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## TECHNICAL NOTE

### Water quality and improving hygienic practices of the rural community in the vicinity of Ramallah, West Bank, Palestine

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The study aims to increase community awareness at the household level about certain hygienic practices and water quality in order to develop an effective program that will target improving specific hygiene-related behavior. The study was carried out in two Palestinian villages and applies a quasi-experimental design where chemical and biological water quality analysis as well as residential behavioral aspects related to some hygiene practices were assessed before and after envisaged intervention applications. A questionnaire was used to evaluate the housewives' knowledge, and practices in regard to hygienic practices and water use, followed by face-to-face health education and awareness sessions to the selected housewives. After 3 months, another assessment was conducted using the same questionnaire to measure improvement in their knowledge and practices. On the first visit, in addition to collecting data related to the questionnaire, the water quality in the selected houses was tested to ensure the quality aspects of the hygiene practices. Based on these findings, the chosen methodology was able to promote a real change in improving the water quality on household taps and in improving hygienic practices and knowledge.

**Keywords:** health education; hygiene promotion; water quality; Palestine

#### Introduction

It has been estimated that inadequate water, sanitation and hygiene account for 2.2 million deaths annually, or 4% of the global total, and 5.7% of the global burden of disease in disability adjusted life years (DALYs) (Prüss et al. 2002). Most of these deaths are in children under the age of five (Kosek et al. 2003). The millennium development goals stipulate that many more people should have access to improved water sources and sanitation by 2015 (United Nations 2002), and the mortality of children under five should be reduced by two thirds. The mere provision of water supply and sanitation facilities is not enough to lower mortality and morbidity rates significantly; hygienic behavior has a greater impact on health, and also helps to ensure hygienic maintenance of the facilities. A hygiene promotion component is therefore recommended as an adjunct to most water and sanitation programs in the developing world (WHO/UNICEF 2000). Research has shown that hygiene promotion can change hygiene behavior (Feachem 1984; Curtis et al. 2001). However, the sustainability and the relative effectiveness of the different approaches to hygiene promotion is still relatively unknown.

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The Palestinian Ministry of Health (2004) stated that a number of water samples in Palestine that had been bacteriological examined increased 34.4% from 7099 water samples in 2002 to 9540 in 2003. Water contamination is considered an urgent public health problem that requires prompt intervention. This contamination has its evidence in waterborne diseases.

The Palestinian Hydrology Group (2005) states about 3% of the people in Ramallah district are infected by waterborne diseases. Diarrhea and gastroenteritis diseases represent 3.4% of the leading deaths among ages 1–4 years in Palestine (Ministry of Health 2004).

The estimated infant mortality rate for Palestine (24/1,000 live births), which is *relatively* good in comparison to the countries living with similar socio-economic conditions (Egypt, Syria and Lebanon), but the achievements of the last 30 years are now eroding and even reversing.

Diarrhea is no longer a major cause of mortality. This is due to the positive impact of the Palestinian Ministry of Health, WHO, and UNICEF CDD programs. Infant deaths due to diarrheal disease decreased from 1.5 per 1,000 live births in 1995 to 0.1 per 1,000 in 2003. Similarly, deaths among children under five decreased from 2.6 in 1995 to 0.5 in 2003 per 100,000 deaths (Palestinian Ministry of Health 2004).

Diarrheal diseases are significant causes of morbidity in infants and children in Palestine. Children under the age of five with an episode of diarrhea within the last 2 years ranged from 12–23% (Palestinian Central Bureau of Statistics [PCBS] 2004). Excluding the influence of the intense political factors, the incidence of diarrhea has decreased in recent years, but still remains high. Seasonal and environmental factors such as disruption of the water infrastructure play a key role in the incidence of diarrhea, and can explain local variations.

Water quality problems are increasing and imposing public and environmental health risks in Palestine. Local solutions to these problems are greatly needed in order to minimize possible waterborne disease outbreaks, as well as to improve water and environmental security.

