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A survey on drinking water preferences and point of use water treatment systems in Adana, Turkey

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ABSTRACT

The World Health Organization (WHO) reports show that the accessibility of improved drinking water in Turkey has improved by 100% since 1990. However because of the threat of water-borne diseases, many still think that it is not wise to drink tap water. This has increased the demand for "point-of-use" water treatment systems in Turkey. This study aims to assess public preferences on drinking municipal tap water amongst the inhabitants of Adana, Turkey, and to establish the awareness of filter replacement of point of use water treatment systems. 5,139 individuals were interviewed (women 44% and men 56%) and a high percentage of the respondents expressed a preference for using tap water rather than bottled or filtered water. The users of filtered water stated that they preferred the filtration system to remove the pathogens and to change the odor/taste/color of the water. As the age of consumers increased, the bottled and filtered water utilization increased while tap water utilization decreased. In terms of gender, men had a higher ratio to prefer drinking tap water than women. Consumption of tap water decreased as education level and income increased.

Keywords: Drinking water; Water preferences; Water treatment systems; Public awareness

1. Introduction

Water, being the most indispensable nutrient in human life, should be a clear, odorless liquid and free from chemical, microbiological and radiological contaminants [1], especially for drinking purposes.

The chemical contamination of water is often due to synthetic organic chemicals, many of which are carcinogenic or mutagenic. The oxidization of the metals used in the water supply system and the use of plastic pipes may lead to the chemical and microbiological contamination of drinking water and is considered to be a serious health risk [2]. Microbial contamination mainly caused by fecal matter particularly human fecal matter, entering the water supply, contains pathogenic organisms [3,4]. Water contamination by feces is a major health problem as it can transmit diseases such as diarrhea, cholera, dysentery, typhoid, and polio. Contamination may also result in changes to the organoleptic system including taste, odor, color, or turbidity.

The WHO and United Nations Children's Fund (UNICEF) monitor the global access to safe drinking water, and this data is used as an indicator for "use of an improved source", but does not account for water quality measurements. According to the WHO; at least 91% of the world's population now has access to an improved drinking-water source (WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation (wssinfo.org) and Turkey has increased the access to improved drinking water from 89% to 100% since 1990. However, due to identified potential risk factors (organoleptic and health) of community drinking water, consumers still believe that bottled and/or filtered drinking water is cleaner and safer. The impact of tap water on public health is very important and municipalities are responsible to provide clean and safe tap water for public

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use. Even though reports show accessibility of improved drinking water sources in Turkey is 100%, due to the water-borne diseases and outbreaks, a significant proportion still thinks that it is not wise to drink tap water. Even in 2016, many villages and small towns in the rural areas of Turkey no longer had access to spring water, even though it is still the main beverage and, among other uses, is consumed alongside meals. In urban areas, the retail volume sales of bottled water continued to increase because of the low quality of tap water according to market studies in 2016 [5].

Bottled water is preferred as it is considered safer than tap water and is thought to have other health benefits, even though this is not necessarily the case [6,7]. The other reasons are that bottled water is readily available and easy to access, offers better taste and odor, and has successful advertising strategies [8,9]. Filtered water is mostly obtained through point of use (PoU) household water treatment devices that contain several different filters inside to improve the organoleptic of water and to decrease environmental pollution of drinking water with heavy metals or toxic organic substances as well as to eliminate microbial contaminations. These filters must be changed at the recommended time intervals to maintain successful filtration [7].

Adana is a major province in southern Turkey and has a population of 1.7 million making it in the top five most populous cities in Turkey. Seyhan and Çukurova are two of the four main popular districts in Adana. Seyhan has the highest population among four districts (~800,000 people) and is the most diverse district, hosting all ethnic groups which also causes a huge variation in income. Çukurova district (population around ~360,000) has a large community of people from all over Turkey who mostly have higher incomes [10].

This study aimed to assess public perceptions and preferences on municipal tap water among 5,139 inhabitants that live in the Seyhan and Çukurova districts and to identify their awareness of tap water and filtered water consumption.

