Research Paper

Household drinking water safety among the population of Gaza Strip, Palestine: knowledge, attitudes, practices, and satisfaction

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ABSTRACT

A descriptive cross-sectional study employing a structured questionnaire was employed to assess knowledge, attitude, practice, and satisfaction (KAPS) of Gaza's community on issues related to household drinking water safety. The results showed that of 1,857 household heads, 1,621 (87.3%) were males, with the majority (967, 52.1%) having a university educational level. Of surveyed households, 744 (40.1%) consisted of 5–7 persons and 885 (47.7%) of the households resided in refugee camps. Mean percentages for KAPS were 82 ± 15.5%, 64.9 ± 39.7%, 53.2 ± 14.1%, and 37.3 ± 26.56%, respectively. There were statistically significant associations between some sociodemographic variables and mean percentage of KAPS scores. Educational level was the only variable significantly associated ($p < 0.05$) with all mean KAPS scores. There was a significant positive linear correlation between knowledge-attitude ($r = 0.362$, $p < 0.05$), but a significant negative linear correlation between knowledge-practice ($r = -0.070$, $p < 0.05$) was also observed. Therefore, the Local Government Authority (LGA) should arrange community awareness campaigns on the importance of safety and hygiene measures of drinking water storage. Furthermore, and due to the poor financial capabilities of the LGA in Gaza, it is highly recommended that LGA contact relevant international donors in order to support programs aiming at improving household water supply.

Key words | attitude, drinking water safety, Gaza Strip households, knowledge, practice, satisfaction

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INTRODUCTION

Provision of safe drinking water for a community is recognized as a priority protection and to sustain human life (WHO 2016). Undoubtedly, the provision of safe water for the entire population remains one of the challenges of our era, particularly in developing countries (Bain *et al.* 2014; Oye 2014). Almost 663 million people throughout the world still suffer from lack of access to potable water (WHO 2015). The annual global burden of waterborne diseases has been estimated at 2.4 million deaths and 73 million disabilities (WHO 2004; Pruss-Ustun 2008). There is an increasing body of evidence and research suggesting that improved sources of drinking water in many cases were not entirely safe (Lim *et al.* 2012; Boakye-Ansah *et al.* 2016). Contamination of drinking water can take place during the distribution from the point of production to the consumer's tap as well as due to erroneous practices

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of handling and storage of drinking water in households (Wright et al. 2004; Levy et al. 2008; Macharia et al. 2015). Hence, proper management of drinking water supplies, from catchment to consumer, based on a water safety plan (WSP), would ensure the safety of drinking water and protect people from the risk of waterborne diseases (WHO 2004, 2009). In addition, there is a necessity for capacity building and technology development in order to improve the contamination surveillance system and data reporting (Rahman et al. 2011; Brunson et al. 2013).

The excessive consumption of aquifer water, virtually the only source of fresh water in the densely populated Gaza Strip, has led to a severe deterioration in both quality and quantity of groundwater (Shomar 2006; Amr & Yassin 2008; Hamdan et al. 2008). In this regard, the proposed small-scale brackish desalination plants have been welcomed as an optimal solution to alleviate the suffering of Gaza's people and meet the community need for potable water. However, water surveillance programs and country level research confirmed that the water supply system in Gaza Strip is subjected to microbiological, chemical, and physical hazards, maybe attributable to the bad practices related to water transportation, handling, and storage (Baalousha 2006a, 2006b; Shomar 2006; MacDonald et al. 2016).

The epidemiological bulletin reports of United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) showed that the prevalence rate of diarrheal diseases among children had increased markedly from 4,017.1 cases per 100,000 individuals in 2009 to 6,909.1 cases per 100,000 individuals in 2012 (UNRWA 2009). Moreover, diarrheal diseases are the most self-reported illness among children under five years old (MoH 2017). A gap between real practice in the disinfection process of the water supply system and WHO limits was concluded by several studies conducted in the Gaza Strip (Al-Safady & Al-Najar 2011; Sadallah & Al-Najar 2015). It is worth mentioning here that the weak water sector institutional arrangements in the Gaza Strip primarily result from lack of investment and lack of support by the local population (Al-Ghuraiz & Enshassi 2005). Therefore, analyses of water consumers' needs and existing knowledge, attitudes, behaviors, and satisfaction are important. Such analyses are significantly more useful if conducted at the household level to disaggregating data and analyzing differences to subsequently develop an adequate communication strategy. Such information would make a communication strategy more effective, as messages to different stakeholders could be better delivered (Judeh et al. 2017).

To the best of our knowledge, this is the first study aimed at assessing the knowledge, attitude, practices, and satisfaction of water consumers towards household water quality and transmission of waterborne diseases in Gaza Strip. The results could contribute to proposing possible future solutions for an effective prevention of waterborne diseases.

