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Measuring the Impact of Health Education Modules in Cameroon, West Africa

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Abstract

Each year, more than two million people die from diarrhea-associated diseases. Although there is a global need for safe drinking water, culturally appropriate health teaching is essential to behavior change. This study evaluated the impact of a health education program in a small rural community in Cameroon. Flash cards and a modified version of the CDC-KPC 2000 survey were used to collect data in 57 homes. Children who lived in households with working Manz BioSand filters were less likely to have had diarrhea in the 2 weeks prior to the evaluation. There remained a gap between health knowledge and healthy behaviors for hand hygiene and malaria prevention. This gap was significant in the diarrheal treatment (McNemar's test, $p < .000$). The interdisciplinary program and 7-year time frame were crucial to sustainability. Faculty and students learned the importance of pairing service learning and research that respect local cultures in fostering a healthier global community.

Keywords

community health, transcultural health, focus group analysis, Lamso tribe in Cameroon

Introduction

Approximately one billion people worldwide have no access to clean water. In developing countries, contaminated food and water sources are main contributors to diarrhea. Every year 1.5 million children worldwide die from diarrheal-related causes (World Health Organization, n.d.-a, n.d.-b). One community, Nkuv, a rural village in Cameroon, West Africa, illustrates such problems. The main water source for Nkuv is a river, but the village is downstream from a nomadic tribe of cattle farmers. As a result, the water is infested with *Escherichia coli* and other parasites.

The village of Nkuv is located in a mountainous area northeast of Douala, Cameroon, near the border of Nigeria. Nkuv has a population of approximately 500 to 700 people, which varies due to seasonal farming migrations. Kumbo, the nearest town with a hospital, is located about 4 miles overland on footpaths from Nkuv, a journey that takes 4 to 5 hours. Nkuv lacks the most basic infrastructure: drinking water is obtained from surface water and toilets are simple hand-dug pits, called latrines (Brown, Barton, & Rees, 2009). Most often, tree branches are laid over the pit to stand on while using the latrine. It is common for multiple homes to share the same latrine.

The Cameroonian president of the Life and Water Development Group, a registered Common Development Group in Cameroon initiated a clean water project with Engineers without Borders (EWB)-USA (Brown et al.,

2009). After obtaining approval from Hope College's Human Subjects Review Board, the Hope College student chapter of EWB began work on this project in October 2005 and returned to Nkuv each summer through May 2012. An interdisciplinary approach to project development was implemented: engineering students developed ways to increase the community's access to clean water; nursing and education students focused on health and hygiene teaching. Faculty from each of these disciplines provided technical support and mentoring to the students. This health education component of the project is the focus of this study.

Problem and Purpose

Children in Nkuv are dying from preventable diarrhea. Caregivers have incomplete knowledge and information about managing diarrhea and other childhood health concerns. The interdisciplinary team created health and hygiene teaching modules to address these problems. The Nkuv culture was carefully considered as these teaching modules

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were developed. The purpose of this study was to evaluate the effectiveness of these modules.

Research Questions

Research Question 1: How effective were health education modules in changing behavior?

Research Question 2: Can maternal caregivers of children below the age of 5 years correctly identify behaviors that promote health (balanced nutrition, safe water handling, diarrhea prevention, dehydration treatment, and malaria prevention)?

Research Question 3: What factors have contributed to the sustainability of this health education project?

Theoretical Models

The creation and implementation of the health education modules were based on several theoretical models: Leininger's Cultural Care Theory, Hunter's Instructional Theory Into Practice Model (ITIP), Knowles's Theory of Andragogy, and Giles's Communication Accommodation Theory. It is difficult to translate Caucasian American standards of health and hygiene into cultural practices of other communities. Leininger has challenged nurses since the 1950s to consider the impact culture has on shaping health practices and outcomes. She is well known for creating the Sunrise Model "in order to help nurses visualize components of her theory," which also provides a framework for nurses to "systematically examine the conceptual components in the model" (Reynolds & Leininger, 1993, pp. 3, 26). Leininger emphasized that nurses should analyze cultural traditions and practices to determine which to preserve, which to modify, and which are harmful and need to be repatterned to provide culturally congruent care (Leininger & McFarland, 2002).