2. Methods

A 15-question survey was designed to evaluate water preference and awareness on residential water treatment systems, including point of entry and PoU under-counter/sink water filtration systems (FS) among 5,139 inhabitants of the Seyhan and Çukurova districts of Adana. The set of questions included socio-demographic information such as sex, age and educational level of participants and household size. The survey also contained questions concerning daily drinking water preferences and opinions about tap water safety, taste and reasons for using PoU FS or purchasing bottled water (S1). 2,277 women and 2,862 men out of 8,000 randomly chosen inhabitants were interviewed in the spring of 2016 using face to face and computer-assisted telephone interviewing by a professional survey company based in Adana. The survey data was analyzed using SPSS 11.5 Statistical Package for the Social Sciences. The Chi-square test was used for comparing the data and the significance level of the statistical alpha was identified as $P < 0.05$. Random calls were made to back-check the interviews.

3. Results and discussion

Of the 8,000 randomly chosen individuals for 6 weeks in 2016 with at least several attempts, 64% (5,139 persons) were successfully interviewed. The remainder refused to be interviewed, or could not be reached for reasons such as traveling or business commitments, etc. In the end, 2,277 women (44%) and 2,862 men (56%) individuals were interviewed. The dominant age range of the respondents was thirty-five years old or older (35+) were the lowest range was 18–24 (18.60%). 38.8% of the interviewed individuals had completed secondary education and 28.6% higher education. The people who live with two or more family members were in a higher percentage among the respondents compared to single persons (Table 1a).

When the interviewed individuals were asked if they prefer to drink tap water, 29% of them (1,487 persons) replied "no", despite the general increase in the retail volume sales of bottled water. When asked, "why do you not prefer to drink tap water", the majority of the respondents explained their dissatisfaction because they do not believe that tap water is clean and healthy enough to drink. Other reasons were that they did not like the taste, the odor and were concerned about chemical impurities such as rust, chlorine, calcium lime, etc. (Table 1b).

The survey indicated that 56% of the interviewed people preferred to use only tap water, 23% bottled water, 5.3% both bottled and tap water, 11% FS and 1.4% preferred both filtered and bottled water as their drinking water resource. To understand if the bottled water market was fragmented or not, and whether there was any preference between brands, respondents were asked which brand of bottled water they preferred. The results showed that the bottled water market was highly fragmented. The leading brand was Danone Hayat Icecek ve Gida Sanayi ve Ticaret AS (Adana, Turkey)

Table 1a
General information about the respondents

Age	N*	%	Education	N*	%	Household number	N	%	Income (TL)	N*	%
18–24	958	18.60	Middle school	1,641	31.9	1	177	3.40	1,000 and lower	309	6.0
25–34	1,106	21.50	High school	1,995	38.8	2	677	13.20	1,001–1,500	1,216	23.7
35+	3,075	59.80	University	1,470	28.6	3	1,120	21.80	1,501–2,000	1,664	32.4
			No respond	33	0.7	4	1,709	33.30	2,501–3,000	458	8.9
						5 and above	1,439	28.04	3,001 and over	913	17.8
						No respond	17	0.33	No respond	579	11.3

N*: number of the respondents.

Table 1b
Reasons for not using tap water as drinking water (over 29% of the total respondents)

he reasons why people do not use tap water as drinking water	N*	%
I do not trust its safety and sanitation	844	57
I do not like the taste	362	24
I do not like the smell	126	8.5
I believe it may contain lime, chlorine or rust	77	5.2
It is pumped from/through a water storage tank or hydrophore system	50	3.4
I am not used to using it	28	1.9

N*: number of the respondents.

with a 29% value share with its leading and known brand Hayat Su (Adana, Turkey) where Nestlé Waters (Bursa, Turkey) Gida ve Mesrubat was the second with its long-established brands Erikli (Bursa, Turkey) and Nestle (Bursa, Turkey) (Fig. 1a). Marketing has a great impact on consumer behavior and providing good logistics makes the brands easy to access in the market. These leading brands might probably become well-known with relevant marketing strategies and logistics networks that consumers preferred to purchase among other brands.