METHODS

Study design and setting

The current community-based cross-sectional descriptive study was conducted in the Gaza Strip governorates between August 2017 and June 2018. Data collection was from September 2017 to March 2018. This area is situated in south-west Palestine, with a current projected population of 1,912,267 within an area of approximately 365 square kilometers, and its population density per square kilometer is considered to be one of the highest in the world (PCBS 2017). Gaza Strip is bounded on the east and north by the occupied Palestinian lands, on the south by Egypt, and on the west by the Mediterranean Sea (Figure 1) (Baalousha 2011).

Study tool

A 44-item structured questionnaire was used to gather information about sociodemographic characteristics, knowledge, attitude, practices, and satisfaction about household drinking water safety. The questionnaire was produced based on previous literature reviews (WHO 2006; UNICEF 2010; Onabolu et al. 2011; Wang et al. 2018). Content validity of the questionnaire was achieved by six experts from different fields related to water resources management and public health. Thereafter, the questionnaire was piloted among 45 households. Minor adjustments were made after the pilot testing to ensure its acceptability and consistency.

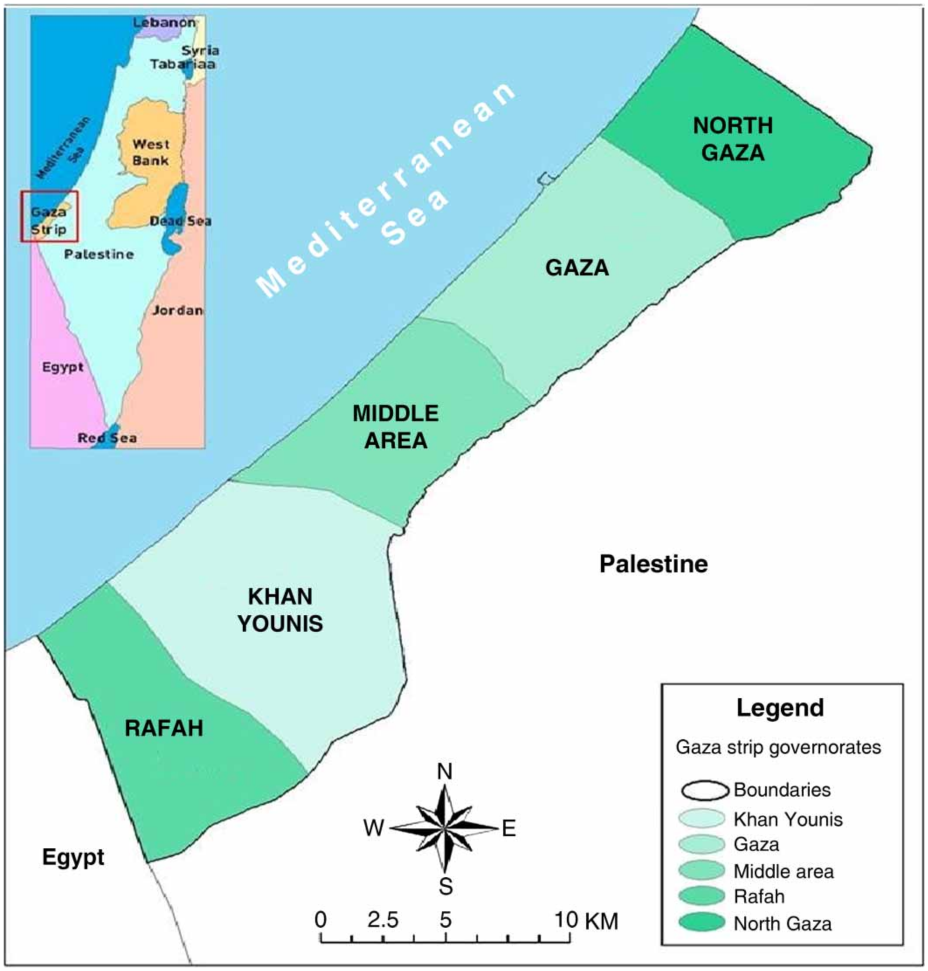

Figure 1 | Gaza Strip map and its five governorates.

Sample size determination

The representative sample size in the current study was determined using the following formula (Charan & Biswas 2013):

$$\text{Sample size } (n) = \frac{Z^2_{1-\alpha/2}\, P(1-P)}{d^2} = \frac{(1.96)^2(0.50)\,(1-0.50)}{(0.05)^2} = 384 \quad (1)$$

where $Z_{1\text{-}\alpha/2}$ = standard normal variate (Z value is 1.96 for a 95% confidence level); p = response distribution (50%); d = margin of error (5%).

The calculated sample size was 384 households. Unexpectedly, after data collection was finished, some items of the sociodemographic characteristics and drinking water-related variables were zero frequency at the sample size of 384 households. Thus, we recalculated the sample size after decreased margin of error (2.274%) to increase the sample size and raise the level of representation, as well as to get a narrower confidence interval (Amin 2005). Finally, the sample size calculated by the same equation with adjusted margin of error was 1,857 subjects.

$$\text{Sample size } (n) = \frac{Z^2_{1-\alpha/2}\;\; P(1-P)}{d^2} = \frac{(1.96)^2(0.50)\;\;(1-0.50)}{(0.02274)^2} = 1,857 \quad (2)$$

Sampling process

A cluster random sampling was used to select 1,857 households in the five governorates of Gaza Strip. The distribution of households among the governorates according to the number of households in each governorate was as follows: 126 in North Gaza, 466 in Gaza, 472 in Middle Area, 477 in Khan Younis, and 316 in Rafah governorate.

