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SURVEY OF PUBLIC ATTITUDE TOWARDS BOTTLED AND TAP WATER QUALITY IN THE UAE

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ABSTRACT

The United Arab Emirates (UAE) is one of the leading countries in the per capita bottled water consumption. This seems to be in controversy with adherences of local water authorities to stringent municipal water standards. A public survey (n= 891) was conducted to ascertain the perception of people in the country regarding bottled and tap water quality. The survey form was formulated based on the stated preference approach and was furnished in both Arabic and English languages. Some questions in the survey form require rating the quality of tap water and identifying the type of water the respondent drinks. For respondents who usually drink bottled water, they were asked to choose the reason(s) why they usually drink bottled water. Those who drink tap water more often were similarly asked to choose the reason(s) why they prefer tap water to bottled water. The study revealed that a large fraction of the UAE residents classify the quality of tap water as either good or excellent, yet many of them drink bottled water. This could be attributed in part to the high standard of living where the cost of bottled water is considered by the majority of the respondents as affordable. Other influential factors include the belief that bottled water has a better taste and concerns about tap water contamination. The latter may stem from the perception that water is not sufficiently treated or contamination is induced into the water from the distribution system or the in-house storage tanks. The study shows that more people in the UAE will drink tap water if relevant authorities provide information about tap water quality and if regular inspections and cleaning of the in-house storage tanks is conducted.

Keywords: Bottled water, tap water, quality perception, public survey

1. Introduction

In spite of the availability of cheap good quality tap water in many countries, bottled water consumption tremendously increased in the last 4 decades at an annual worldwide growth rate of 7% (Ferrier, 2001). As a result, bottled water has become the fastest growing segment of non-alcoholic beverages, representing a market worth $22 billion (Ferrier, 2001). In arid regions where nonconventional water resources are utilized and weather conditions require the consumption of more water, increases in bottled water consumption were more noticeable. For example, doubling bottled water consumption was reported in the Middle East between 2003 and 2008 (Saleem, 2008).

The main two reasons that cause public dissatisfaction with tap water are organoleptics (i.e. taste, odor, color and turbidity) and health/risk concerns (Doria, 2006; 2010). In some surveys, however, bottled water seems to be mostly consumed as a substitute for other beverages (FWR, 1996). People also drink bottled water

thinking it has additional benefits for their health, but not necessarily because of tap water risks (Finucane *et al.*, 2000; Black, 2009). However, there is evidence that bottled water in some developed (Olson, 1999; Cidu *et al.,* 2011) and developing (Nsanze *et al.*, 1999; Dabeka *et al.*, 2002; Mahajan *et al.*, 2006) countries is not as healthy as sometimes proclaimed. As stated by Doria (2006), bottled water is not necessarily better than tap water but that depends on the specificity of the considered case. Therefore, it seems paradoxical that people choose to drink bottled water given that this option is much more expensive (Olson, 1999), less comfortable, and has more negative environmental impact (Freire *et al.*, 2001; Botto *et al.*, 2011) than tap water.

Factors that affect public perception of water quality are diverse. Concerns regarding tap water quality could be attributed to demographic variations including race, age, income, occupation and gender (FWR, 1996; Abrahams *et al.*, 2000; Dupont *et al.*, 2010). Also, the perceived quality of the water source can be a significant predictor of bottled water consumption (Levallois *et al.*, 1999; Anadu and Harding, 2000; Pintar *et al.*, 2009; Hu *et al.*, 2011). Other factors that influence public behavior are past incidents of tap water contamination, trust in tap water companies, marketing of bottled water companies (Giacosa and Giovando, 2012), changes of life style, increasing standards of living, the wide spread markets of bottled water (Ferrier, 2001), among others.

In the last five years, the United Arab Emirates (UAE) was among the top 6 countries worldwide in the annual per capita bottled water consumption of about 40 gallons compared to a global average of 8.8 gallons (IBWA, 2009; 2010; 2011; 2012; 2013). This increase in per capita bottled water consumption appears to contradict the adherence of local water authorities to stringent municipal water standards. Our objective was to ascertain the perception of people in the country regarding bottled and tap water quality. Such knowledge can assist in understanding public concerns and behaviors associated with drinking bottled and tap water.

