Water drinking attitudes and behaviours in Guatemala: an assessment and intervention

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Abstract

In March of 2002, a 244-meter ground water well was installed at an orphanage in Lemoa, a small village in Guatemala, providing a free and sustainable source of drinking water for the surrounding community. The well gave the local residents access to much higher quality water than their traditional sources provided. However, meter readings at the pump showed that few of the residents availed themselves of this new resource. A research team revisited the community in Spring 2004 to assess attitudinal and behavioural determinants of water usage in the community and in a second community with no access to safe well water. Both Lemoa respondents (N = 21) and Camanchaj respondents (N = 30) reported higher ratings of water safety than were warranted by objective data. Educational materials (card-sorting tasks) were prepared to help residents of both communities better understand the importance of correct water drinking decisions. These were administered approximately one year after the first survey to independent samples in both communities (*N's* = 31 and 32). After completing the card-sorting tasks, participant ratings of water safety were significantly lower. Both the survey and the educational interventions appeared to have positively impacted use of the well at Lemoa.

Keywords: Attitudes, Cross Cultural Studies, Health

Introduction

The World Health Organization (WHO) has established as one of its Millennium Development Goals the objective of cutting in half the proportion of people without access to safe drinking water (WHO 2005). One of the criteria set by WHO for the realization of this goal is to increase the percentage of residences in rural areas with household connections for drinking water. In Guatemala, the site of the present study, this percentage rose from 34% of all households in 1990 to 53% in 2002. While this is a creditable achievement, the implication is that nearly half of Guatemala's inhabitants of undeveloped areas must obtain drinking water of doubtful quality from nearby lakes or streams, cisterns, shallow wells, or spring-fed gravity-flow systems. A variety of health problems are associated with consumption of contaminated water, including amoebic dysentery, hepatitis, and cholera. Although organizations from developed countries have made strenuous efforts to address the problem of water quality in Guatemala and other countries in the developing world, it is clear that much remains to be done.

Most of the research on remediation of drinking water in developing regions focuses on technological interventions (Sobel et al 1998, Rangel et al 2003) or institutional or governmental initiatives (e.g., Team SER, 2003). However, the installation of superior apparatus or institutional mechanisms to deliver safer water to rural areas does not ensure that inhabitants of such areas will immediately abandon water consumption habits they may have observed for generations (Kroutil and Eng 1989). Accordingly, researchers have increasingly turned to the investigation of consumer attitudes and knowledge of health risks in evaluating the impact of technological interventions in the developing world and other regions (Thevos et al 2003). This research has identified obstacles inhibiting indigenous peoples from utilizing new water sources, including trust, customs, dissemination of information, and communication networks (Thornton et al 1989, Peavey 1995). To understand the role each of these obstacles plays in determining water consumption requires some understanding of their prevalence and salience.

Water consumption behaviours can perhaps best be construed as habits, where these are defined as "tendencies to repeat behaviours given a stable supporting context" (Ouellette and Wood 1998, p. 55). Even in the developed world, selection of drinking water can be a discretionary behaviour (e.g., use of bottled water rather than tap water). Residents of underdeveloped areas are faced with similar choices, although the stakes of their decisions are more critical, as the WHO data suggest. But what factors enter into such individuals' decisions to select one water source over others? It is possible that health behaviour models incorporating attitudes, intentions, and behaviours can provide preliminary answers to this question.

In developed countries, the Health Belief Model (HBM, Ronis 1992) has provided a viable theoretical framework for psychological assessment of health attitudes and risk perceptions. The fundamental premise of HBM is that individuals will take active measures to avoid unhealthy behaviours when they (a) recognize the risk and its serious nature; (b) believe there is a course of action that will reduce the risk; and (c) believe that the potential benefits of taking the action outweigh its costs (Strecher et al 1997). Thus, HBM predicts that health-related interventions will only be effective if recipients are aware of their susceptibility (e.g., the condition of their drinking water and its relationship to illness) and feel capable of taking an active role in addressing the problem (e.g., are receptive to utilization of alternative drinking water sources). This approach to remediation of health problems has been extensively validated in the U.S. and other developed countries, and is based on converging streams of research in the social and cognitive psychology fields. Less is understood, however, about the generalisability of such cognitive-behavioural models to Third World populations. Thus, scholars (Coreil1997, McKinlay and Marceau, 2000) have argued that a large percentage of the health behaviour research in developing countries suffers from weak or underdeveloped conceptual grounding, especially at the level of individual motivation and behaviour.

