

A special risk group for hepatitis E infection: Turkish agricultural workers who use untreated waste water for irrigation

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SUMMARY

Untreated waste water usage in agriculture is an important health-threatening issue which could affect both workers' and the public's health. In this study we researched hepatitis E infection in 46 of 57 farmers who used untreated waste water in agriculture. We compared them with 45 persons of the same socio-economic status and age. Anti-HEV seropositivity was 34·8% in the workers and 4·4% in the control group. We suggest that this type of irrigation is an important potential risk for hepatitis E infection.

INTRODUCTION

Hepatitis E, formerly called enterically transmitted non-A, non-B hepatitis, is a water-borne infection, and is one of the risks of untreated waste water usage in agriculture. In recent years there has been a notable increase in the use of wastewater for irrigation in Diyarbakir and other provinces in Turkey. This has occurred as a result of scarcity of irrigation water and the high cost of artificial fertilizers. The value of nutrients in wastewater which significantly increase crop yield, is well recognized.

In this study we have investigated the hepatitis E virus (HEV) antibody positivity rate in workers who used wastewater irrigation. The aim of the study was to determine the health risks for workers and the public and to encourage recognition of the potential problem by workers and local authorities.

METHODS

This study was performed in Hevsel field, Diyarbakir, Turkey. Hevsel field is a region near the city of

Diyarbakir where untreated wastewater has been widely used by the farmers for irrigation. In Hevsel field a 236·9 ha area was irrigated with untreated waste water. Both crops likely to be eaten uncooked and cereals were planted. The workers did not use protective clothing and their children were in the field when they were working. However there was no programme which informed people about their health risks. They frequently ate the crops in the field. There were low standards of personal hygiene and sanitation.

In this cross-sectional study 46 of 57 people working in the field agreed to give blood samples and fitted the eligibility criteria, which were to have no risks for hepatitis (including history of blood transfusion and surgical intervention) other than working in the field and contact with untreated wastewater. Two persons with a history of surgical intervention were excluded from both the study and control groups. Blood samples were also obtained from 45 persons who were their neighbours who did not work in the field and were suitable as a control group. The control group was selected from the persons within the same age group, with the same socio-economic level, by nomination by cases. A questionnaire was used to collect data about the socio-economic status of

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Table 1. Age, sex, literacy, income and tap water quality of study and control groups, Hevsel Field Diyarbakir, Turkey

Total	Workers 46	Control 45	<i>P</i>
Mean age (years)	27.6	28.5	>0.05*
Number of male persons (%)	37 (80.4)	37 (82.2)	>0.05†
Number of literate persons (%)	32 (69.6)	30 (66.7)	>0.05†
Number of persons with low income	46	45	
Number of persons with microbiologically and chemically acceptable tap water (%)	39 (84.7)	37 (82.2)	>0.05†

* Analysed by *t* test.

† Analysed by χ^2 .

Table 2. Distribution of anti-HEV positivity in study and control groups, Hevsel Field Diyarbakir, Turkey

	Workers Number (%)	Controls Number (%)	OR	χ^2 (95% CI)
Anti-HEV positive	16 (34.8)	2 (4.4)	11.5	13.2 (2.3 < OR < 78.2)*

* Figures in parentheses are 95% CIs.

subjects and history of jaundice. Income lower than \$30 per month was regarded as low income. The persons who had never attended primary school were regarded as illiterate. We read the acceptance form and gave information about the aim of the study to illiterate persons. Although they could not read and write, all of them were able to produce a signature. All the persons in the study and control groups signed the acceptance form for inclusion in the study. Clotted blood samples were taken from test and control subjects. The sera were separated and stored at $-20\text{ }^{\circ}\text{C}$ until analysed for anti-HEV IgG. The Micro ELISA (Biyoser G:D 6280 SrI Milano) was used to detect anti-HEV IgG.

Environmental data

Residential tap water samples were analysed microbiologically and chemically. Coliform counts and chlorination were investigated. Zero coliform counts and more than 0.3 p.p.m. of residual chlorine indicated adequate quality tap water.

Statistical methods

Data were analysed using χ^2 tests for contingency tables and for trends and *t* tests for mean difference. Odds ratios (OR) and their 95% confidence intervals (CI) for disease risk were also calculated. In analysis Epi-info version 6.04 package programme was used. A *P* value of <0.05 was considered significant.

RESULTS

Mean ages of the study (27.6 years) and control groups (28.5 years) were similar (Table 1). Most of the study and control groups were male (80.4 vs. 82.2%). Literacy rates were not high either in the study or the control groups (69.6 vs. 66.7%). All subjects were from low income families. Analyses of the chlorination of tap water were found acceptable; there was no difference between study and control groups according to household tap water quality. None of the persons had a recent history of jaundice or clinical illness. There was no detailed information about how long the subjects had been exposed to waste water.

Anti-HEV positivity was higher in workers than in control group subjects (34.8 vs. 4.4%) (Table 2). The risk of acquiring hepatitis E was 11.5-fold higher in workers than in controls. The age-specific percentage of anti-HEV-positive workers is shown in Figure 1. Distribution of anti-HEV was not significantly different according to age group ($P=0.51$).