2. Methodology

The UAE consists of 7 emirates: Abu Dhabi, Dubai, Sharjah, Ajman, Fujairah, Ras Al Khaima, and Umm Al Qaiwain. The country is characterized by a tropical dry weather, with relatively high temperatures throughout the year, especially in summer. The estimated population of the UAE in 2013 is about 6.3 million, with almost 40% of the population is located in the Emirate of Abu Dhabi (UAE Year Book, 2013). Meanwhile, a large fraction of the residents (75%) are expatriates (Maraqa and Mohamed, 2013). The country is considered one of the richest in the world with a gross domestic product (GDP) of US $375 billion. Abu Dhabi Emirate contributes approximately 60% of the GDP, followed by Dubai at 30%, Sharjah at 5%, and the remaining 5% are distributed among the other emirates (UAE Year Book, 2013).

In order to assess public perception towards bottled and tap water quality, a preliminary survey form was prepared and distributed to a limited number of UAE residents to assure the questions are understandable, not long-winded, and free of technical jargons. Based on this, the survey from was modified and was then distributed to a statistically sufficient number of residents. A copy of the survey form is shown in Appendix A. Forms were collected during the period of 2011-2014. The sample size was calculated from Eq. (1), which gives the minimum number of survey forms that are required for a given confidence level with a normal distribution response of a large population size (Roses *et al.*, 2004).

$$N = \frac{z^2 s^2}{e^2} \quad (1)$$

where, *N* is the minimum sample size; *z* is the z-value of a given confidence level (for 95% confidence level it is 1.96); *s* is the coefficient of variation (assumed as 0.5) and *e* is the tolerance level (assumed as 5%). Based on Eq. (1), the minimum sample size was found to be 384. A total of 891 filled survey forms were collected from all the different emirates which far exceeds the minimum number required to be collected. Form

distribution was carried out using a paper-administered method. The survey targeted residents who are 18 years or older. The respondents were either nationals of the UAE or expatriates who are residing in the country for at least 2 years. The latter constraints excluded many short-term visitors or temporary workers who reside in the country for less than 2 years.

Some of the questions in the survey form were intended to identify the respondent's nationality, age, education, etc. Respondents were asked to rate the quality of tap water at their residence and to indicate the type of water they drink (i.e. bottled, tap, or both). They were also asked about the frequency they drink tap water. For those who usually drink bottled water, they were asked to choose from a given list the reason(s) why they usually drink bottled water most often. Similarly, those who drink tap water more often were asked to choose the reason(s) why they usually drink tap water most often. Respondents were also asked to choose the concerns they have about drinking tap or bottled water. They were also asked about the cost of bottled water. Respondents were further asked if they have a ground tap water storage tank and the frequency the tank is cleaned. They were also asked if they have a roof water storage tank and how often it is cleaned. In another question, respondents were asked to choose among a given list the action(s) that could be done to encourage them to drink more tap water. Finally, respondents were asked about the source from which they obtain information about tap and bottled water quality.

The survey form was formulated based on the stated preference approach. In some of the survey questions, respondents were asked to choose one answer from a given list. In other questions, respondents were requested to choose all applicable answers from a given list (see for example questions 11-14 and 27-29). In the analysis of the latter set of questions; the answers are expressed in terms of percent responses relative to the total number of responses received. The survey form was furnished in both Arabic and English languages. A platform was developed to ease the entry of data into a spread sheet. Survey results were analyzed using summaries of descriptive statistics. Meanwhile, cross tabulation using Pearson Chi-Square analysis was conducted to investigate possible association between responses received on different issues asked in the questionnaire.

3. Results

Figure 1 shows some demographical characteristics of the respondents. About 55% of the respondents are from Abu Dhabi Emirate, 12% from Sharjah, 11% from Ras Al Khaima, and the remaining (22%) are from the other four emirates. Almost two-thirds of the respondents are 18 to 25 years old and the second largest group (17.1%) are 26 to 35 years old. Most of the respondents are UAE nationals (77.9%), while the second largest group are Arab residents (14.8%). Also, about 71% of respondents have a university degree, and 26.3% completed secondary school.

