Water usage habits and the incidence of diarrhea in rural Ankara, Turkey

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Summary This aim of this study was to determine water usage behavior and incidence of diarrhea during the summer months among people in rural areas of Turkey. Information was collected using a questionnaire during face-to-face interviews with people aged 18 years and over in their homes. Diarrhea was detected in 31.7% of the 543 households included in the study in the summer of 2003. The percentage of those living in the study area experiencing at least one bout of diarrhea was 10.0%. The diarrhea episode rate was 18.7%. A logistic regression model of factors that could influence the incidence of diarrhea showed that the reported distance between the septic tank and the well, the total monthly household income and water shortages of longer than 12 h had a significant effect on diarrhea incidence (P < 0.05). The fact that water shortages are the biggest risk factor for diarrhea points to the need for (i) health education to raise awareness and (ii) the supply of equipment to enable households to use both the first running water after a water shortage and the water they have collected during the shortage as drinking water.

1. Introduction

The presence of a water and sewerage network is a fundamental condition of protecting the health of the public against diseases carried by water. The availability to the public of an adequate and uninterrupted clean water supply and the elimination of wastewater are directly related to the protection of public health (Akdur et al., 2001).

In 2000, 1.1 billion people did not have enough water and 2.4 billion people lived without adequate sanitation. Water supply and sanitation are much worse in rural than urban areas (WHO and UNICEF, 2000). While the percentage of those with an adequate supply of water is 94% in urban dwellings and 71% in rural areas worldwide, the percentage with adequate sanitation is 86% in urban dwellings and

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Diarrhea is an important public health problem closely associated with hygiene conditions and how water is used. Approximately 4 billion cases of diarrhea are seen every year, mostly involving children less than 5 years old, and 2.2 million of these end in death. These numbers are equivalent to a child dying every 15 s or a jumbo jet crashing every day. These deaths also make up 15% of all childhood mortality below the age of 5 years in developing countries. Work on water, sanitation and hygiene will decrease the number of diarrhea cases by one-third to one-fourth (WHO and UNICEF, 2000).

This study aimed to determine the incidence of diarrhea during the summer (June, July and August 2003) in four rural villages in Turkey and the water usage behavior of their populations.

2. Materials and methods

2.1. Study sites and population

The study was carried out in the villages of Gokcehoyuk, Beynam, Ahiboz and Karagedik, near the town of Golbasi, Ankara, in September 2003. The primary care center records in the villages showed that a total of 2619 people lived in 590 households. We aimed to visit all the houses in these villages and collect data. Houses classified in the results as 'nobody at home' were visited twice with the same result.

2.2. Questionnaire and data collection

The questionnaire used to collect data was implemented via face-to-face interviews. We interviewed one resident per household. The father and/or mother was preferred for the interview; otherwise, one of the children aged 18 years or over was interviewed. The questionnaire contained questions on water-transmitted diseases occurring during June, July and August 2003 (covering the entire summer period) and the factors determining the risk of disease.

The first part of the questionnaire concerned the household. The second part included questions about the house the interviewee lived in, while the third part was about the household's access to infrastructure. The fourth part comprised questions on the water usage habits of the household and whether hygienic procedures are used during the consumption of water. All information was obtained verbally and no observations were conducted.

The fifth part of the questionnaire concerned the incidence of diarrhea in the household during the 3 months before September (June, July and August 2003), the month the questionnaire was implemented. Diarrhea was defined as a change in defecation habits (Iliciç et al., 2003).

The household residents provided consent before the interviews.

2.3. Data analysis

The study data were entered into the Epi Info 6.0 software (CDC, Atlanta, GA, USA), and then analyzed after transfer into the SPSS software, version 10.0 (SPSS Inc., Chicago, IL, USA). Analysis of relevant data related to the households was performed for 543 households. The diarrhea rate analysis was performed for these households and the total of 2471 persons living in them. The incidence of having diarrhea at least once within the previous 3 months [(the number of those with at least one incidence of diarrhea/total population) × 100] and the diarrhea episode rate [(the total number of diarrhea cases/total population) × 100] were calculated for those living in the study area. The statistical methods used were $\chi^2$, McNemar’s and Student’s $t$ tests, and logistic regression analysis.