In designing health modules, the team followed Hunter's ITIP model. This teacher-directed model follows a series of sequenced steps. The lesson begins with an activity that engages the learners' interest and thinking, after which the lesson objective is stated and taught using modeling skills. Understanding is checked and students are provided opportunities for practice until the lesson objective is learned and demonstrated (Dell'Olio & Donk, 2007; Hunter, 1994).

According to Knowles's Theory of Andragogy, adults are self-directed, expect to take responsibility for their decisions, and fear failure. It is important to emphasize why new ideas are critical to a healthy lifestyle and to present content in a problem-solving manner within a group setting. It is also essential that adults see the immediate value of a new behavior before they adopt it. Instructors assume the role of facilitator and use strategies such as case studies, role-playing, simulations, and self-evaluation (Knowles, 1970, 1973).

Giles's Communication Accommodation Theory suggests that a competent communicator needs to adapt to the linguistic style of the receiver in order to facilitate

communication. Linguistic and cultural differences should be minimized when conversing with people of a different culture. This emphasis on the sociohistorical context as well as the intercultural dynamics of interpersonal communication was particularly appropriate in the creation of the health education modules as the team sought to obtain speech convergence and use traditional teaching methods such as storytelling and songs (Giles, Coupland, & Coupland, 1991).

Literature Review

A literature review identified factors to consider when developing and evaluating health education across cultures. These factors include the following: pertinent content selection, environmental restraints, local beliefs and perceptions, teaching methods, implementation strategies, and evaluation of the implementation strategies.

Content selection is important, as several components of health need to be addressed simultaneously in order to affect morbidity and mortality rates. Smith, Garbharran, Edwards, and O'Hara-Murdock (2004), in their study of sanitation practices among Zulu and Xhosa women, addressed "multiple public health issues of which sanitation was an integral part" (p. 63). Environmental constraints need to be minimized and behavioral motivations understood in order to change previously ingrained hygiene habits. These constraints include the availability of water and soap (Lohiniva, Saeed, El-Sayeed, & Talaat, 2008), existing hand washing habits, behavioral motivation influenced by cultural perceptions of cleanliness (Scott, Curtis, Rabie, & Garbrah-Aidoo, 2007), and socioeconomic variables (Schmidt et al., 2009).

Local beliefs and perceptions must be explored to optimize care, as these factors often shape how an illness is defined. For example, Kauchali, Rollins, and Van den Broeck (2004) found that 11 types of diarrhea were recognized in the KwaZulu/Natal region of South Africa. Caregivers described each type of diarrhea with symptoms, perceived causes, perceived severity, and actions taken. The authors then classified them into three categories: (a) natural causation (diarrhea from teething), (b) supernatural causation (diarrhea with sunken fontanels), and (c) caused by "germs" or change in diet (cholera). A health education program must reflect cultural practices and resources. Lessons should be structured for individuals who are illiterate or semilliterate (Smith et al., 2004). Many health education and promotion programs in the developing world use conventional teaching methods that do not address social constraints of women or cultural issues related to teaching. As such, they "are based on the premise that individuals have control over their environment and health-seeking behaviors" (Smith et al., 2004, p. 63). Scott et al. (2007) noted that

[m]uch health promotion . . . has been based on the premise that educating people about the threat of disease will lead to reductions in risk behaviors. Despite 70 years of interventions,

didactic health education appears to have been unable to achieve sustained hygiene behaviour change. (p. 226)

Dieleman (1999) stated that “[h]ygiene education is more likely to be effective when participatory methods are employed” (p. 436). Smith et al. (2004) used skits, roleplays, and dance to communicate health messages. These teaching strategies are more appropriate, too, in high-context cultures where people have shared understanding “of meanings and inferences” (Murray, Wenger, Downes, & Terrazas, 2011, p. 31).