More than 68% of the respondents classified tap water as either good or excellent (Fig. 2). However, 78% of the respondents prefer drinking bottled water, with 88% of them indicated that they rarely or never drank tap water. According to the respondents, the cost of bottled water in the UAE is reasonable (60%) or cheap (32%). Meanwhile, half of the respondents select bottled water based on quality, 37% based on availability, and 9.5% based on cost. Our findings are consistent with those reported in previous studies which indicated that bottled water in the UAE is consumed by 77% (Wait, 2008) to 90% (Mahajan *et al.*, 2006) of the population. However, our findings differ from those of Wait (2008), who found that only 26.4% of the UAE respondents rate their tap water as good or excellent. Variations in this regard possibly reflect an improved public perception of the quality of tap over time.

While all surveyed age groups prefer drinking bottled water, those who are 18 to 25 years old constitute the highest percentage (77.6% relative to the group). Meanwhile, all nationalities prefer drinking bottled water but UAE nationals constitute the highest percentage (78.3% relative to the group). Also, residents of all seven emirates prefer drinking bottled water but those who reside in Abu Dhabi constitute the highest percentage

(76.2% relative to the group). Furthermore, those who selected reasonable cost for bottled water price constitute 76.6% among those who prefer to drink bottled water.

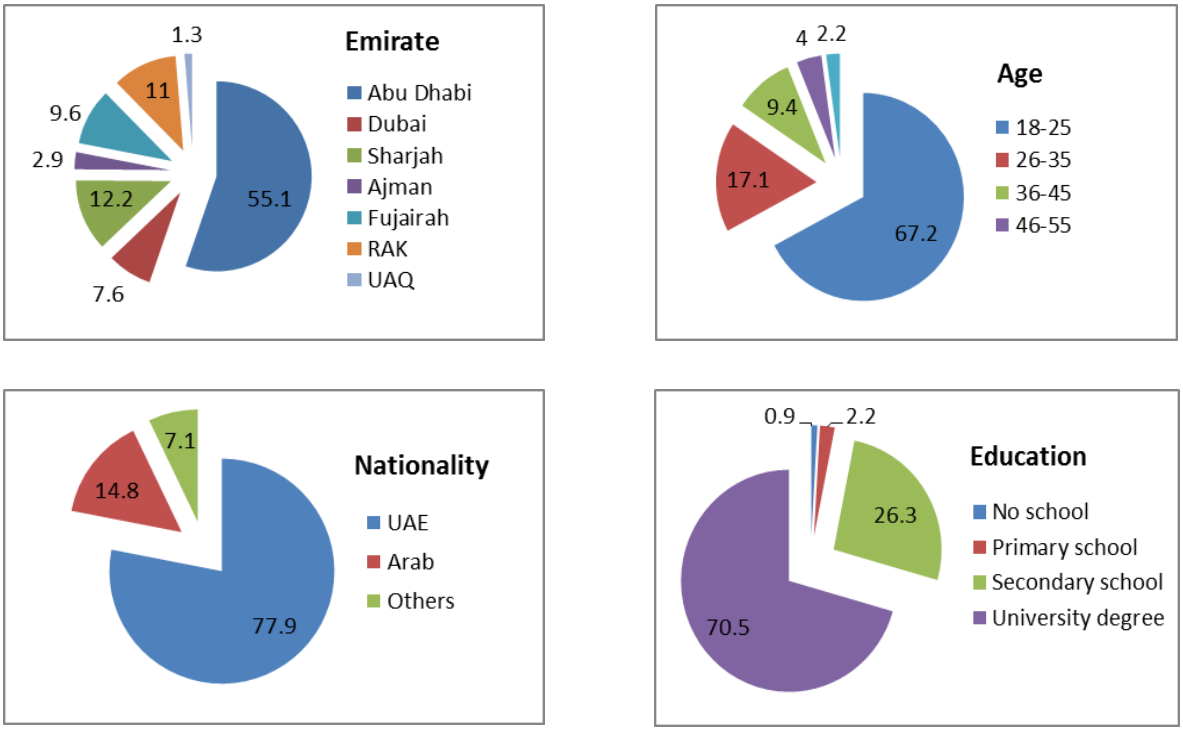

Figure 1. Demographical characteristics of the respondents

Results also revealed that respondents from all educational levels prefer drinking bottled water but those with a university degree constitute the highest percentage (55%). In terms of association between drinking preferences and cost of bottled water, selectors of all three cost categories (cheap, reasonable, and expensive) prefer drinking bottled water but those who indicated that the cost of bottle water is reasonable constitute the highest percentage (46%).

