# SHORT REPORT

# Wastewater workers and hepatitis A virus infection

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| **Background** | The main occupational hazard of wastewater workers (WWs) is the direct exposure to the variety of infectious agents present in sewage material, with hepatitis A virus (HAV) being the most frequent one. Most epidemiological studies have shown a higher risk of hepatitis A among WWs, although some studies have produced conflicting evidence. |
| **Aims** | To evaluate the hypothesis of increased risk of HAV infection in WWs. |
| **Methods** | The prevalence of antibodies to HAV in 869 WWs was compared to 311 other subjects and analysed to detect the main potentially confounding variables. |
| **Results** | Univariate analysis demonstrated that occupational exposure to sewage was not significantly associated with the prevalence of anti-HAV(+). The anti-HAV(+) prevalence was strongly associated with age and shellfish consumption ($P < 0.05$) when the subcategories of workers were examined separately (WWs and control group) and jointly. In the logistic regression model, a significant association between anti-HAV(+) prevalence and duration of employment ($P < 0.05$) was found. The interaction term (age × duration of employment) was significant ($P < 0.001$) when included in the logistic model. |
| **Conclusions** | This study shows that working in a wastewater treatment plant does not seem to be related to a greater prevalence of antibodies to hepatitis A. Moreover, the relative risk of HAV infection among WWs seems to be correlated with low anti-HAV(+) prevalence in the general population. |
| **Key words** | Hepatitis A virus; wastewater worker; occupational risk. |

## Introduction

The main occupational hazard of wastewater workers (WWs) is direct exposure to infectious agents present in sewage material, with hepatitis A virus (HAV) being the most frequent [1]. Most epidemiological studies have shown a higher risk of hepatitis A among WWs, although some studies have produced conflicting evidence [2,3,4,5]. Venczel *et al.* [2] in a study on 365 WWs reported little or no increase in the risk of hepatitis A among WWs [2]. Similarly, Levin *et al.* [3] failed to find higher anti-HAV prevalence in this category of workers in Israel, where the general population aged 20 years old had a seroprevalence >80%. On the other hand, in a group of 343 sewage plant workers in Germany, significant differences were encountered in anti-HAV antibodies between low- and high-exposed sewage workers [4]. In Singapore, statistically significant differences in anti-HAV levels between sewage workers (73%) and controls (50%) were also found [5].

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The aim of this study was to evaluate the hypothesis of increased risk of HAV infection among WWs.

## Methods

The study was conducted on employees of the Naples Municipality (14992 employees) between January 2006 and December 2007 in compliance with the Italian Law on Health and Safety for Workers (Act 626/94) [6]. The study group consisted of 950 WWs and a control group of 311 administrative employees with no potential occupational exposure to HAV randomly matched to WWs based on age, sex, residence area, socio-economic status, duration of employment and educational status.

Participants were questioned about potentially confounding variables of HAV infection. All participants underwent blood sampling by venepuncture; specimens were analysed for total antibodies to HAV (clinical specificity and sensitivity were 98.1 and 99.8%, respectively) as well as for seropositivity to hepatitis B surface antigen (HBsAg), hepatitis B surface antibody (HBsAb) and hepatitis C antibody (HCV-Ab). Statistical analyses were conducted with SPSS, version 14.01 for Windows (SPSS Inc., Chicago, IL, USA). A logistic regression model was performed and the model building strategy suggested by Hosmer and Lemeshow was applied [7].

The power of this study was 0.541 (the Type I error probability associated with the test of this null hypothesis is 0.05). The study was carried out in accordance with the ethical requirements for epidemiological research in Italy, and the project was approved by the Ethics Committee of 'Federico II' University Medical School, in Naples (Italy).

## Results

Out of 950 WWs eligible for inclusion, 58 employees refused to participate and 23 were excluded due to previous vaccination against HAV giving a final study group of 869 workers who underwent health surveillance.

The prevalence of anti-HAV seropositivity in all subjects enrolled in the study was 1070/1180 (90%). There was no statistically significant difference in anti-HAV seropositivity between WWs and controls (91.4 versus 88.7%, respectively).

A univariate analysis of each variable measured in the study was tested considering all subjects as a single group and on the WWs and the controls separately. The statistically significant results ($P < 0.05$) of each variable tested are presented in Table 1. Anti-HAV seropositivity prevalence was strongly associated with age and shellfish consumption ($P < 0.05$) when WWs and controls were

examined both separately and jointly. We also found a significant association between anti-HAV seropositivity and weight, alcohol consumption, duration of employment, seropositive status to HBsAg and HCV-Ab, when we considered all subjects as a single group. However, except for alcohol consumption, these associations remained significant in the WWs when they were examined separately from the controls. Haematocrit and the presence of HBsAb were associated with anti-HAV seropositivity in the control group, but not in the study group (WWs) or when considering all subjects as a single group. HAV infection was significantly associated with duration of employment in the study group (WWs) and when all the subjects were considered as a single group, but not in the control group.