The present investigation was designed to test HBM in a field setting in the Third World where health-related decisions with regard to drinking water are consequential. Two communities in Guatemala were selected for the research site, partly because objective data had been collected showing that the traditional sources of water available in these communities was contaminated (Elmore et al 2005), and an alternative, healthy water source (a groundwater well) had been made available in one of the communities. In accordance with HBM, questionnaires were designed to tap individuals' attitudes and beliefs related to water consumption (risk perceptions), and their willingness to consider switching to other, healthier sources of drinking water (behaviour change). In a follow-up visit to both communities, educational materials were administered showing causal relationships between drinking water decisions and health outcomes.

Background

In March of 2002, a team of geological engineering faculty and students led by the second author installed a ground water well at a depth of 244 m for an orphanage (Hogar del Nino) in San Sebastian del Lemoa (Lemoa), a small village of approximately 2,000 to 3,000 inhabitants[1] in the Western Highlands of Guatemala. A pump with an 87 L/min production rate was also installed. The rationale for this project was to provide a safe and reliable source of water for the orphanage. However, it was subsequently determined that the well production was sufficient to satisfy the water requirements of the surrounding townsfolk as well as the orphanage. Because water from spring-fed systems, a nearby lake, and shallow hand-dug wells located in or near Lemoa proved to contain significant bacterial and pesticide contamination, the orphanage water system was expanded to provide the general population of Lemoa free access to the well water via a public spigot. It was expected that the residents would readily switch to the safer and more reliable well water at the orphanage.

Subsequent fieldwork, however, showed that many of the residents of Lemoa were reluctant to utilize the new water source, choosing instead to rely on their traditional sources (chiefly rainwater cisterns or concrete backyard basins, or pilas, fed by upcountry springs) for their water needs. Meter readings from the new water system indicated that the use of the water by village residents was very limited. Specifically, in May 2003 public consumption of well water averaged only 34 gallons per day (gpd). Rates of consumption in the following months stabilized at slightly lower levels (Fig. 1).

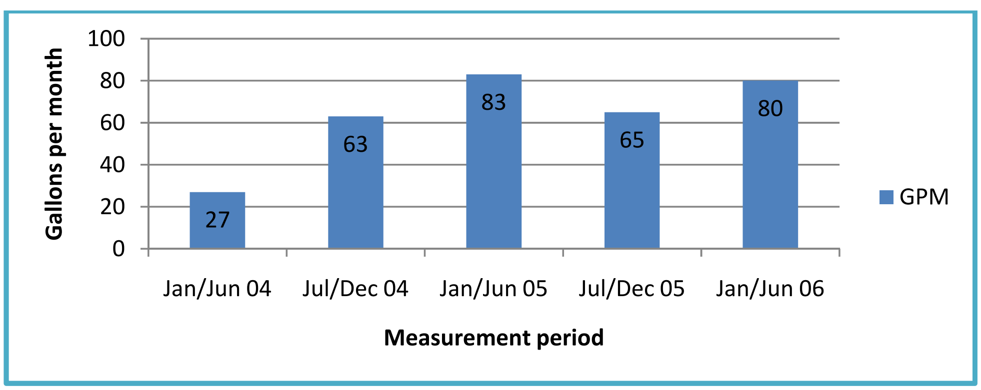

Figure 1*:* Datalogger readings from spigot at Lemoa well from Jan 2004 to Jun 2006.

Aims

The present authors conjectured that the relatively low volume of usage of the Lemoa well could be attributed to lack of knowledge of the well, specific attitudes toward well water safety, general perceptions of the links between water drinking decisions and health problems, or combinations of these attitudes. A short survey based on Health Belief Model concepts was designed and administered in Spring 2004. Our principal hypothesis for this exploratory study was that, due to lack of information about the superior quality of the water from the deep well, Lemoa's residents would not associate the well water with better health outcomes than those attained through their usual drinking water. To determine whether the newly installed well had had any impact on the local perceptions of drinking water, and of perceptions of well water in general, the same survey was administered to residents of Camanchaj, a town several kilometres removed from Lemoa with similar population (between 2,000 and 3,000[1]) and demographic characteristics, but with no high-quality well water. It was hypothesized that general beliefs regarding well water (agua que sale del suelo) would not significantly differ between the two populations, as use of the Lemoa well had fallen below expectations.