Ethical consideration

The study protocol was approved by the Ethics Committee of Tehran University of Medical Sciences, Helsinki Declaration (Code: IR.TUMS.REC.1396.3917). Written permission was sought and granted by the Palestinian Ministry of Health to carry out the study. Also, the head of the household's consent was obtained after explaining the purpose of the study and they were not obliged to answer any questions which they did not like and were free to terminate the interview at any given time.

Data analysis

In order to guarantee the quality of data, each completed questionnaire was checked before it was coded in MS Excel 2007. The data were analyzed using IBM SPSS statistics program. Findings were presented as frequency and percentage tables; Chi-square test was performed to identify relationships for categorical variables with $p < 0.05$. Meanwhile, Spearman's rank correlation coefficient ($p < 0.05$) was applied to assess the association between KAPS.

The measurement scale of knowledge, attitude, practice, and satisfaction questions was from 1 to 4 and then changed and presented in this paper as a dichotomous classification. A score less than 3 was considered a negative response, while scores 3 and 4 were considered a positive response.

The scores for KAPS were transformed into mean percentage scores by dividing the sum scores obtained by the respondents with the number of items and multiplied by 100. The sum score of each outcome was evaluated according to Bloom's cut-off point. Consequently, the overall mean percentage of scores for each category of KAPS with 60% and above was considered as good level, whereas less than 60% was deemed as poor level (Bloom 1956).

RESULTS AND DISCUSSION

A total of 1,857 household heads were interviewed, of which, 47.7% were living in refugee camps and 25.0% were from agricultural zones. In terms of gender, the vast majority of the respondents (87.3%) were males (Table 1). With regard to educational level, 52.1% of the respondents reported that they had a university level of education. The majority of household heads (73.6%) were employed. Out of employed respondents, nearly 43.4% were doing entrepreneurial work and 43.2% were working as a staff member. Forty percent of surveyed households comprised four to seven members and a small percentage (9.6%) of households had a monthly income more than 3,000 new Israeli shekel (NIS), the local currency.

In relation to household water supply, about 44.4% and 25.5% of the study participants relied on desalinated water transported by tanker truck and municipal water network for drinking purposes, respectively, while 49% and 92% of households depended on municipal water network for cooking and domestic uses, respectively.

Half of the surveyed households (49.9%) had running water from the municipal network just 2–3 days a week and 55.2% of households had access to municipal water only 5–12 hours on those days. The majority (63.1% and 60.7%) of the respondents reported that the former month they had paid 60–80 NIS and 10–20 NIS for municipal water and desalinated water, respectively. Most of the participants (72.5%) revealed that the average of drinking water consumption per person per day in their households was less than or equal to ten cups, since one cup equals 240 mL.

Knowledge about household drinking water safety among the participants of the study was assessed by ten items about drinking water handling, storage, and waterborne diseases (Table 2). Out of 1,857 participants, 1,730 (93.2%) were within the good knowledge range whereas 127 (6.8%) demonstrated poor knowledge. The overall percentage of the mean of scores for knowledge was 82 ± 15.5%.

The lowest level of knowledge was regarding the fact that children are more vulnerable to waterborne diseases and the next that chlorination of drinking water could reduce the risk of waterborne diseases. This finding was in line with the outcomes of a local study conducted by

Table 1 | Respondents' sociodemographic characteristics and Gaza's household drinking water-related variables

Variables	Frequency (%)
Governorate	
North Gaza	126 (6.8)
Gaza	466 (25.1)
Middle Area	472 (25.4)
Khan Younis	477 (25.7)
Rafah	316 (17)
Type of living area	
Agricultural	465 (25)
Herding	147 (7.9)
Camp	885 (47.7)
Towers	360 (19.4)
Sex	
Male	1,621 (87.3)
Female	236 (12.7)
Level of education	
Nil	124 (6.7)
Primary	259 (13.9)
Secondary	507 (27.3)
University	967 (52.1)
Employment	
Employed	1,366 (73.6)
Unemployed	491 (26.4)
If employed, your career	
Cattle herder	44 (3.2)
Farmer	139 (10.2)
Entrepreneurial	593 (43.4)
Staff member	591 (43.2)
Household members	
Less than 5	675 (36.3)
Between 5 and 7	744 (40.1)
More than 7	438 (23.6)
Household monthly income	
Less than 1,000 NIS	484 (26.1)
Between 1,000 and 2,000 NIS	468 (25.3)
Between 2,001 and 3,000 NIS	724 (39.1)
More than 3,000 NIS	177 (9.6)
Drinking water source at the household	
Municipal network	474 (25.5)
Point of use RO units	45 (2.4)