The logistic regression model was utilized on all subjects, considering them as a single group, using all the variables collected whose univariate test had a *P*-value <0.25. All second-degree interactions were tested and none were significant at a level of 0.15, except the interaction term (age × duration of employment). The *r*-coefficient and the *t*-test computed to check the bivariate correlation between age and duration of employment were also statistically significant ($r = 0.535$; $P < 0.01$). The logistic regression analysis (*P*-value model <0.01) showed an increased risk of anti-HAV seropositivity at

**Table 1.** Municipal employees by HAV seropositivity

| Variable | Total (*n* = 1179) | | | Exposed (*n* = 869) | | | Non-exposed (*n* = 310) | | |
|---|---|---|---|---|---|---|---|---|---|
| | HAV+ (*n* = 1069) | HAV− (*n* = 110) | *P*-value | HAV+ (*n* = 794) | HAV− (*n* = 75) | *P*-value | HAV+ (*n* = 275) | HAV− (*n* = 35) | *P*-value |
| Age (years)[a] | 54 (±5) | 52 (±6) | <0.001 | 54 (±5) | 52 (±6) | <0.01 | 53 (±6) | 51 (±5) | <0.05 |
| Weight (kg)[a] | 84 (±8) | 81 (±9) | <0.01 | 86 (±8) | 83 (±9) | <0.05 | 80 (±9) | 77 (±6) | <0.01 |
| Alcohol consumption *n* (%)[b] | | | | | | | | | |
| Yes | 493 (46) | 64 (58) | <0.05 | 358 (45) | 41 (55) | 0.14 | 135 (49) | 23 (66) | 0.09 |
| No | 576 (54) | 46 (42) | | 436 (55) | 34 (45) | | 140 (51) | 12 (34) | |
| Shellfish consumption *n* (%)[b] | | | | | | | | | |
| Yes | 896 (84) | 78 (71) | <0.01 | 668 (84) | 55 (73) | <0.01 | 228 (83) | 23 (66) | <0.05 |
| No | 173 (16) | 32 (29) | | 126 (16) | 20 (27) | | 47 (17) | 12 (34) | |
| Duration of employment (years)[a] | 26 (±3) | 25 (±4) | <0.01 | 26 (±3) | 25 (±4) | <0.01 | 26 (±3) | 25 (±4) | 0.61 |
| HBsAg positivity *n* (%)[b] | | | | | | | | | |
| Positive | 77 (7) | 18 (16) | <0.01 | 69 (8) | 14 (19) | <0.01 | 8 (3) | 4 (11) | 0.06 |
| Negative | 992 (93) | 92 (84) | | 725 (91) | 61 (81) | | 267 (97) | 31 (89) | |
| HBsAb positivity *n* (%)[b] | | | | | | | | | |
| Positive | 529 (49) | 53 (48) | 0.87 | 447 (56) | 35 (47) | 0.13 | 82 (30) | 18 (51) | <0.05 |
| Negative | 540 (51) | 57 (52) | | 347 (44) | 40 (53) | | 193 (70) | 17 (49) | |
| HCV-Ab positivity *n* (%)[b] | | | | | | | | | |
| Positive | 133 (12) | 3 (3) | <0.01 | 118 (15) | 3 (4) | <0.05 | 15 (5) | 0 | 0.19 |
| Negative | 935 (88) | 107 (97) | | 676 (85) | 72 (96) | | 260 (95) | 35 (100) | |
| Haematocrit *n* (%)[b] | | | | | | | | | |
| <40 or >50 | 456 (43) | 57 (52) | 0.83 | 369 (46) | 38 (51) | 0.56 | 87 (32) | 19 (54) | <0.05 |
| 40–50 | 613 (57) | 53 (48) | | 425 (54) | 37 (49) | | 88 (68) | 16 (46) | |

[a]Student's *t*-test.

[b]$\chi^2$ test.

  
older ages (odds ratio 2.68; 95% confidence interval 1.48–4.85; $P < 0.01$). Shellfish consumption and duration of employment were significantly associated with positivity ($P < 0.01$ and $P < 0.05$, respectively). The interaction term (age $\times$ duration of employment) was significant ($P < 0.001$).

## Discussion

In this study, WWs did not have a greater prevalence of antibodies to hepatitis A. Several considerations should be taken into account in trying to explain this finding. First, the relative risk of HAV infection among WWs seems to be correlated with low anti-HAV seropositivity in the general population [2,3,4,5]. HAV infection rates in Italy have always been higher than in Central and Northern Europe, although decreasing rates in the last few years are attenuating this difference [8,9]. However, the time period embracing this phenomenon is still too short to bring to light the significant differences in the risk of infection between WWs and non-exposed individuals. Second, the results of this study show a significant interaction between duration of employment and subjects' ages.

The limitations of our study are its cross-sectional design and that it is not known whether anti-HAV seropositivity antedated employment. Although the high prevalence of HAV antibodies in the exposed and unexposed populations may suggest statistical difficulties in detecting a difference, the power of this study was acceptable (0.541). A properly designed prospective cohort approach would overcome these problems, but would be limited by the need for very large numbers.

In conclusion, this study shows that working in a wastewater treatment plant does not seem to be related to a greater prevalence of antibodies to hepatitis A. Moreover, the relative risk of HAV infection among WWs appears to be correlated to low anti-HAV seropositivity in the general population. Another finding was the strong interaction between subjects' ages and the duration of employment, which has been the basis for the hypothesis of increased risk of HAV infection among WWs.

## Key points

- Working in a wastewater treatment plant does not seem to be related to a greater prevalence of antibodies to hepatitis A virus.
- The hypothesis of increased risk of hepatitis A virus infection among wastewater workers may be due to the strong interaction between subjects' ages and the duration of employment, and further field studies to assess this hypothesis are needed.

## Conflicts of interest

None declared.

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