The project reached different households in two rural communities near Ramallah City in order to improve the quality of water used in the household and to improve hygiene practices as a part of healthy life style.

## **Materials and methods**

### ***Target group***

The study targeted 50 mothers or housewives at different ages currently residing in two villages near Ramallah (Figure 1), Abu-Shkeidim and Abu-Qash. Housewives in general are responsible for the level of hygiene in their homes; increased knowledge and improved practices would influence all the members in house.

### ***Study areas***

The study covered two villages in the Occupied Palestinian Territory each with 1000 capita. The first was Abu-Shkeidim, a rural Palestinian village located 10 km northwest of Ramallah City. It has water networks connected to 204 households, but is without sewer networks. The people dispose of their waste in cesspits. The second village was Abu-Qash, 6 km northwest of Ramallah City. It has water networks connected to 189 household but is without a sewer network. The people dispose of their waste in cesspits (PCBS 2004).



Figure 1. Study area location map.

### ***Sampling techniques and size***

The study was designed on the basis of a social survey of households on the quality of water, sampling and analysis chemically and biologically, and indicators of potential presence of pathogens. Water samples were taken from roof water tanks.

Twenty-five households were selected in each village. Maps for each village were used in order to provide local knowledge and information to help select the sampling locality. A team of three people covered each household: one for the interview and two to conduct sampling and observation.

### ***Data collection methods***

A specialized questionnaire was developed to assess the mothers' knowledge, attitudes, and practices related to certain hygienic practices: hand washing, showering and water storage. The questionnaire was designed to be analyzed descriptively. Before applying the questionnaire, a pilot study was conducted in order to the performance of the questionnaire. Some modifications were made to the questionnaire to improve clarity of some questions which were given particular attention during training sessions for the field teams. The questionnaires were acceptable to the participants, and the questions were not considered too sensitive.

Six field coordinators and two supervisors (all females) conducted the fieldwork. At each house, the mother was interviewed face to face and subsequently received intensive

health education and promotion about better hygiene practices. Each selected house was visited two times by the field coordinators with different objectives for each visit. On the first visit, field workers introduced themselves and the objective of the study while recording the mothers' knowledge, attitudes and practices concerning:

- The method and frequency of cleaning tanks and wells;
- Household water source and connections;
- Waterborne diseases;
- Water pollution and water disinfection;
- Some hygienic behaviors, such as hand washing and showering.

Field workers provided health education and counseling session for each mother about proper disinfections and cleaning methods for the tanks. In addition, they counseled the mothers about waterborne diseases and how to prevent them, as well as some relevant hygienic practices. Field workers obtained information from mothers on motivations for promoting best practices as well as barriers to adopting best practices, and gaps of knowledge about specific behavior. The field workers collected water samples manually from the roof water tank. They tested the temperature, pH, and turbidity in the field. All samples were analyzed within 3 hours after collection at the water and sanitary laboratory at Birzeit University. Composite samples were analyzed by Standard Methods (American Public Health Association [APHA] 1992) for microbiological parameters including total coliforms, fecal coliforms and *Pseudomonas aeruginosa*. Mothers were informed of the results of the water samples. Houses with contaminated samples were advised to complete proper cleaning and disinfecting of their water tanks.

In April 2006, field workers conducted the second visit. They evaluated the mothers' new knowledge and practices, and checked to see if any mother cleaned her roof water tank. Motivations for promoting best practices and also barriers to adopting best practices were investigated.

### ***Consent, confidentiality, and ethical considerations***

Verbal consent was sought from all mothers participating in the study and agreement was noted on the questionnaires by the interviewers. The fact that participation was voluntary was made clear. No payment or incentives were offered to participants. The name and address of the survey participants was included on the survey form. This was to allow the team to return for the second visit to inform the mother of the results of the water sampling tests. Name and address details have been kept confidential. Data are only presented at the aggregate level preventing individuals or households from being identified. Personal identification information is kept securely within Birzeit University.