Factors thought to influence diarrhea incidence rate and thus included in logistic regression were separating water for drinking and general usage (yes/no), continuous water shortage for longer than 12 h (yes/no), purifying water for drinking (yes/no), amount of water used, water bill amount, monthly household income [above or below US$ 216 per month, because the median monthly income for the household was US$ 216 and US$ 1 was YTL (New Turkish Lira) 1.388 on September 30 2003] and the reported distance between the septic tank where wastewater is disposed of and the well. Univariate analysis was performed. Factors found to be significant were included in the logistic regression analysis. The following variables were included in the model: drinking water purifying situation, water shortages longer than 12 h, monthly household income and the reported distance between the septic tank and the well. The final step obtained as the result of the analysis is presented.

3. Results

We interviewed 543 people (representing 92.0% of the total households). For the remaining households, no one was interviewed due to reasons such as nobody being home, refusal to answer the questions and no one living in the house. A total of 2471 people lived in the 543 households we interviewed (94.3% of the total population of the study villages). The interviewee was the father and/or mother in 88% of households (478 persons). The average family size was 4.55 ± 1.73. The median monthly income for the household was US$ 216 (range US$ 72–10807). Among the households, 84.0% had a bath, 49.2% a toilet, 89.9% a kitchen, 74.0% a washing machine and 13.1% a dishwasher. Of those included in the study, 65.6% had a garden with an average area of 800 m² (range 10–8000 m²). Of those with a garden, 52.4% used it to grow fruit or vegetables; 32.8% did not irrigate it, while 30.1% used water from the household well, 27.2% from the current network and 9.9% from a natural source, river, village fountain or other source.

While 52.7% of the households used the network present in the residential area for water for general use, 14.0% used a well, 6.7% used a fountain, 22.5% a storage area (from a fountain or river) and 4.7% other sources such as a river or other natural source. For drinking water, 63.7% of the households used the network in the residential area, 14.9% a
well, 6.1% a water fountain, 1.7% water in large containers, 0.2% bottled water and 13.4% other sources. There was a statistically significant difference ($P < 0.05$) between sources of drinking water and sources of water for general usage as related to using or not using the network present in the residential area.

Figure 1 shows the distribution of water resources used for drinking water and water for general usage in the households. Table 1 shows the distribution of answers to some questions concerning water usage habits.

Answers to questions about bathing habits of those studied showed that 7.6% took a bath every day, 70.4% 2–3 times a week, 21.1% once a week and 0.9% once every 15 days. The average water usage was 68.1 l/person/day. Only 9.9% of those studied made a distinction between drinking water and general usage water. While 65.8% thought that the drinking water conformed to standards, 21.1% thought it did not and 13.1% did not have an opinion. Of those studied, 94.8% used the drinking water directly without further processing, while 1.7% purified the water and 3.8% boiled it.

Table 2 shows how water used in residences is removed. There was a statistically significant difference ($P < 0.05$) between the areas of the household where water was used as to how the water used was removed (Table 2). This was due to a higher percentage of the water used in the toilet being discharged to a septic tank (92.6% of households), but the other households (7.4%) discharged it into environment (e.g. garden, road).

Figure 1 shows the distribution of water sources for drinking and general usage in the households.

Table 1 Water usage habits in the studied households

<table>
<thead>
<tr>
<th>Water usage habit</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>We use water we have collected in containers instead of running water to wash fruit and vegetables ($n = 543$)</td>
<td>36.8</td>
<td>63.2</td>
</tr>
<tr>
<td>We clean dishes in running water before placing them in the dishwasher ($n = 71$)</td>
<td>82.5</td>
<td>17.5</td>
</tr>
<tr>
<td>We wash in the bath by collecting water in a pail ($n = 536$)</td>
<td>71.6</td>
<td>28.4</td>
</tr>
<tr>
<td>We use water emptied from the washing machine to clean the house ($n = 402$)</td>
<td>12.1</td>
<td>87.9</td>
</tr>
<tr>
<td>We use the water collected in the reservoir or in the storage area for cleaning the toilet ($n = 506$)</td>
<td>65.6</td>
<td>34.4</td>
</tr>
</tbody>
</table>

Well, 6.1% a water fountain, 1.7% water in large containers, 0.2% bottled water and 13.4% other sources. There was a statistically significant difference ($P < 0.05$) between sources of drinking water and sources of water for general usage as related to using or not using the network present in the residential area.

