV non rappresenta un rischio occupazionale significativo per gli addetti alla raccolta dei rifiuti. La vaccinazione contro l'HBV negli addetti alla raccolta dei rifiuti solidi urbani e la promozione e l'uso di metodi più sicuri per la raccolta di rifiuti sanitari non ospedalieri potrebbero rappresentare misure potenziali per la prevenzione dell'infezione da virus dell'epatite B in questa particolare popolazione.

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