(*continued*)

Table 1 | continued

Variables	Frequency (%)
Desalinated water transported by tanker truck	824 (44.4)
Desalinated water from vendor shops	151 (8.1)
Desalinated water from NGOs plants	227 (12.2)
Well water	136 (7.3)
Cooking water source at the household	
Municipal network	907 (48.8)
Point of use RO units	14 (0.8)
Desalinated water transported by tanker truck	590 (31.8)
Desalinated water from NGOs plants	203 (10.9)
Well water	143 (7.7)
Domestic water source at the household	
Municipal network	1,706 (91.9)
Point of use RO units	8 (0.4)
Desalinated water transported by tanker truck	6 (0.3)
Well water	137 (7.4)
Municipal water supply at household (day/week)	
Not connected	48 (2.6)
4–7 days/week	491 (26.4)
2–3 days/week	927 (49.9)
Once a week	318 (17.1)
Less than once a week	73 (3.9)
Municipal water supply at household (hour/day)	
Not connected	11 (0.6)
Less than 4 hours per day	559 (30.1)
5 to 12 hours per day	1,025 (55.2)
More than 12 hours per day	262 (14.1)
The monthly bill for municipal water (NIS)	
<60	401 (21.6)
60–80	1,171 (63.1)
>80	285 (15.3)
Monthly payment for desalinated water (NIS)	
<10	165 (10.4)
10–20	967 (60.7)
>20	460 (28.9)
Average of drinking water consumption per person per day at household (one cup = 240 mL)	
≤ 10	1,347 (72.5)
>10	510 (27.5)

1 USD = 3.5 NIS; RO denotes reverse osmosis.

Table 2 | Responses of participants to knowledge items towards household drinking water safety

Knowledge items	Yes, N (%)	No, N (%)
Have you ever heard of a disease termed as waterborne	1,769 (95.3)	88 (4.7)
Have you ever heard that children are more vulnerable to water diseases	1,327 (71.5)	530 (28.5)
Have you ever heard that chlorination of drinking water reduces the spread of waterborne diseases	1,413 (76.1)	444 (23.9)
Storage of drinking water for a long time can cause deterioration of its quality	1,563 (84.2)	294 (15.8)
Change in taste, odor, or color of drinking water can affect human health	1,498 (80.7)	359 (19.3)
Mixing of improved drinking water with non-improved water can reduce its quality	1,544 (83.1)	313 (16.9)
Access of birds and animals to drinking water storage tank can expose it to contamination	1,577 (84.9)	280 (15.1)
Putting the drinking water tank near the toilet can expose it to contamination	1,509 (81.3)	348 (18.7)
Putting the drinking water tank directly on the ground can expose it to contamination	1,465 (78.9)	392 (21.1)
Periodical cleaning of the drinking water storage tank can reduce the spread of waterborne diseases	1,563 (84.2)	294 (15.8)

Amr & Yassin (2008), which reported that the residents of the Gaza Strip were knowledgeable about drinking water contamination. Findings were also consistent with the results of community-based studies from different parts of the world (Swaroop *et al.* 2012; Bharti *et al.* 2013; Furlong & Tippett 2013; Sah *et al.* 2014; Pachori 2016).

The participant's attitude towards household drinking water safety was evaluated using four items (Table 3). Out of 1,857 respondents, 1,128 (60.7%) were within the positive attitude range, whereas 729 (39.3%) showed a negative attitude towards household water safety. The overall percentage of the mean of scores for attitude was 64.9 ± 39.7%. A positive overall level of attitudes was found among the study participants towards the effectiveness of awareness campaigns and promotion programs using various media, providing safe drinking water, and prevention of water-borne diseases occurrence in the household. This positive level of attitudes was consistent with the standards of achieving safe drinking water (WHO 2011).

Table 3 | Responses of participants to attitude items towards household drinking water safety

Attitude items	N (%)
How important do you think is the awareness campaigns related to water-related diseases prevention?	
Important	1,268 (68.3)
Not important	589 (31.7)
How important do you think is the monitoring of water supply system components?	
Important	1,178 (63.4)
Not important	679 (36.6)
How serious are you in providing safe water for your household?	
Serious	1,244 (67)
Not serious	613 (33.1)
How serious are you when your children get diarrhea?	
Serious	1,128 (60.7)
Not serious	729 (39.3)

The majority of the household heads (68.3%) acknowledged the importance of awareness campaigns related to water safety and water-related diseases prevention. Sixty-seven of the study respondents reported that they were serious about providing safe water for their household's members. Nearly, 60.7% of the study respondents showed that they were serious about their children's diarrheal disease and seeking treatment.