Table 2 Water disposal methods according to the household areas where water is used (%)

<table>
<thead>
<tr>
<th>Area of the household</th>
<th>Septic tank</th>
<th>Released into environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchen ($n = 531$)</td>
<td>52.4</td>
<td>47.6</td>
</tr>
<tr>
<td>Toilet ($n = 525$)</td>
<td>92.6</td>
<td>7.4</td>
</tr>
<tr>
<td>Bath ($n = 529$)</td>
<td>58.3</td>
<td>41.7</td>
</tr>
</tbody>
</table>

$\chi^2 = 227.18; P < 0.05$. 

The median reported distance between the septic tank where the used water is taken away and the well was 15 m (range 2–100 m). There was no statistically significant difference as to the reported distance between those obtaining their water from wells and those obtaining it from sources other than wells ($P > 0.05$).

Of the households studied, 48.1% had suffered a water shortage of longer than 12 h within the 3 months before the study. Some 93.6% of the households obtained the water to be used during a water shortage from water they had collected previously (stored water) or from the community water fountain. Following the water shortage, 21.6% of the households used the running water right away, 67.4% used it after having it run for a while, and 11.0% did not think this matter was important.

During the summer of 2003, 31.7% of the 543 households studied had suffered from diarrhea. The rate of having at least one bout of diarrhea within the previous 3 months for those living in the study area was 10.0%. The diarrhea episode rate was 18.7%.

The average age of those experiencing at least one episode of diarrhea within the previous 3 months was 12.0 (range 1–80). When we looked at the distribution of those experiencing diarrhea according to age groups, the 5-year-old or younger age group ranked first with 27.5%, followed by the 6–10-year-old age group with 18.4% and the 11–15-year-old age group with 9.4%. Dirty water was believed to be the reason for the diarrhea in 16.6% of the households.

Table 3 shows the factors that might influence the chance of suffering from diarrhea. The chance of diarrheal disease decreased as the reported distance between the septic tank where the wastewater is discharged and the well increased. Households with a monthly income of less than US$ 216 had...
The incidence of diarrhea in both developed and underdeveloped countries makes this disease a public health problem. A study from rural areas of the USA reported the incidence of acute gastroenteritis within a 28-day period as 15.1% for the 0–10 years age group, 9.1% for the 10–49 years age group and 3.1% for the 50 and over age group (Strauss et al., 2001). A study from East Africa investigating the prevalence of diarrhea from 1967 to 1997 found an increase from 6% to 18% in Kenya, from 16% to 21% in Uganda and a decrease from 11% to 8% in Tanzania (Tumwine et al., 2002).

In the regression model developed, increased reported distance between the septic tank where wastewater is removed and the well seems to be a factor preventing diarrhea, while low monthly income and water shortages are risk factors. However, the risk factor stated as the reported distance between the septic tank and the well was analyzed for the houses with wells in our study. It may therefore be postulated that water shortages and monthly income are risk factors that influence a larger section of the population.

A regional cohort study from Turkey on children 5 years old or younger found a diarrhea incidence of 8.56 (person-month) and 9.12 (cases-month). The factors involved in the incidence of diarrhea were household conditions, age, educational status of father and the hand-washing habits of the parents (Bozkurt et al., 2003). The risk factors increasing the risk of diarrhea have been specified in various regions of the world as follows: rural location, inadequate sanitation, no water network, unsafe wastewater arrangements, inadequate hygiene of children or their carers, direct usage of surface water such as rivers, bacterial contamination of well water and water contamination during transport or storage (Checkley et al., 2004; Gasana et al., 2002; Nanan et al., 2003; Plate et al., 2004; Strauss et al., 2001; Strina et al., 2003; Tumwine et al., 2002).