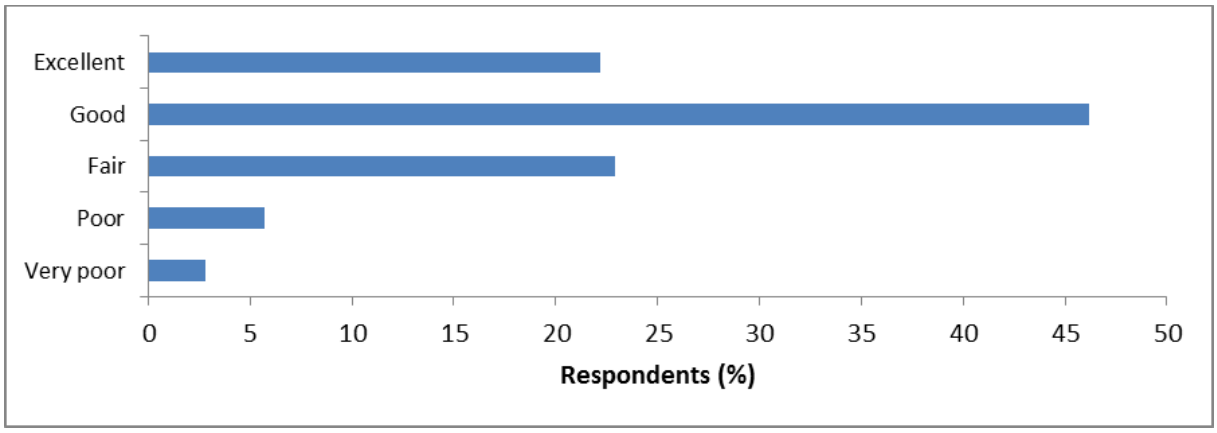

Figure 2. Quality of tap water in the UAE

When asked about the main reasons for preferring to drink bottled water, taste was the most important reason, followed by concerns about tap water microbial contamination, concerns about tap water chemical pollution, social habit and then tap water chlorine smell (Fig. 3). These results are in agreement with those of Levallois *et al*. (1999) and Wait (2008), where respondents identified organoleptics (especially taste) as the main reason for drinking bottled water. On the other hand, the main concerns identified by the respondents in this study about bottled water were related to purity/cleanliness (19%), cost (15%), taste (14.5%) and the origin of the water (12.5%).

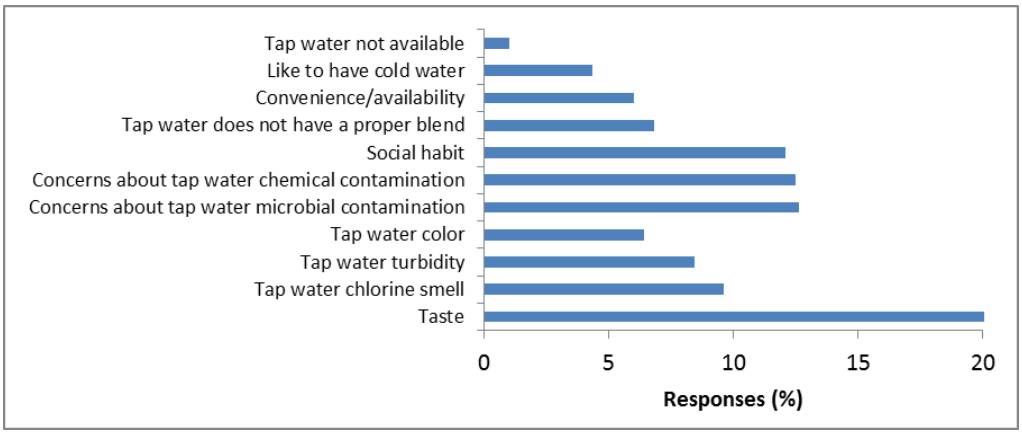

Figure 3. Reasons for drinking bottled water

When asked about the main concerns about tap water, 18% of the responses were related to sanitation of in-house water storage tanks. This is equivalent to 38% of the respondents expressing concern about this issue. Other issues include worry about building water pipes (15.9%), treatment process (15%), insufficient regulations (14.6%), sanitation of the distribution system (11.9%) and cleanliness of seawater (11.5%) as shown in Fig. 4.