Survey results from the initial visits in 2004 indicated that, although Lemoa's residents were in fact aware of the public groundwater spigot and understood that it was freely available to the community, they did not appear to discriminate between the quality of water from this source and their traditional sources. However, Camanchaj residents, who probably associated the term "well-water" with shallow, hand-dug wells which are subject to contamination, exhibited a much lower level of confidence in well water than did Lemoa's residents.

These preliminary findings led us to believe that the reason for the low volume of use at the Lemoa well was lack of education. Accordingly, a second team of investigators assembled a set of educational materials showing potential implications of unsafe drinking practices. These were administered to residents of both villages, along with survey materials, in Spring of 2005.

Method

Participants

Four independent samples were surveyed in two communities. In the third week of April, 2004, twenty-one residents (16 women, 5 men) age 16 to 82 (M = 39, SD = 15.68; Md = 39) of Lemoa, a small village of approximately 2,500 inhabitants in south-central Guatemala, were selected based upon the proximity (i.e., within one mile) of their residences to the orphanage well.

Precise population data for Guatemala municipalities are surprisingly hard to obtain. Hawkins and Adams (2005) characterize Lemoa and Guatemala as *aldeas*, rural hamlets generally ranging in size from 2,000 to 3,000 inhabitants. These communities in the Central Highlands are characterized by small-scale corn and bean cultivation, and are linked via bus networks to larger cities (e.g., Chichicastenango), which provide markets and jobs to the inhabitants of the *aldeas.*

The first author, a research assistant, and an interpreter walked around the community and administered the questionnaire to people at their residences and at local businesses. On a second occasion later the same day, attendees at a community market were randomly selected for participation in the survey. As compensation, participants were given five quetzals each (Q5; approximately $0.63). Later the same week in 2004, 30 residents (19 women, 11 men) age 21 to 60 (M = 36, SD = 12.76; Md = 30) of Camanchaj, a village similar in size and to the southwest of Lemoa, were surveyed. Participants were recruited at the Salud y Paz medical clinic, a charity health outlet supported by the US Methodist Church, where they were waiting for free, routine dental examinations. They were also paid five quetzals for participating.

Both communities were revisited about a year later (April, 2005), and similar recruitment strategies and incentives were employed. Thirty-five residents (31 women, 4 men) age 12 to 70 (M = 30, SD = 14.11; Md = 30) of Lemoa, and 32 residents (20 women, 2 men) age 17 to 85 (M = 37, SD = 16.09; Md = 34) of Camanchaj participated in exchange for five quetzals each. These samples were independent of those surveyed in 2004. Age ranges were similar between studies, but the 2005 samples had a slightly higher proportion of females than did the 2004 samples (81% vs. 73%).

Measure

A 32-item questionnaire concerning water consumption attitudes and behaviours was developed to assess participants' perceptions and habits. The questionnaire was originally created in English; a language instructor translated it into Spanish, then a second Spanish-speaking individual translated it back into English. The two English-language versions agreed nearly perfectly, providing evidence of the adequacy of the translation. Because for some survey participants the items had to be rendered by local interpreters into a third language (Quiche), wording was kept as simple as possible. The original questionnaire was pilot-tested among 8 residents at the first data collection site. It was then determined that some of the items were redundant (e.g., where one's friends collect water; whether all family members drink the same water) or not relevant (e.g., whether one drinks different water when travelling; whether water consumption is regulated) to their drinking water habits. The revised questionnaire, therefore, consisted of fourteen items, including demographic questions.

The survey tapped respondents' water drinking attitudes across multiple areas, including:

(a) Primary sources of drinking water currently used during the past six months
(b) Source of parents' water
(c) Whether anyone in their family had been sick from drinking water
(d) Whether they believed their current source of drinking water was safe
(e) What their opinion was of well water.