The fact that water shortages are the biggest risk factor for diarrhea points to the need for (i) health education to raise awareness and (ii) the supply of equipment to enable households to use both the first running water after a water shortage and the water they have collected during the shortage as drinking water.

When residential planning is carried out in rural areas, the distance between the septic tank and the well should be considered a primary health factor, and health education programs encompassing this subject should be developed on water usage and hygiene for the public. The emergence

### Table 3 Logistic regression analysis model of factors influencing diarrhea

<table>
<thead>
<tr>
<th>Influencing factor</th>
<th>β</th>
<th>P</th>
<th>Odds ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reported distance between the septic tank where wastewater is discharged and the well</td>
<td>−0.46</td>
<td>&lt;0.05</td>
<td>0.955</td>
<td>0.918–0.993</td>
</tr>
<tr>
<td>Total monthly income of household (&lt;US$216/&gt;US$216)</td>
<td>1.265</td>
<td>&lt;0.05</td>
<td>3.543</td>
<td>1.235–10.162</td>
</tr>
<tr>
<td>Water shortage of longer than 12 h (yes/no)</td>
<td>2.325</td>
<td>&lt;0.05</td>
<td>10.281</td>
<td>2.950–35.482</td>
</tr>
<tr>
<td>Constant</td>
<td>−2.489</td>
<td>&lt;0.05</td>
<td>0.83</td>
<td></td>
</tr>
</tbody>
</table>

3.5 times the risk of those with an income of more than this amount, while those experiencing water shortages had 10.2 times the risk.

### 4. Discussion and conclusions

We have considered some possible limitations of our study. The study period was 3 months, covering the entire summer period; this might have been long enough for the interviewees’ memories to become unreliable when the probable duration of an acute diarrhea attack was considered. Although no observations were made, we think that the verbal information received is correct as this was a small community and the interviewees were familiar with the investigators. For example, the distance between the septic tank where wastewater is discharged and the well was not measured, and the subject's self-reported declaration was used, creating another limitation. We therefore specified the distance as reported distance.

The average water consumption of those studied was 68.11 l/person/day. The water usage per person is directly associated with the developmental level of the population. This figure is very high in developed countries and low in developing countries. The daily water consumption per person around the world is 266 l in industrialized countries, 67 in Africa, 143 in Asia, 158 in Arab countries and 184 in Latin America. In Turkey the average daily water consumption per person is 111 l. This figure is 125 for Istanbul and 141 for Ankara (Turkey and Middle East Institute of Public Administration, 2005).

While 92.6% of the studied households removed water used in the toilet using the septic tank, the rate for the same method was 58.3% for water used in the bath and 52.4% for water used in the kitchen. The lower rate of septic tank usage to remove the water used in the bath or kitchen may be due to the unavailability of septic tanks close enough to be used to discharge water from these locations or to prevent rapid filling up of the septic tank. This is an important risk factor that could lead to undesired medical consequences.

Septic tanks should be located where they will not contaminate surface and underground water or damage the surroundings, i.e. at least 15 m away from underground water sources, wells, water storage areas or channels (Akdur et al., 1998). The distance was less than 15 m in 46.4% of the studied households with wells.

The 31.7% incidence of diarrhea during the summer of 2003, the 10.0% rate for suffering from diarrhea at least once during the previous 3 months and the diarrhea episode rate of 18.7% demonstrate that diarrhea continues to be a public health problem in the study area. With the group suffering from diarrhea most being the 5-year-old and younger group, followed by the 6–10-year-old group, children constitute the main risk group for mortality from diarrhea and this matter requires close attention.
of low income as a risk factor for diarrhea emphasizes the importance of the inclusion of a better distribution of wealth in health protection.

Authors’ contributions: All authors conceived and designed the study and collected data; SO, HT, NG and SeA analysed and interpreted the data; SO, HT, NG and MC drafted the manuscript; SO, HT, SeA, MAB revised the manuscript critically for intellectual content. All authors read and approved the final manuscript. SO and HT are guarantors of the paper.

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References