The participants' practice towards household drinking water safety was evaluated using ten items (Table 4). The overall percentage of the mean of scores of practice towards drinking water safety in households was 53.2 ± 14.1%, revealing poor practices among Gaza Strip households towards drinking water safety. The poorest practice was for the item related to the cleanliness of the area around their drinking water storage tank, since only 26.4% of the participants had good practices in this regard. Only 28.7% of study participants got rid of water in the case of its odor, taste, or color changes. Just 31.7% of the study participants had good practices in what relates to periodically washing drinking water storage tanks with soap. Thirty-six percent of the participants washed their hands before filling the drinking water storage tank and 40% of participants had never checked the license of the desalination plant and the tanker truck that supplies their households with drinking water. However, good practices have been reported in some items where the majority of the participants (91.3%) have never filled their drinking water storage

Table 4 | Responses of participants to practice items towards household drinking water safety

Practice items	Yes, N (%)	No, N (%)
Have you ever filled your drinking water storage tank with other liquid/ material?	160 (8.7)	1,697 (91.3)
Have you ever verified the license of a desalination plant and a tanker truck that supplies your household with drinking water?	748 (40.3)	1,109 (59.7)
Is there a leak from your drinking water storage tank?	663 (35.7)	1,194 (64.3)
Do you periodically wash your drinking water storage tank with soap?	589 (31.6)	1,268 (68.4)
Do you get rid of or re-treat drinking water in the case of its odor, taste, or color change?	533 (28.7)	1,324 (71.3)
Do you take care over the cleanliness of the area around your drinking water storage tank	491 (26.4)	1,366 (73.6)
Do you mix improved drinking water with other non-improved water?	517 (27.8)	1,340 (72.2)
Is the cap of your drinking water tank not present or not tightly closed?	548 (29.5)	1,309 (70.5)
Do your children drink water directly from the water storage tank using their mouth and hands	566 (30.5)	1,291 (69.5)
Do you wash your hands before filling the drinking water storage tank?	680 (36.6)	1,177 (63.4)

tank with other liquid/material. Seventy-two percent of the participants did not mix improved drinking water with other non-improved water. Almost 29% of the surveyed participants revealed that the cap of their drinking water storage tank has neither been available nor tightly closed. Sixty-four percent indicated that there has been no water leak from their drinking water storage tank. Only 30.5% revealed that their children's drinking water can be provided directly from the water storage tank using their mouth and hands. However, the results showed poor practices regarding drinking water safety and prevention of waterborne diseases. Such a low level of good practices indicates the probability of the occurrence of waterborne diseases among household members (Mintz *et al.* 1995; Sobsey *et al.* 2003; Fonyuy & Innocent 2014; Vishnupriya *et al.* 2015; Misati 2016; Mudau *et al.* 2017). Provision of safe drinking water lies in identifying the mechanism of contamination transmission and taking prevention measures at hazardous points to prevent the pollution of drinking water (Trevett *et al.* 2004). We, therefore, highlighted the bad practices among our study participants towards drinking water safety in households. In spite of 84.2% of the participants reporting their knowledge regarding the importance of periodic washing of the drinking water tank, the majority of them (68.4%) did not follow this practice which can prevent formation of a suitable environment for biofilm bacteria growth in drinking water storage tanks (Roeder *et al.* 2010). Previous studies conducted in Gaza Strip governorates showed diarrheal diseases were strongly associated with cleaning of drinking water storage tanks (Mourad 2004; Amr & Yassin 2008).

Likewise, 71.3% of respondents stated that they did not dispose of water in the case of it changing its smell, taste, or color even though they know this practice is wrong. This result could be attributed to the price of drinking water and the average monthly income of households in Gaza Strip, where only 9.6% of participating households had a high monthly income (more than 3,000 NIS). The monthly payments of the majority of households were 60–80 NIS and 10–20 NIS for municipal water and desalinated water, respectively. According to a study conducted to examine the affordability and willingness of people in Gaza to pay for improved water supply service, establishing a new approach to support poor households that cannot afford an average price of 3 NIS/m^3 is recommended (the price affordable by all income levels by the WHO) (Al-Ghuraiz & Enshassi 2005). Within this context, a significant association between the willingness to pay for the quality of drinking water and the economic situation of the household has been found in different developing countries (Sattar *et al.* 2007; Wang *et al.* 2010; Dauda *et al.* 2015; Mvangeli Dlamini 2015; Dhungana & Baral 2017). Most of the participants (73.6%) in this study have not taken care about the cleanliness of the area around their drinking water storage tank despite their knowledge about such practice (Bora *et al.* 1997; Sarkar *et al.* 2007). Even though handwashing is one of the most effective ways to prevent gastrointestinal infections (Curtis *et al.* 2009; UNICEF 2009), more than half of study participants (63.4%) demonstrated inappropriate practices in this respect before filling their drinking water storage tank.