Educational materials

Based on findings from the 2004 research, which showed that many respondents were unaware of the risks associated with contaminated drinking water, materials were developed to educate participants on the potential benefits to be gained by following safe water practices. The theoretical framework for the design of the materials was the Health Belief Model (HBM; Ronis 1992), as discussed in the Introduction. The challenges of creating persuasive materials in the present context were daunting: First, because many of the respondents spoke only the local Mayan dialect (Quiche), complex verbal interactions were impracticable. Second, only a very small minority were able to read or write. Consequently, the messages had to be delivered using pictorial materials.

Materials have been developed in the past for health education of indigenous peoples (Rangel et al 2003). WaterAid, a non-governmental organization based in the UK, has developed several pictorial representations of proper techniques for harvesting rainwater, treating water, and other practices related to safe water management. A three-pile sorting game prepared by WaterAid showing water habits sorted into good, bad, and neutral categories was obtained and modified for the present study. For example, one card depicted an individual taking water from a lake in the left panel, and suffering nausea in the right panel. Another showed water being boiled on the left, and a healthy child on the right. Twelve cards were selected from a larger pool after being piloted for clarity and comprehensiveness by a group of students in an International Engineering and Design class.

Procedure

The methodology was approved by the Institutional Research Board at the University of Missouri-Rolla. During both visits, questionnaires were administered at the two sites on separate days. In Lemoa, site of the well, the investigators and interpreters fluent in Spanish and the local Quiche dialect visited residents at their homes and administered the questionnaire on a one-on-one basis. Most interview sessions lasted approximately 20 minutes. During the same week, the questionnaire was administered to residents of Camanchaj. Questionnaires were administered in a waiting room at the dental clinic. For the 2005 visit, the educational materials described above were administered immediately prior to the survey at both sites. Clearly this was a methodological shortcoming, as the ideal method would have been to administer the surveys at least a week after the educational intervention. Unfortunately, practical and financial limitations prohibited this approach, as students had to administer the materials during their Spring Break.

Results

Percentages of affirmative and negative responses on five key survey items are presented in Table 1. We report Pearson's chi-square (χ^2) statistics and p-values for these items. Effect sizes are estimated using C^2, a measure of association derived from phi coefficients (Gibbons 1997).

Table 1: Percentages of affirmative and negative responses at both sites and occasions.

Survey Site	Occasion	*N*	Sick [a]		Safe [b]		Well water [c]	
			Yes	No	Yes	No	Yes	No
Lemoa	Spring 2004	21	10	90	81	19	76	24
Camanchaj	Spring 2004	30	33	67	83	17	43	57
Lemoa	Spring 2005	35	11	89	26	74	71	29
Camanchaj	Spring 2005	32	22	78	6	94	3	97

[a] Have you or a family member ever been sick from drinking unclean water?
[b] Do you believe the water you are drinking is safe?
[c] Do you believe that well water is safe to drink?

Sources of drinking water

Respondents were asked to describe their current source of drinking water, where their parents had obtained their water, and whether they used different sources for different purposes. The privately owned outdoor basin (pila) drawing water from spring-fed systems was the most widely used source in Lemoa in both the 2004 and 2005 surveys (33% and 26%, respectively). Camanchaj residents were heavier users of spring-fed pilas in both surveys (57% in 2004; 84% in 2005), and most used multiple sources of water. Other sources cited included precipitation-fed collection cisterns, shallow hand-dug wells, and a nearby lake. All of these sources in Lemoa have been shown to contain significant bacterial contamination (Elmore et al. 2005). In the 2004 survey only five Lemoa residents cited the deep well as a water source (24%), whereas 11 (31%) respondents named the well in the 2005 survey. However, most respondents on both occasions said they used the well in combination with other sources.

Six of the 18 (33%) Lemoa residents reported that they used the same source of water as their parents in the 2004 survey, compared with 21 out of 35 (60%) in the 2005 survey. Fewer Camanchaj residents reported such changes in habit, with 84% (2004) and 88% (2005) saying they drew water from the same sources as had their parents.