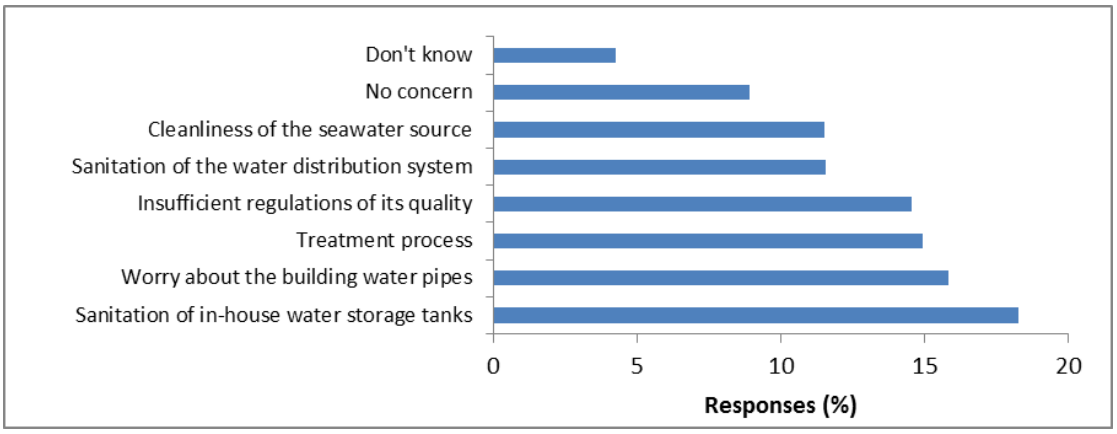

Figure 4. Concerns of drinking tap water

In-house storage tanks, building water pipes and the distribution network are usually referred to as contextual cues (Doria, 2010). Jones *et al.* (2007) found that some people attributed tap water contamination to the distribution network. Meanwhile, in the work of Contu *et al.* (2005) more than 50% of the survey participants indicated the conditions of the distribution network as one of the main causes of concern with their tap water. It should be noted that more than half of the respondents (54%) in this study have a ground storage tank for

municipal water at their residences, but 22% don't know how often the tank is cleaned. Also, 77% of the respondents have a roof water storage tank, but 32% don't know how often the tank is cleaned. Example images of ground and roof water tanks are shown in Fig. 5. The presence of these tanks in the UAE is necessary since water is not pumped continuously to residents.

(a) (b)

(c) (d)

Figure 5. Images of water storage tanks; (a) a tank located under a parking area, (b) a tank located above ground, (c) tanks located on roofs, and (d) inside a water tank

Our results are consistent with previous findings which show that tap water odor, color and taste come first in the list of public concern (Ferrier, 2001). Following this comes health concerns and people's belief of tap water as being unsafe. According to Ferrier (2001), this belief is mainly due to previous bacterial contamination, seasonal shortage of tap water, fear of fecal contamination, toxic substances or high nitrate levels in agriculture areas and water running in old distribution pipelines. Wait (2008) identified that most UAE water users do not believe desalinated water, in general, is fit for regular drinking due to perceptions of mineral imbalances, concern about cleanliness of the seawater source, and sanitation of in-house water storage tanks. Amiri *et al.* (2013) sampled ground and roof water storage tanks of 11 houses located in the Emirate of Sharjah for a period of six weeks. Although none of the samples contained E. coli, they did contain other coliforms such as Klebsiella, Enterobacter spp., and Serratia. The authors found that about 73% of the collected samples showed a high total bacterial count (>10 CFU/100ml). They suggested cleaning the water

tanks at least twice a year to prevent accumulation of contaminants. Further research, however, is needed to investigate if public concerns regarding tap water quality in the UAE are scientifically sound.

Pearson Chi-Square analysis was conducted to investigate possible association between drinking tap water and the perceived cost and drinking tap water and frequency of cleaning the in-house water tanks. The results revealed that respondents who indicated that bottled water is expensive tend to drink a combination of tap water and bottled water. Also, those who frequently drink tap water are more in the categories where the in-house water tanks are cleaned regularly or they do not know how often the tanks are cleaned. However, no significant association was found between the cost of bottled water and the frequency of drinking tap water. Also, no significant association was found between cleaning the in-house water tanks and the type of water the respondents drink.