It is interesting to note that a high dissatisfaction level was found among the study participants about both the quality and availability of municipal water. On the other hand, access to desalinated water as an improved water source has significantly raised the level of the participants' satisfaction. Similar findings were reported in rural Ethiopia (Abebaw et al. 2010). It is noteworthy that the majority of Gaza Strip households rely on desalinated water for drinking purposes, with the remainder using other water sources. Slightly less than half of the participants (44.4%) indicated that desalinated water transported by tanker trucks was the main source for drinking water in their households. This is essentially a consequence of the high level of salinity of groundwater, the only source of water in Gaza Strip (Baalousha 2006a, 2006b; Shomar 2006; PAW 2015). The majority of study participants (69.8%) expressed their satisfaction with the taste of desalinated water. However, this could not necessarily guarantee the safety of the water because disinfection of drinking water in Gaza Strip in most of the cases is not adequate, and the water still could provide an appropriate environment for biofilm bacteria regrowth in drinking water storage tanks (Roeder et al. 2010; Kuberan et al. 2015; Sadallah & Al-Najar 2015).

Satisfaction towards water status in the households was measured by asking four questions (Table 5). Out of 1,857 respondents, only 196 (10.6%) were within the contentment range, while 1,661 (89.4%) showed dissatisfaction towards water quality and waterborne disease. The overall mean percentage of the satisfaction scores was $37.3 \pm 26.6\%$, revealing dissatisfaction among the Gaza Strip community with regard to quantity and quality of water supplies in their households. Of household heads, 80.7% and 89% expressed their dissatisfaction with the taste and quantity of municipal water for their households, respectively. Fifty-one of the surveyed household heads were not satisfied with the quantity of desalinated water for their households. However, nearly 69.8% of the study participants were satisfied with the taste of desalinated water in their households. From our point of view, the significant relationship between participants' satisfaction and the governorate of residence ($p = 0.007$, which is less than 0.05) could be interpreted either as a result of the disparity in municipal performance in supplying water to households or due to the variation in the quality of groundwater and depth of the groundwater table among the governorates. Different concentrations of groundwater pollutants were recorded in governorates mainly due to the hydrogeological setting, land use, seawater intrusion, and contamination load in each governorate (Yakirevich et al. 1998; Baalousha 2006a, 2006b, 2011). A clear positive relationship was achieved between participant satisfaction and number of days per week and number of hours per day that households had access to municipal water.

Table 5 | Responses of participants to satisfaction items towards household drinking water safety

Satisfaction items	N (%)
Do you like the taste of municipal water?	
Yes	359 (19.3)
No	1,498 (80.7)
Do you like the taste of desalinated water?	
Yes	1,296 (69.8)
No	561 (30.2)
Are you satisfied with the quantity of municipal water that reaches your household?	
Yes	204 (11)
No	1,653 (89)
Are you satisfied with the quantity of desalinated water that reaches your household?	
Yes	911 (49.1)
No	946 (51)

Among study participants, characteristics variables, educational level was the only variable significantly associated ($p < 0.05$) with all mean KAPS scores, whereas nature of the occupation and source of cooking water was significantly associated with mean KAS scores ($p < 0.05$). The number of hours that municipal water was available at the household per day was significantly associated with mean KS scores ($p < 0.05$). Governorate of residence, nature of the residential area, households' monthly income, the source of drinking water, the average of drinking water consumption per person per day, and source of domestic water in households were significantly associated with mean KA scores ($p < 0.05$). Monthly municipal water bill was significantly associated with mean attitude scores ($p < 0.05$). Number of days that municipal water was available in households per week was significantly associated with mean satisfaction scores ($p < 0.05$) (Table 6).

Spearman rank correlation explained the significant positive linear correlation between knowledge and attitude ($r = 0.362$, $p < 0.05$). Otherwise, there was a negative linear correlation between knowledge and practice ($r = -0.070$, $p < 0.05$) (Table 7).