### ***Data quality assurance***

Analysis of data was performed using a standard computer software package (SPSS-X). Double entry of 5% of questionnaires was undertaken to assess the transcription errors. Post data entry consistency and validation checks were made on the data using standard techniques to identify missing and incorrect information.

### Response rate

The rate of refusal to participate was zero. The field worker's consideration of the response rate was that it was fairly high, with no refusal cases.

### Analysis plan

Statistical analysis was used to study the effectiveness of community awareness by conducting pre- and post-tests (Quasi-experimental study design). A pilot phase was conducted in which the questionnaire's validity and reliability were tested.

*T*-tests were performed to measure the significant difference between the kind of tank and contamination levels. A Chi-square test was implemented to measure the improvement in the knowledge and practices after the awareness campaign. The comparison between the extent of performance before and after the intervention would bring evidence regarding the impact of the intervention.

## Results

### Characteristics of the study population

A total of 50 households were surveyed. Figure 2 presents the age distribution of mothers and husbands. The level of education is likely to influence both hygienic knowledge and practices. Moreover, husbands will influence decisions and help in implementing healthy lifestyle practices. Figure 3 presents the level of education among the surveyed household. Husbands in general had higher educational attainments than their wives.

Household size is often used as a proxy to measure the quality of living conditions with large household occupancy often associated with overcrowding and poor socio-economic circumstances. Large households are common in Palestine and the mean household size across the study was 7.4. The average household sizes in this survey were larger than the published national average of 5.7; 44% of the surveyed households had 7–8 members. Thirty-four percent of the sample had children under five, while 19.1% of the samples had one child, 34% of the mothers had 2 children, and 8.5%, 4.3% had three and four children, respectively.

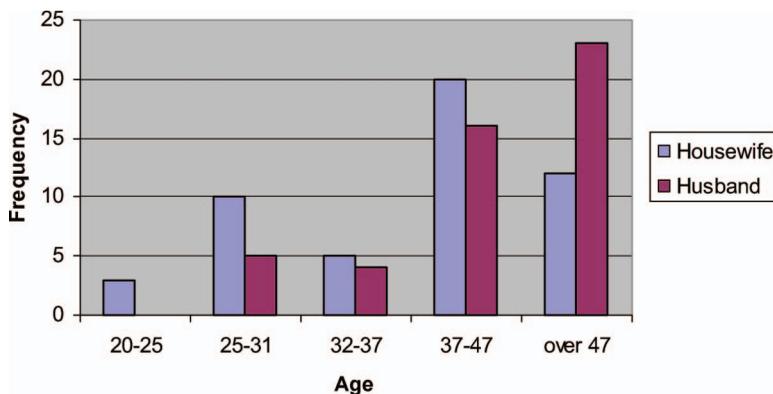


Figure 2. Age distribution of mothers and husbands.

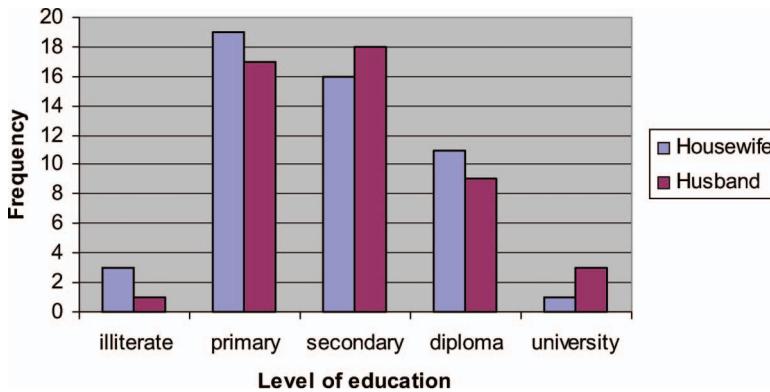


Figure 3. Level of education among the surveyed household.