When asked about the actions that could be taken to encourage the public to drink tap water more, 18.6% of the responses were related to improving water treatment followed by provision of more information about tap water quality (18.5%), inspection of water storage tanks (15.8%), provision of free filters (12.9%), and reducing/eliminating chlorine smell (11.9%) as demonstrated in Fig. 6.

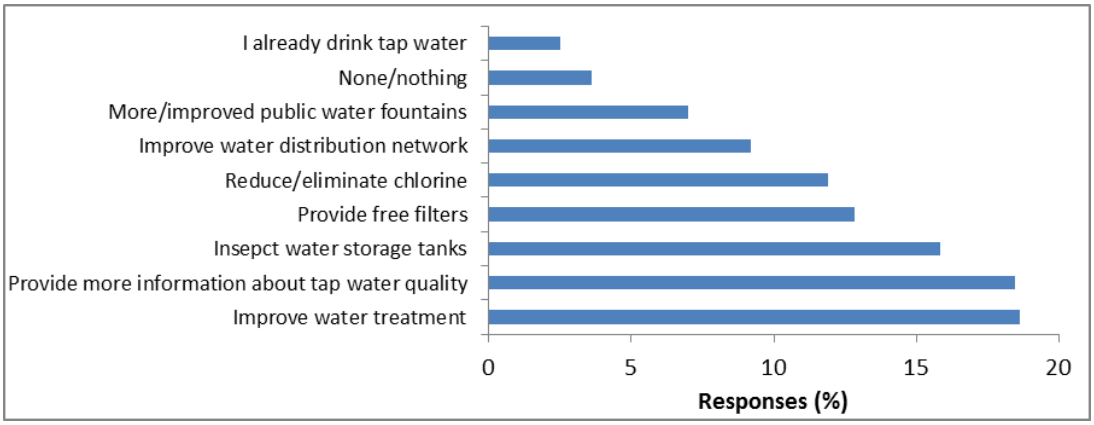

Figure 6. Actions to encourage people to drink more tap water more often

4. Conclusion

Many UAE residents drink bottled water, although a large fraction of them consider the quality of tap water as either good or excellent. The reasons for preference of bottled water in the country could be attributed in part to the high standard of living where the cost of bottled water is considered by the majority of the respondents as cheap or reasonable. Other influential factors include the belief that bottled water has a better taste and concerns about tap water contamination. The latter may stem from the perception that water is not sufficiently treated or contamination may be induced in tap water from the distribution system or the in-house storage tanks. More people in the UAE will be encouraged to drink tap water if the water utilities provide information about the quality of water and if regular inspection and cleaning of the in-house storage tanks is conducted.

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Appendix A: Survey form

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Bottled versus Tap Water Quality in the UAE

We would like to know your views about the quality of water you drink in the UAE.
Please note that this survey is solely intended for educational and research purposes.