Table 6 | Mean scores of knowledge, attitudes, practices, and satisfaction

		Knowledge		Attitude		Practice		Satisfaction	
Variables	**N**	**Mean ± SD**	***p***	**Mean ± SD**	***p***	**Mean ± SD**	***p***	**Mean ± SD**	***p***
Governorate									
North Gaza	126	84.1 ± 13.8	0.000	43.8 ± 42.4	0.000	52.1 ± 13.6	0.334	33.9 ± 26.2	0.007
Gaza	466	82.7 ± 15.4		60.4 ± 41.1		52.9 ± 13.5		37.5 ± 26.1	
Middle Area	472	84.3 ± 13.1		68.3 ± 38.3		52.4 ± 13.8		39.1 ± 24.9	
Khan Younis	477	80 ± 15.7		66.8 ± 38.1		54.1 ± 14.4		38.9 ± 27.6	
Rafah	316	79.8 ± 18.6		71.8 ± 37.4		53.7 ± 15.2		33.1 ± 27.6	
Type of living area									
Agricultural	465	80.5 ± 14.9	0.000	58.1 ± 39.7	0.000	52.5 ± 13.7	0.666	39 ± 26.3	0.099
Herding	147	74.6 ± 15.2		48.6 ± 42.2		53.5 ± 14.1		39.8 ± 29.7	
Camp	885	83.7 ± 15.3		67.8 ± 39		53.4 ± 14		35.8 ± 26.9	
Towers	360	82.9 ± 16.2		72.9 ± 37.2		53.4 ± 14.9		37.8 ± 24.4	
Sex									
Male	1,621	82.1 ± 15.3	0.318	65.5 ± 39.4	0.057	53 ± 14	0.266	37.4 ± 26.6	0.791
Female	236	81.1 ± 17.3		60.3 ± 41.1		54.1 ± 14.7		36.9 ± 25.9	
Level of education									
Nil	124	44.8 ± 10.5	0.000	33.7 ± 37.5	0.000	58.3 ± 14.5	0.000	38.1 ± 31.6	0.001
Primary	259	68.4 ± 11.5		43.5 ± 39		52.4 ± 14.5		32 ± 30.1	
Secondary	507	80.1 ± 8.8		45.9 ± 42.4		52.7 ± 15		40.4 ± 30	
University	967	91.4 ± 7.4		84.5 ± 26		53 ± 13.3		36.9 ± 22.4	
Employment status									
Employed	1,366	82.4 ± 15.5	0.095	65.5 ± 39.7	0.221	52.9 ± 14.3	0.246	36.8 ± 26.1	0.188
Unemployed	491	81 ± 15.7		63 ± 39.6		53.8 ± 13.6		38.6 ± 27.6	
If employed, your career									
Cattle herder	44	68 ± 15.9	0.000	33.5 ± 37.3	0.000	55.9 ± 14.7	0.397	36.9 ± 31.2	0.011
Farmer	139	67.5 ± 16.8		33.8 ± 35.8		51.7 ± 14.3		43.3 ± 29.9	
Entrepreneurial	593	81.5 ± 16		63.9 ± 40.3		53.1 ± 14.5		35.2 ± 26.6	
Staff member	591	87.8 ± 10.7		76.9 ± 34.3		52.9 ± 13.9		36.9 ± 24.1	
Household members									
Less than 5	675	81.1 ± 15.2	0.113	63.6 ± 39.6	0.165	52.9 ± 14.1	0.797	35.9 ± 27.8	0.141
Between 5 and 7	744	82.2 ± 15.9		64.1 ± 40.5		53.1 ± 14.2		38.6 ± 25.5	
More than 7	438	83.1 ± 15.4		68 ± 38.3		53.5 ± 13.9		37.2 ± 26.2	
Household monthly income									
Less than 1,000 NIS	484	80.7 ± 15.8	0.000	62.1 ± 39.9	0.000	53.8 ± 13.7	0.514	38.9 ± 27.8	0.147
Between 1,000 and 2,000 NIS	468	77.9 ± 16.6		55.7 ± 39.9		53.1 ± 14.4		35.8 ± 27.1	
Between 2,001 and 3,000 NIS	724	85 ± 13.9		70.4 ± 38.6		52.6 ± 14.1		37.8 ± 25.7	
More than 3,000 NIS	177	83.6 ± 15.3		73.4 ± 37.7		53.8 ± 14.6		34.6 ± 25	
Drinking water source at the household									
Municipal network	474	80.9 ± 15.6	0.000	55.4 ± 38.2	0.000	52.8 ± 13.7	0.084	38.6 ± 27.3	0.625
Point of use RO units	45	84.7 ± 15.5		77.8 ± 33.8		53.6 ± 13.7		33.3 ± 27.7	

(*continued*)