Water-related illness

Participants were asked whether they or a family member had experienced illness due to contaminated water. On both occasions few Lemoa respondents reported a history of water-related illness in their families (9% in 2004, 11% in 2005). More Camanchaj respondents gave an affirmative response to this item (30% in 2004, 22% in 2005). The effect for location (Lemoa vs. Camanchaj) was significant ($\chi^2 = 5.23$, $p = .02$; $C^2 = .04$), such that Camanchaj residents reported more water-related illness. However, there was no effect for occasion (2004 vs. 2005: $\chi^2 = .93$, *n.s.*).

Perceptions of water safety

Participants were asked, “Do you believe your current drinking water is safe?” During the 2004 survey a large percentage of respondents in both Lemoa and Camanchaj said they believed it was (81% and 83%, respectively). In contrast, 2005 survey respondents (who were surveyed after the administration of the educational materials) reported much lower levels of confidence in their water. Specifically, 26% of the Lemoa residents said they believed their water was safe, and only 6% of the Camanchaj residents said so. Chi-square tests showed the groups were equivalent by location ($\chi^2 = .10$, *n.s.*). However, the perceptions of safety were significantly lower in the 2005 survey ($\chi^2 = 50.88$, $p < .01$; $C^2 = .44$).

Perceptions of well water

As shown in Table 1, 16 of 21 Lemoa respondents in 2004 (74%) gave a “safe” rating to well water. In the 2005 survey, the safe ratings dropped slightly, as 25 out of 35 (71%) said they believed well water was safe. The Camanchaj ratings of well water safety dropped much more radically, as 13 out of 30 (43%) of the 2004 respondents said they believed well water was safe, whereas only three out of 32 (3%) believed it in 2005 ($\chi^2 = 14.31$, $p < .01$).

There were significant differences between the Lemoa and Camanchaj residents regarding perceptions of well water, such that Lemoa’s respondents believed it was safer ($\chi^2 = 30.31$, $p < .01$; $C^2 = .26$). Interestingly, there was only a minimal difference between the 2004 and 2005 respondents ($\chi^2 = 3.79$, $p = .05$; $C^2 = .03$). This suggests that although the educational cards may have raised awareness of water-related risk, there was still doubt concerning the safety of well water.

Water use data

The most desirable outcome of the interventions described above would be that Lemoa’s residents would use the well water in place of their customary sources. Datalogger readings from the public well spigot at Lemoa from April, 2003 to January, 2006 are presented in Figure 1. Visual inspection of the data shows several months of consistently low usage between well installation to Spring of 2004, when consumption rose from an average of 27 gallons per day (March 2004) to 83 gallons per day (April 2004). Public consumption levels remained at higher levels during subsequent months. After an initial burst of activity at the well following the 2004 visit, use dropped off. A similar spike occurred following the Spring 2005 intervention, and residents have continued to draw heavily from the well since then. Across the entire period there was a strong, positive quadratic trend for water usage ($F[3] = 6.02$, $p < .01$; $R^2 = .80$).

Discussion

The first purpose of the present studies was to determine why residents of San Sebastian de Lemoa, a community in rural Guatemala, were not availing themselves of newly available clean drinking water from a deep well. A survey was developed using a theoretical model of health-seeking attitude and behaviour relationships and administered to inhabitants of the community. Results suggested that (a) many inhabitants believed their current drinking water was safe; (b) residents did not discriminate between the water from the deep well and their traditional sources of water. However, they showed more general acceptance of groundwater wells as a delivery system than did residents of a similar community with no deep well access. In a second visit to the sites, a short educational tutorial showing the benefits of drinking water drawn from deep wells was introduced to residents of these villages. Participants on this occasion showed more acceptance of well water following the educational sessions. In the one and a half years following the initial visit to Lemoa, the use of the community well increased more than threefold. This may or may not have been attributable to the intervention; in any event, it was gratifying to see Lemoa's residents making more use of the deep well than previously.