When participants were asked why they chose a particular brand, the taste was chosen as primary preference factor by the majority (32.9%) followed by the reliability of the brand (Fig. 1b). When participants were asked whether they use any water FS, 86.6% of respondents stated that they do not use any water treatment devices to clean the water while 13.4% of them said that they do.

Some additional questions were asked to the 689 people who informed us that they use FS. They said that they used FS to clean the water from pathogens (51.5%) or sought to change the odor/taste/color of the water (24%) or to clean the water by removing chemicals and heavy metals (22%). When the respondents were asked how often they change the filter cartridge, 9.3% of the respondents did not know that FS has filters inside. Still, responses revealed that only 60.9% of the respondents have changed their water filter cartridge 2–4 times in the last two years.

Drinking water preference presented a statistically significant relationship with the variables; income (x_2 = 141.02; P < 0.05), education level (x_2 = 69.79; P < 0.05), age (x_2 = 50.05; P < 0.05) and gender (x_2 = 35.86; P < 0.05). According to the survey results, as the consumers' age increased, bottled and filtered water utilization increased and tap water utilization decreased. In terms of gender, more men than women preferred drinking tap water. Consumption of tap water decreased as education level and income increased. The usage of residential water FS showed a statistically significant relationship with the variables age (x_2 = 30.75; P < 0.05); the highest ratio is seen between the ages of 35 and above, education level (x_2 = 6.17; P < 0.05); university graduates tended to use FS more than other education levels, income (x_2 = 6.17; P < 0.05); wealthier families were more likely to use FS. On the other hand, the awareness of the water filter cartridges replacement only showed a statistically significant relationship with age (x_2 = 14.69; P < 0.05) as the age increased, the awareness also increased.

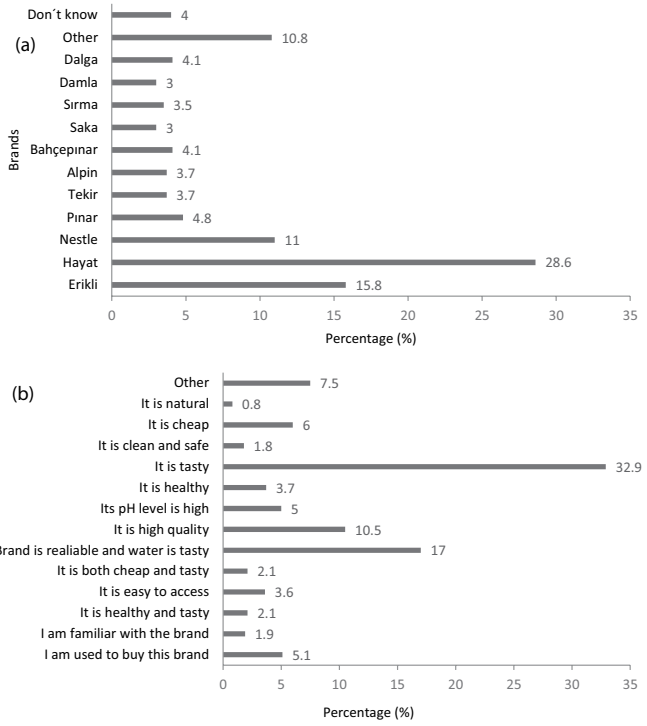

Fig. 1. (a) Percentage shares of the bottled water brands and (b) preference motive of choosing the brand among the respondents.

This study shows the drinking water choices and influencing factors in two districts of Adana, Turkey. The participants of this survey preferred municipal water (56%) over other types of water (29%). Boyraz et al. [11] stated that in Konya, Turkey 19.4% of the participants chose tap water while 22.0 % of participants chose bottled water and 9.5% of the participants chose water purifier equipment. They also determined that 80.6% of the participants did not prefer tap water because of the taste and odor problem, lime deposits, or they thought that the water was dirty or smelled of chlorine. Ufacık et al. [12] showed that in Trabzon, Turkey 31.7% of the participants preferred only municipal tap water, whereas Til et al. [16] reported that in Denizli, Turkey 39.5% preferred tap water. Elsewhere according to the survey in an African American pediatric population in Philadelphia [13], 30.1% of the participants never drank tap water, 17% the participants consumed only tap water and 38% of the

participant drank only bottled water. Mcleod et al. [14] also showed that both tap (city) water and bottled water were preferred for daily consumption in rural Saskatchewan. Sajjadi et al. [15] reported that in Gonabad, as a small semi-arid city, peoples' preferences for tap water were 27.8% and for bottled water 3.5%. Our results in Seyhan and Çukurova showed a significant difference from that reported in other publications.