Table 6 | continued

		Knowledge		Attitude		Practice		Satisfaction	
Variables	**N**	**Mean ± SD**	***p***	**Mean ± SD**	***p***	**Mean ± SD**	***p***	**Mean ± SD**	***p***
Tanker truck	824	82.8 ± 15.7		70 ± 39.8		53.9 ± 14.4		36.5 ± 25.8	
Vendor shops	151	85.8 ± 10.7		77.8 ± 34.2		54 ± 13.4		38.6 ± 25.5	
NGOs plants	227	81.5 ± 15.3		62.8 ± 40.8		52.5 ± 13.8		36.7 ± 28.1	
Private well	136	76.7 ± 17.5		51.5 ± 38.8		50.1 ± 14.9		38.2 ± 26.3	
Cooking water source at the household									
Municipal network	907	82.8 ± 14.7	0.013	66.3 ± 39.3	0.000	53.1 ± 13.9	0.074	37.8 ± 26.7	0.000
Point of use RO units	14	85.7 ± 14		82.1 ± 31.7		47.9 ± 11.9		5.4 ± 14.5	
Tanker truck	590	81.9 ± 16.4		66.9 ± 39.9		54.2 ± 14.4		37.3 ± 25.8	
NGOs plants	203	81.1 ± 15		60.3 ± 40.2		52.3 ± 13.6		35.1 ± 27.9	
Private well	143	78.1 ± 17.5		52.3 ± 38.1		51.2 ± 15.1		39.9 ± 25.6	
Domestic water source at the household									
Municipal network	1,706	82.4 ± 15.3	0.000	65.8 ± 39.7	0.000	53.3 ± 14	0.220	36.9 ± 26.7	0.055
Point of use RO units	8	60 ± 20.7		31.3 ± 22.2		57.5 ± 17.5		59.4 ± 26.5	
Tanker truck	6	95 ± 5.5		95.8 ± 10.2		45 ± 10.5		41.7 ± 12.9	
Private well	137	78.3 ± 17.4		53.6 ± 37.9		51.7 ± 14.9		40.1 ± 25.1	
Municipal water supply at household (day/week)									
Not connected	48	79.4 ± 15.6	0.107	67.2 ± 42.3	0.421	52.5 ± 13.8	0.775	42.2 ± 23.2	0.036
4–7 days/week	491	82.2 ± 15.8		64.7 ± 39.7		53.2 ± 14.2		35.4 ± 25.4	
2–3 days/week	927	82.4 ± 15.7		63.5 ± 40		52.8 ± 14.3		37.4 ± 27	
Once a week	318	82.1 ± 14.4		67.5 ± 38.7		53.7 ± 13.7		40.2 ± 27.4	
Less than once a week	73	77.7 ± 16.5		70.2 ± 37.4		54.5 ± 13.3		32.5 ± 25.9	
Municipal water supply at household (hour/day)									
Not connected	11	76.4 ± 23.4	0.005	36.4 ± 46.6	0.016	50.9 ± 10.4	0.896	15.9 ± 23.1	0.008
Less than 4 hours per day	559	81.4 ± 16.2		65.1 ± 39.4		53.4 ± 14.2		39.4 ± 26.8	
5–12 hours per day	1,025	83 ± 14.6		66.2 ± 39.3		53.1 ± 13.9		36.4 ± 26.5	
More than 12 hours per day	262	79.6 ± 17.1		60.3 ± 40.7		52.9 ± 14.8		37.4 ± 26	
The monthly bill for municipal water (NIS)									
<60	401	81.4 ± 15.1	0.099	64.7 ± 38.5	0.014	52.1 ± 13.7	0.197	36.2 ± 27.4	0.511
60–80	1,171	81.8 ± 15.8		63.4 ± 40.6		53.3 ± 14.3		37.3 ± 26.6	
>80	285	83.8 ± 15.3		71.1 ± 36.6		54 ± 13.5		38.6 ± 24.9	
Monthly payment for desalinated water (NIS)									
<10	165	82.3 ± 15.4	0.970	66.2 ± 39.8	0.546	52.6 ± 15.1	0.318	33.5 ± 24.8	0.184
10–20	967	82.4 ± 15.3		67.9 ± 39.6		53 ± 14.2		37.5 ± 26.9	
>20	460	82.6 ± 16.1		69.8 ± 39.9		54.1 ± 13.5		37.3 ± 25.4	
Average of drinking water consumption per person per day at household (one cup = 240 mL)									
≤10	1,347	81.5 ± 15.9	0.016	66.1 ± 39.3	0.023	53.2 ± 14.1	0.742	36.9 ± 26.9	0.346
>10	510	83.4 ± 14.4		61.5 ± 40.4		53 ± 14		38.2 ± 25.5	

P value less than 0.05 is significant.

Table 7 | Correlation between knowledge, attitudes, practices, and satisfaction score

Variable	Correlation coefficient *r*	*P* value
Knowledge and attitudes	0.362	0.001
Knowledge and practices	−0.070	0.003
Knowledge and satisfaction	0.040	0.083
Attitudes and practices	−0.016	0.484
Attitudes and satisfaction	−0.030	0.192
Practices and satisfaction	0.019	0.421

The negative correlation between knowledge and practice in this study could be due to the theory-practice gap. In other words, one's knowledge of theory, therefore, may not necessarily yield good practice and good practice may not necessarily occur in the presence of theory. Moreover, many socioeconomic, cultural, physical, and institutional barriers limit the good practices that would ensure drinking water safety in the household despite good knowledge; for instance, the unaffordability of constructing safe drinking water infrastructure in the household, the lack of space inside the house, and the poor design of latrines inside the house, demonstrating concern for inspection of drinking water tank only in the case of water color change or appearance of water-related diseases among family members, and lack of mechanisms or forums for consultation about drinking water safety. This result is in agreement with the outcome of some earlier studies in developing countries where the majority of respondents were knowledgeable about household drinking water safety but did not practice them appropriately (Kioko & Obiri 2012; Kuberan *et al.* 2015; Vishnupriya *et al.* 2015).

CONCLUSIONS

The study showed that most respondents had high knowledge and positive attitude towards household drinking water safety. Nevertheless, a low percentage of the study respondents illustrated positive practices relating to drinking water safety in the household as well as a low level of satisfaction on household water supplies. There were some statistically significant associations between several sociodemographic variables and mean of KAPS scores. There was a significant positive linear correlation between knowledge-attitude and significant negative linear correlation between knowledge-practice. Therefore, the LGA should arrange community awareness campaigns on the importance of safety and hygiene measures of drinking water storage. Furthermore, and due to the poor financial capabilities of the LGAs in Gaza, it is highly recommended that LGAs contact the relevant international donors in order to support programs aiming at improving household water supply.

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