### *Household income*

Women were asked to state the average monthly income for their household. Eighty-two percent knew the answer and were content to tell the interviewer. There was marked poverty among the households sampled. The average household income across the study area was 1824 NIS per month (1 NIS = 0.24 USA \$). The poverty line in Palestine was defined as an income of less than 1934 NIS per month for a household composed of two adults and four children (PCBS 2004). Some 60% of the households were below the poverty line.

Ninety-eight percent of the mothers interviewed were housewives, while 44% of the husbands were workers; 12% were government employees, 14% were working in the private sector, and 18% were unemployed.

### *Water quality of the roof tanks*

The materials of the roof tanks were either plastic (63.3%) or metal tanks (36.7%). Some of them were physically clean (26.5%) and (16.3%) were rusty. Almost all (98%) of the water tanks had closed lids. Fifty water samples were biologically and physically tested in the laboratory. Eight samples were contaminated with total coliform, four samples were contaminated with fecal coliform and five samples were contaminated with *Pseudomonas aeruginosa*. Twenty five samples had a value of turbidity exceeding the Palestinian Drinking Water Standard (more than 5 NTU).

An interesting finding showed that, upon testing microbiological contamination, the plastic tanks were significantly more contaminated microbiologically than the metal ones ( $t$ -test  $p < 0.05$ ). This was evident in Abu-Sheikhdem village.

The results of water quality for the roof tanks were communicated back to all visited households by phone. The households which had contamination were encouraged to clean their tanks using the different methods that they had learned during the first visit. Upon completion of the second visits, the field workers found that all contaminated households responded by cleaning their water tanks as soon the results had been communicated.

### *Study findings*

The study applied a quasi-experimental design where chemical and biological water quality analysis as well as residential behavioral aspects related to some hygiene practices were managed before and after envisaged intervention applications.

**Study results before the intervention**

The collected data before the intervention was analyzed for some hygienic practices. Regarding the showering habits, 36% of the surveyed mothers showered every day, 34% showered twice a week, and 30% three times a week.

Upon further probing regarding their showering patterns, 26% indicated that they took a shower every day as a result of dirt and filth from their jobs (e.g. farmers), 64% stated they took showers when they felt dirty, and 10% stated that they took showers because of the weather conditions. When asked why they felt showering was important in general, 86% of the participants stated that showering reduced waterborne diseases, 24% believed that showering was a health requirement, and 48% indicated that showering and bathing made them feel fresh and clean.

Table 1 presents the answers to hand washing practices. The first column shows the answers without reading the choices while the second column shows the answers after reading the choices. The percentages increased dramatically and significantly to 94–100% for the prompted options. This may indicate that while people's knowledge is adequate and they know when they should wash their hands, the real practices might not be consistent with their knowledge. As per usual with surveys of this type, the prompted answers led to a large increase in correct responses.

All the surveyed houses received drinking water from the national Jerusalem Water Undertaking. Only 6% of the houses used mineral water besides the municipality source for drinking purposes. Thirty-four percent had cisterns in their houses in addition to the municipality water.

Sterilization of water was not a common practice in the two villages. Fifty percent of the mothers mentioned that they did not need to sterilize their water because they used only water coming from the municipality source which they considered to be clean and therefore did not need to be sterilized. Fifty percent sterilized their water by boiling because they used cisterns.

Eighty-eight percent of houses indicated that they cleaned their water tank on a regular basis. Twenty-four percent cleaned the tanks twice a year, 41% cleaned once a year and 24% cleaned once every two years. Almost all interviewed women (96%) acknowledged the importance of cleaning their water roof tanks from time to time. Almost half of the houses had cisterns in addition to the municipality water, and 89% of them cleaned the cisterns regularly every year.

The majority (82%) of the mothers who were asked if their children had been sick during the last month replied negatively and only four children and three adults had

Table 1. Hand washing practices.