1.	In which emirate do you live? ☐ Abu Dhabi ☐ Dubai ☐ Sharjah ☐ Ajman ☐ Umm AlQuwain ☐ Fujaira ☐ Ras AlKhaima
2.	Your age in years is? ☐ 18-25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ 56 or older
3.	What is your nationality? ☐ National of UAE ☐ Expatriate **[Please specify]** _____
4.	If you are not a national of the UAE, how long have you been living in the country? ☐ Less than one year ☐ 1-2 years ☐ 3-4 years ☐ 5 years or more
5.	Please mark the highest level of education you have received ☐ No school ☐ Primary school ☐ Secondary school ☐ University degree
6.	Do you pay for tap water at your residence? ☐ Yes ☐ No
7.	How do you rate the quality of tap water at your residence? ☐ Very Poor ☐ Poor ☐ Fair ☐ Good ☐ Excellent
8.	What type of drinking water do you personally drink? ☐ Tap water ☐ Bottled water ☐ Combination of both
9.	How frequently do you drink tap water? ☐ Never ☐ Rarely ☐ Most of the time ☐ All the time
10.	When do you drink tap water? **(Select all that apply)** ☐ At home ☐ At work ☐ At restaurants ☐ While travelling ☐ I don't drink tap water at all
	If you do not drink tap water most often then please answer question 11 and skip question 12. Otherwise, skip question 11.
11.	What are the reasons why you usually drink bottled water over tap water most often? **(Select all that apply)** ☐ Taste ☐ Color ☐ Chlorine smell ☐ Like to have cold water ☐ Turbidity ☐ Not available ☐ Convenience/portability ☐ Does not have a proper blend of minerals ☐ Social habit ☐ Concerns about microbial contamination ☐ Concerns about chemical pollution ☐ Other [Specify]_____
12.	What are the reasons why you usually drink tap water over bottled water most often? **(Select all that apply)** ☐ Cost ☐ Taste ☐ Convenience ☐ Environmental reasons ☐ Safe ☐ Health reasons ☐ Availability ☐ Don't like to drink out of plastic bottles ☐ No difference/just as good as bottled water ☐ Don't know ☐ Other [Specify]_____
13.	What, if any, concerns do you have about drinking tap water? **(Select all that apply)** ☐ No concern ☐ Treatment process ☐ Sanitation of in-house water storage tanks ☐ Cleanliness of the seawater source ☐ Sanitation of the water distribution system ☐ Worry about the building water pipes ☐ Insufficient regulations of its quality ☐ Others [Specify]_____ ☐ Don't know
14.	What, if any, concerns do you have about drinking bottled water ?**(Select all that apply)** ☐ No concern ☐ Cost ☐ Does not have a proper blend of minerals ☐ Purity/cleanliness ☐ Taste ☐ Not sure where it comes from ☐ Bad for the environment ☐ Insufficient regulations ☐ Contaminants from bottle ☐ Don't know ☐ Other [Specify]_____
15.	How do you consider the cost of bottled water? ☐ Cheap ☐ Reasonable ☐ Expensive
16.	On what basis you select the bottled water brand that you usually drink? ☐ Availability ☐ Cost ☐ Quality ☐ Other [Specify]_____

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17.	In your opinion, what kind of bottled water is best? ☐ The one that comes from underground (i.e., wells, springs, etc.) ☐ The one that comes from a freshwater surface source, such as a lake, river, or stream ☐ The one that comes from desalination of sea water ☐ It doesn't matter ☐ Don't know
18.	Regarding bottled water, do you prefer to drink ☐ Locally manufactured brands ☐ Imported brands ☐ No preference when choosing between locally and imported brands ☐ I do not drink bottled water
19.	Please mark any tap water purification system that you use at your residence ☐ Carbon filter ☐ Ultraviolet light ☐ Reverse osmosis ☐ Microfilters ☐ Boiling ☐ Others ☐ None
20.	Do you have a ground storage tank for tap water at you residence? ☐ Yes ☐ No ☐ Don't know
21.	If your answer to Question 20 is "Yes", then where is the ground tank located? ☐ On the ground ☐ Below ground surface and there is no car parking area above it ☐ Below ground surface and there is a car parking area above it ☐ Other [Specify]_____
22.	If your answer to Question 20 is "Yes", then how often the ground tank is cleaned? ☐ Never ☐ At least once a year ☐ Once every two years ☐ Don't know
23.	Do you have a roof storage tank for water at your residence? ☐ Yes ☐ No ☐ Don't know
24.	If your answer to question 23 is "Yes", then how often the roof tank is cleaned? ☐ Never ☐ At least once a year ☐ Once every two years ☐ Don't know
25.	Do you think the local water authority should yearly inspect the water storage tanks at your residence? ☐ Yes ☐ No ☐ Don't know
26.	If the water tanks at your residence are inspected by a certified authority, would you then drink tap water? ☐ Yes ☐ No ☐ Don't know
27.	What could be done to encourage you to drink more tap water more often? **(Select all that apply)** ☐ I already drink tap water only ☐ Provide more information about tap water quality ☐ Improve water treatment ☐ Reduce/eliminate chlorine ☐ Improve the water distribution network ☐ Inspect water storage tanks ☐ More/improved public water fountains ☐ Provide free filters ☐ None/nothing ☐ Other [specify]_____
28.	From where do you usually obtain information about tap water quality? ☐ TV ☐ Newspaper ☐ Internet ☐ Friends/relatives ☐ Books/Journals ☐ None ☐ Other [Specify]_____
29.	From where do you usually obtain information about bottled water quality? ☐ TV ☐ Newspaper ☐ Internet ☐ Friends/relatives ☐ Bottle label ☐ Books/Journals ☐ None ☐ Other [Specify]_____

Thank you very much for your time and opinions.

Collected by:_____ ID no.:_____ Date:_____