The survey showed that the higher the individual's age, the more they tend to use treatment equipment. As the income and education level are interconnected, along with household size, the percentage of those using water FS has increased as these parameters increase. According to Til et al. [16], people both with high education and income tended to consume less tap water in Denizli. According to Dupont et al. [17], respondents with lower education had much higher filtered water consumption levels.

This survey also showed that the number of bottled water users was much higher than filtered water users even though the bottled water may be no safer or healthier than tap water and sells for higher prices. Ufacık et al. [12] also reported that people who tended to prefer bottled water assumed that this was much healthier and tasty compared to the tap water. On the other hand, there was no statistically significant relation between the parameters of income, education, the profession of the head of the household, and sex ($P > 0.05$) with bottled water preference. However, Akpinar and Gul [18] showed that people with high education and high income preferred bottled water in the Mediterranean region. This phenomenon is most probably closely related to the sociological structure of the locals interviewed. A follow-up investigation might be done to see the influence of sociological structure on water consumption and if demographic variables have a significant relationship with consumer satisfaction. The biggest cities in Turkey account for the largest share of bottled water consumption due to the smell and taste of the tap water. Kanat [19] mentioned that consumers preferred well-known brands when purchasing bottled water in Istanbul, which explains why the bottled water market is fragmented. Previous studies showed that women may have been more concerned about the relationship between the environment and human health than men which support our result on gender. According to Ufacik et al. [12], 59% of the women thought bottled water was much safer compared to men (48%).

4. Conclusions

Based on the results, household water FS preference of participants was low compared to tap water usage. The people in Seyhan and Çukurova districts preferred tap water. The number of bottled water users was higher than those using water treatment devices as well. The survey also aimed to promote an awareness of filter replacement even though it was seen that companies regularly warn their users about filter change, this is not fully understood by the public which resulted in using contaminated filters for a long time for economic reasons. Companies should explain to their consumers that the replacement of the filter is needed as long as the device used and in the case of using contaminated filters serious health problems might be faced. This study showed that further follow-up investigation is needed to see the influence of socio-demographic characteristics on public water consumption.

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Supporting information

Supporting information is available from the Wiley Online Library or the author.

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Supplementary information

S1. Survey Questions

Q.1. Demography

Q.2. Do you use your tap water as drinking water?
Yes
No

Q.3. If you do not use your tap water as drinking water, what is your reason?
1. I don't think that it's clean
2. I don't like the taste
3. I think that it smells
4. Other:

Q.4. Do you use any water filtration system?
1. Yes (Please go to the question 5)
2. No (Please go to the question 11)

Q.5. Which brand/s and model/s do you use?

Q.6. How many years have you been using a water filtration system?
Less than a year
Between 1–3 years
Between 3–5 years
5 years or more

Q.7. What is your main purpose for using a water filtration system?
1. To remove disease agent microorganisms from water
2. Purify the water from heavy metals/chemicals
3. Change the smell/taste/color of water

Q.8. Is there a filter in your treatment system?
Yes
No
I do not know

Q.9. Do you know how often you need to change your filter?
Yes
No

Q.10. How many times have you changed your filter in the last two years?
Never
One time
2–4 times
5 times and more

Q.11. In your opinion, what is the definition of treatment?
The process of removing unpleasant odor and taste
Foreign matter removal process
The process of removing toxic chemicals
Complete removal or reduction of all toxic and foreign/unknown substances and living things

Q.12. In the preference of the treatment system, please indicate the effect of the price.
Doesn't matter
Important
Very important

Q.13. What do you use as drinking water? (Please go to question 14 and 15 if the answer is carboy or bottled water).

Q.14. Which brand do you use?

Q.15. What is your reason to use this brand?