Activity	Unprompted responses	Responses when prompted by interviewer
Wash before eating	40%	94%
Wash after eating	16%	100%
During preparation of food	38%	94%
After using the toilet	24%	100%
On need when hands are dirty	80%	96%
Touching animals	2%	96%
Changing the baby	10%	98%
Walking up in the morning	8%	100%

diarrhea during the pervious month, but the cases were mild and they cured completely.

In order to evaluate the mothers' knowledge about the waterborne diseases, they were asked about the possible causes of diarrhea. Their answers were as follows: 58% said contamination of water and food was the main cause, 16% referred to lack of hygiene, 12% referred to cold, and 14% said they didn't know any of the possible causes of diarrhea. In response to how to prevent the waterborne disease, 34% of the mothers said that drinking safe and clean water was the secure tool of prevention, and 18% said that washing their hands appropriately with water and soap was a good way to prevent diarrhea.

Upon asking mothers about other diseases that might be caused by a lack of hygiene practices; 10% said that many types of diseases resulted from a lack of hygiene, 8% said the flu, 8% said skin diseases and 2% said lice were a result of a lack of good hygiene. Forty-eight percent were unfamiliar about other diseases that might be caused by a lack of good hygienic practices. On examining the association between hygienic practices and the conditions of the water samples of their roof tanks, the results showed no significant association between the two factors.

### Study results after the intervention

After applying the health education sessions and informing the households about the quality of water in the roof tanks, the same questionnaire originally answered by the women regarding hygienic practices was applied again. A Chi-square test was used to measure the significant difference between the two responses (before and after the intervention) for each question.

There was a significant difference between the pre- and post-intervention regarding shower habits, shower frequency and the importance of showering ( $p < 0.05$ ). Almost the same percentage of mothers reported taking showers every day (36%); however, the number of mothers who reported showering three times a week increased from 30–40%.

Although the good hygiene information session provided detailed information on the importance of hand washing, there was no significant difference between the pre- and post-intervention for hand washing after using the toilet, washing on need, after contacting animals and upon waking up in the morning. There were significant improvements for the practice of washing hands before and after eating, during preparation of food and changing baby diapers (Table 2).

Table 2. Hand washing practices before and after the intervention.

Activity	Unprompted responses before the intervention	Unprompted responses after the intervention	Chi-square
Wash before eating	40%	60%	$p < 0.05$
Wash after eating	16%	22%	$p < 0.05$
During preparation of food	38%	52%	$p < 0.05$
After using the toilet	24%	24%	$p > 0.05$
On need when hands are dirty	80%	92%	$p > 0.05$
Touching animals	2%	2%	$p > 0.05$
Changing the baby	10%	16%	$p < 0.05$
Walking up in the morning	8%	8%	$p > 0.05$

When asked about the causes of diarrhea, the women responded as follows: 30% said lack of hygiene, 48% said contamination of water and food, 10% cold, and 12% didn't know the causes of diarrhea. After explaining the causes of diarrhea at the first visit there was a significant difference between the pre- and post-question of what might be the causes of the disease.

When asked if their children were sick during the last month, the majority (94%) of mothers replied negatively, stating only two children and one adult had diarrhea during the previous month, and indicated the cases were mild and cured completely. In response to the question of how to prevent diarrhea, 24% said that drinking safe water was a tool of prevention and 36% said that washing hands appropriately with water and soap was a good way.

When asked about other diseases, other than diarrhea, that could be caused by lack of good hygiene, 36% of participants replied not knowing any, 4% mentioned the flu, 16% referred to skin diseases and the rest stated other diseases that could be caused by lack of hygiene and the causes of diarrhea and its complications. Some 6% mentioned that cholera could be caused by lack of hygiene, 2% stated Ameba and 6% mentioned dehydration (which is one of the complications of diarrhea).