The present studies were a preliminary attempt to test the Health Belief Model (HBM), a model of attitudinal-behavioural health-seeking relationships widely validated in the developed world, in a setting in the developing world. As discussed above, HBM predicts that behavioural change will only occur when individuals perceive risk in their status quo behaviour. Without this perception, it is clear that any behaviour change of even minimal cost is unlikely to be seriously considered. Therefore we consider it a matter of concern that large majorities of respondents in both communities surveyed reported that they believed their current drinking water was safe (see Table 1), although testing has shown it to be contaminated (Elmore et al 2005). Additionally, few people surveyed stated that their families had suffered illness due to poor drinking water. It is possible that the respondents reported accurate information, and that the populations of these communities have indeed had less illness related to contaminated drinking water. Alternatively, the findings could reflect chance variation attributable to sampling error. However, we believe it is more likely that most inhabitants of these communities underestimate the potential costs related to unsafe drinking water decisions and that a purely technological approach to the problem is likely to be limited in utility without an accompanying educational intervention.

Although various water intervention systems have been tried for rural Guatemalan towns in the past, drilling deep water wells seems more logical and sustainable when compared with other methods. For example, having people mix chemicals with their water (Rangel et al 2003) is a good short-term solution. However, these chemicals can become bothersome, sources can run dry, or people may tire of using them. Residents of communities with unreliable sources of drinking water are often urged to boil their water for at least 20 min to remove contaminants. However, when wood is their only source of heat, people are less inclined boil their water for the recommended duration. In fact, 18% of the respondents of Study 1 reported that they sometimes did not boil their drinking water at all.

Clearly the mere presence of a technologically sophisticated well was not sufficient to convince Lemoa's residents to change their water consumption habits. Therefore, the next step in this ongoing project was to develop and administer educational materials showing the benefits of deep well water. Unless people link sickness with contaminated water and are informed of the safety of different sources, it is not reasonable to assume that they will be motivated to change their behaviours and use the new water source. Because educational intervention strategies have been implemented in communities in Sub-Saharan Africa where social marketing and motivational interviewing were combined to induce people to employ safe water treatment and storage methods (Thevos et al 2003), it was thought that such methods might be effective here.

Limitations of the present study should be mentioned. Only descriptive data have been reported. Without random assignment to groups or experimental manipulation, we cannot conclude that the presence of the well has definitively impacted the attitudes of Lemoa's residents. Alternative explanations might include differential receptiveness to U.S. interviewers on the part of residents of the two villages, interview location (home versus dental clinic), or simple sampling error. Further research is needed to quantify the effect of technical interventions on attitudes of populations in the developing world.

Clearly there is a need for the collection of additional social and engineering data regarding water supply design in the Guatemala highlands. Work has been initiated to address these needs. In January 2006, a university-supported initiative to install a deep groundwater well at the Salud y Paz Clinic in Camanchaj was completed. Beginning in March 2006, a one year study will be initiated to evaluate both the sustainability of the well to supply the clinic needs as well as the security of the system with respect to maintaining adequate water quality through contamination prevention. If the results of that study are positive, the water from the well will be used to supply water to three families living near the clinic.

An educational intervention will be conducted during the pilot study. The intervention will consist of a group of local school children trained by engineering and psychology students to collect meter readings and water quality data. A website will be used to transmit the data from Guatemala to the U.S. Furthermore, a group of U.S. elementary and/or secondary school students will conduct a series of parallel water quality experiments and will exchange results with the Guatemala students in an effort to build peer-empathy. The overall intent of the education intervention will be to develop a cross-cutting interest in water quality between the Guatemalan students, their teachers, their parents, and their peers participating in the program in the U.S.

Typically, health interventions in communities in the developing have involved either an engineering or a social approach. In recent years there have been calls for more interdisciplinary research in efforts of this kind. In the present study the engineering and social science approaches have been combined, leading to a better understanding of the problems and what can potentially be done to solve them. We believe that combining technological and people-oriented strategies can be difficult, but will ultimately lead to more widely-accepted and effective solutions to health problems in rural communities in the developing world. Additionally, social scientists stand to learn more about the extent to which theories of attitude-behaviour relationships and social influence generalize to other populations. This understanding is critical to the success of any health-based intervention (Elder 2001). Our approach in the present investigation has been to begin with a technological intervention (i.e., installation of the well), followed by a diagnostic intervention (i.e., surveys and educational tools). In future research we will begin with assessment of social attitudes and risk perceptions, and introduce technological interventions only after gaining better understanding of these factors.

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