DISCUSSION

During the past decade, there have been growing concerns about water shortage. The reuse of wastewater is one of the main options being considered as a new water source in regions where water is scarce. However, treatment may be required for safe use of wastewater. When untreated wastewater is used to irrigate crops, there is a potential high risk of water-borne disease.

In our study area, untreated wastewater is used for irrigation. We aimed to compare the prevalence of hepatitis E among workers and their family members who used untreated wastewater for irrigation with the prevalence among those not working in such a job. WHO report stated that 'When untreated wastewater is used for crop irrigation, intestinal nematodes and bacteria present high actual risk and the viruses little or no actual risk' [1]. However, this report only investigated hepatitis A and viral diarrhoeas. It was also reported that transmission of these diseases occurs

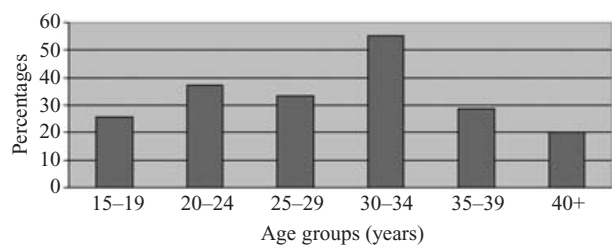


Fig. 1. Age-specific anti-HEV positivity rates in workers, Hevsel field, Diyarbakir, Turkey. χ^2 for trend = 1.34, $P = 0.51$.

predominantly in the immediate domestic environment, especially when low standards of personal hygiene prevail. However, survival times of excreted viruses and protozoa may be long enough to cause a health risk in schemes for wastewater use. It was reported that, in India where hygienic conditions were poor, there were no significant differences between prevalences of parasites or *Giardia intestinalis* among people using treated/untreated sewage compared to controls [2]. In our study group, standards of individual hygiene were also low and people ate crops in the field, which may cause higher risks of food-borne diseases.

Nevertheless in our study there was a significant difference between workers and controls according to anti-HEV positivity. We could not find other data on anti-HEV prevalence in workers who use wastewater irrigation and their families. Reported anti-HEV prevalence is between 3 and 6% in different regions of Turkey [3]. In Diyarbakir province anti-HEV positivity (9.3%) was higher than other parts of Turkey [4]. This might account for the high frequency of anti-HEV positivity in the study group, who may be exposed to sewage derived from the general population.

Although we found a high prevalence of anti-HEV in workers, no one had a recent history of clinical illness. This may be due to memory factors. In the Infectious Disease and Clinical Microbiology Department of Dicle University Hospital, Diyarbakir, 14.5% of the Symptomatic viral hepatitis cases were hepatitis E [5]. There was no information about how many of them were from our study group.

Not only the workers but also their family members were at risk of food-borne diseases. Direct exposure to untreated waste water was associated with an excess risk of *Ascaris lumbricoides* infection in children aged <5 years (OR = 18) [6]. The available circumstantial evidence obtained from epidemiological and microbiological investigations demonstrates that the use of untreated wastewater causes an excess in

prevalence of protozoan infections among children living in El Azzouzia (72%) compared with those from a control area (45%) [7]. In our study group, children were frequently in the fields where workers were using wastewater for irrigation. Further research should be planned to assess the risk among these children.

Hepatitis A is known to cause outbreaks following acquisition via food contaminated by food workers with acute infection. The low standards of personal hygiene in the study population also may lead to further spread of hepatitis. In Diyarbakir, virus (HAV) hepatitis A antibody prevalence is 98.7% between the ages of 16 and 20 years and 100% between 20 and 25 years [8]. Untreated waste water usage may have an effect on the high prevalence of HAV antibody in the general population in Diyarbakir.

The age distribution of the HEV antibody positive cases showed that not only adults but also adolescents were at risk. Age-specific rates of HEV antibody positivity was 25.5% in those under 19 years old, although adults of working age were at higher risk (Fig. 1). Older people did not work in fields, and were at smaller risk. Although there was no statistically significant difference between age groups, age-specific rates of anti-HEV positivity increased in workers aged 30–34 years old. This may be due to occupational exposure to HEV infection.

People eating uncooked crops were at higher potential risk of acquiring contagious and/or food-borne diseases which is an important public health problem. In the WHO guidelines for wastewater use in agriculture it is recommended that 'Irrigation of crops likely to be eaten uncooked, sports fields and public parks increases actual risks for workers, consumers and the general public' [9]. In Diyarbakir province HEV seroprevalence is higher than other provinces of Turkey [3] and usage of untreated waste water in the region may play a role in this.

We conclude that usage of untreated waste water in agriculture presents important health risks for intestinal diseases, especially hepatitis E. When crops are irrigated with untreated waste water and eaten uncooked there may also be a higher risk for the general public. The risk is potentially higher for workers who use untreated waste water and their family members than for those who only eat uncooked crops. Hygienic conditions are one factor affecting the risk. The risk for children should be also investigated and some interventional educational studies should be implemented.

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