## **Discussion**

The study focused on simple, community-based interventions to help develop improved hygienic practices and improved household-level water storage and disinfection practices. The study geared the communication focus towards interpersonal communication (IPC) with an emphasis on the development of a package of printed information, education, and communication (IEC) materials. The materials were used by the field coordinators during home visits and the remainder materials were left in the homes of the participant mothers' after conducting the first visit. Great emphasis was placed on the consistency, technical appropriateness, and clarity of the images and language used and the IEC materials addressed different messages, proper sterilization methods, proper cleaning of tanks, waterborne diseases and how to avoid them and hygienic practices such as washing hands: when and how.

The questionnaire findings showed a very high level of knowledge among mothers after prompting the answers regarding when they should wash their hands. However, it seems the problems are in the application of the practice itself. The real practice could not be measured without direct observation, which was not part of the study methodology and is considered one of the study limitations. Although mothers knew when they should wash their hands, they were not convinced about the consequences of not adopting healthy behavior and how that might affect them and their families.

The availability of water is not a barrier in adopting healthy washing practices, as water is connected to all houses and always available. One woman of an earlier generation said, in the past, when there was no water network they didn't wash their hands or shower as frequently as they did now.

Consumer dissatisfaction regarding the quality of tap water was noted; 14% were dissatisfied with the odor, and 30.6% with the taste or flavor. Health risks, regarding ingestion of tap water that is biologically contaminated, were not perceived as major concerns to consumers.

Through probing, different barriers to disinfecting water were also reported; people were not convinced that water disinfection was necessary. In addition, people were not convinced that the water was polluted. People lacked accurate knowledge regarding this

important component, for they knew and cared about the color and taste of water, but could not conceive of what they could not see. Moreover, the fact that chlorine was not freely available was one of the factors that was mentioned; however, they did know how to use it and would prefer not to.

Many obstacles to cleaning the roof tanks were reported, such as difficulty in reaching the tanks and using children to fit inside. Ignorance regarding the proper frequency of cleaning was also reported.

Therefore, any community-based approach and interpersonal communication strategy should address these different barriers in simple and visible ways at different levels from health education materials to community and institutional support

Assessment of the mothers' knowledge regarding waterborne diseases indicated a lack of accurate information, often rooted in traditional beliefs, such as cold causing diarrhea. This situation reflects the importance of including mothers at a higher age level as well as grandmothers and the community at large in order to address their inaccurate ideas and beliefs.

### **Lessons learned and recommendations**

- (1) Excellent relations with local civic leaders and influential persons helps smooth the facilitation of activities.
- (2) More time and effort from high-level institutions is required in order to have more substantial impact, such as the involvement of government institutions charged with responsibility for health, water resources, local governance.
- (3) In addition to individual counseling and health education at the household level, this component demonstrated that to be conducted and implemented in any future programs, it must be combined with community-based mobilization activities to promote feasible, sustainable improved hygiene practices.
- (4) Explore the possibility of establishing a comprehensive project with sufficient resources and expertise to develop water and sanitation infrastructure, to expand community-based behavior-centered programs to promote improved hygiene practices at the community and household level and to facilitate policy development and institutional strengthening at multiple governmental institutional levels to promote these goals and objectives. These projects may also include sufficient provisions for strategic operations research to support policy development and institutional.

### **Conclusion**

The rapid development of a sound, evidence-based behavior change communications promoting improved hygiene practices in a challenging, complex environment is possible. The results presented in this study point to evidence that the process itself is sound and if provided with sufficient time could yield results by continuing to focus efforts on behavior change with participant groups at the community level.

This focus should be combined with support at the policy level and in terms of water and sanitation infrastructure development in order to have a great chance to yield even better health outcomes in the future.

However, it is difficult to say that the behaviors agreed by the study team with the participant households and promoted as best practices in the communication strategy, are sustainable given the very short period of time allotted for implementation. But the results

seen in this short time and discussed in the body of this study provide us with hope for the implementation of a similar strategy combining community involvement and community mobilization for an increased chance of sustainability. The information provided a solid basis for developing effective program interventions that contribute to improving hygiene practices that will lead to improved hygiene practices as a part of a healthy lifestyle.

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