Implementation strategies suggested in the above-mentioned reviewed articles included pyramid teaching, which involved one community leader teaching health educators who then had a series of workshops (Smith et al., 2004), health clubs (Waterkeyn & Cairncross, 2005), and peer educators (Smith et al., 2004; Dieleman, 1999). As behavior change involves altering norms, a strong community structure needs to be created to reduce the risk of failure (Waterkeyn & Cairncross, 2005). The impact of cultural beliefs and traditions must be considered in selecting dissemination strategies (Smith et al., 2004).

Researchers have employed many approaches to evaluate behavior change, but results have varied. In the studies reviewed, most researchers used structured observations (Dieleman, 1999; Scott et al., 2007; Waterkeyn & Cairncross, 2005), surveys through questionnaires (Waterkeyn & Cairncross, 2005), interviews and focus group discussions (Kauchali et al., 2004; Lohiniva et al., 2008; Scott et al., 2007), and flashcards (Kauchali et al., 2004). Feuerstein (1992) recommended the use of flashcards to evaluate a person’s ability to make connections between different events. These are a sequence of line drawings that can be produced locally and changed if there are any misunderstandings. Crishna (2006) advocated that program evaluation be participatory and include community members. The external evaluator in this process “becomes a facilitator, a teacher and a learner, and creates an environment for shared interactive learning” (p. 221). Naylor, Warf-Higgins, Blair, Green, and O’Connor (2002) defined sustainability as “the extent to which program components and activities are adopted or absorbed into the regular activity of community agencies” (p. 1176).

Methodology

This project developed a partnership between EWB-Hope College, the Life and Water Development Group-Cameroon, and the local community to create a sustainable source of clean water and improve the overall health of the people in Nkuv. Students and faculty from the departments of engineering, nursing, and education formed an interdisciplinary team that emphasized both technical skills for obtaining clean water as well as cultural awareness and community development strategies to change health behaviors. The

engineering students created a clean water distribution system by teaching the villagers to build BioSand filters, slow sand bi-filtration systems designed by D. Manz (<http://www.cawst.org/en/resources/biosand-filter>), which provide potable water by mechanically filtering out bacteria and parasites. In addition, they designed and supervised the building of a piping system to bring water into Nkuv from the mountains. Nursing and education students gathered data on community health indicators and developed health education modules, which were taught to village women and children. A community development strategy created specifically for this project grew out of the faculty’s interdisciplinary collaboration and field experiences in underdeveloped communities. This strategy followed a see-one, do-one, teach-one approach with an emphasis on reflective practice. It is similar to strategies used in teaching practical clinical skills (Rodriguez-Paz et al., 2009) and to the training of trainers approach as peer education was emphasized. However, it expanded both approaches as it intentionally included reflective practice. Each year, the health education team led focus groups with the women in Nkuv to further modify lessons and choose the essential messages to communicate to other community members. Reflective practice and a commitment to building long-term relationships were essential to fostering change and empowerment.

Students who traveled to Nkuv more than once served as mentors during the academic year to the student team preparing for the next trip. On subsequent trips, faculty and students reviewed project components, restructured approaches as needed, and sought a renewed commitment from all partners to implement changes crucial to project sustainability.

Data collection has been integral throughout the project. Baseline data were collected in May 2006 from all families with children less than 5 years of age using a modified Knowledge, Practice and Coverage survey (KPC 2000). Data were recollected during the same season each year (2007, 2008, 2009) so that the availability of water, types of foods, or the in/out migration variations of the sample did not confound analysis results. By 2008, the introduction of BioSand filters had significantly decreased the number of diarrheal cases among children less than the age of 5 years. In the households ($n = 37$) where filters were used, only 7 of 37 children (18.9%) had had diarrhea in the prior 2 weeks as compared with 12 of 37 (32.4%) who did not use filters (Brown et al., 2009). Analyzing this data led the team to develop teaching modules that addressed the most serious issues in Nkuv: safe drinking water, nutrition, and malaria. Following the ITIP model, individual lesson plans were developed. Cultural information and adaptations to local resources were incorporated into the material. Lessons were participatory and included skits, stories, and songs. Culturally appropriate pictures and handouts were created to enhance lesson content. For example, students created line drawings from photographs of the villagers, which strengthened the learning process as participants could closely identify with

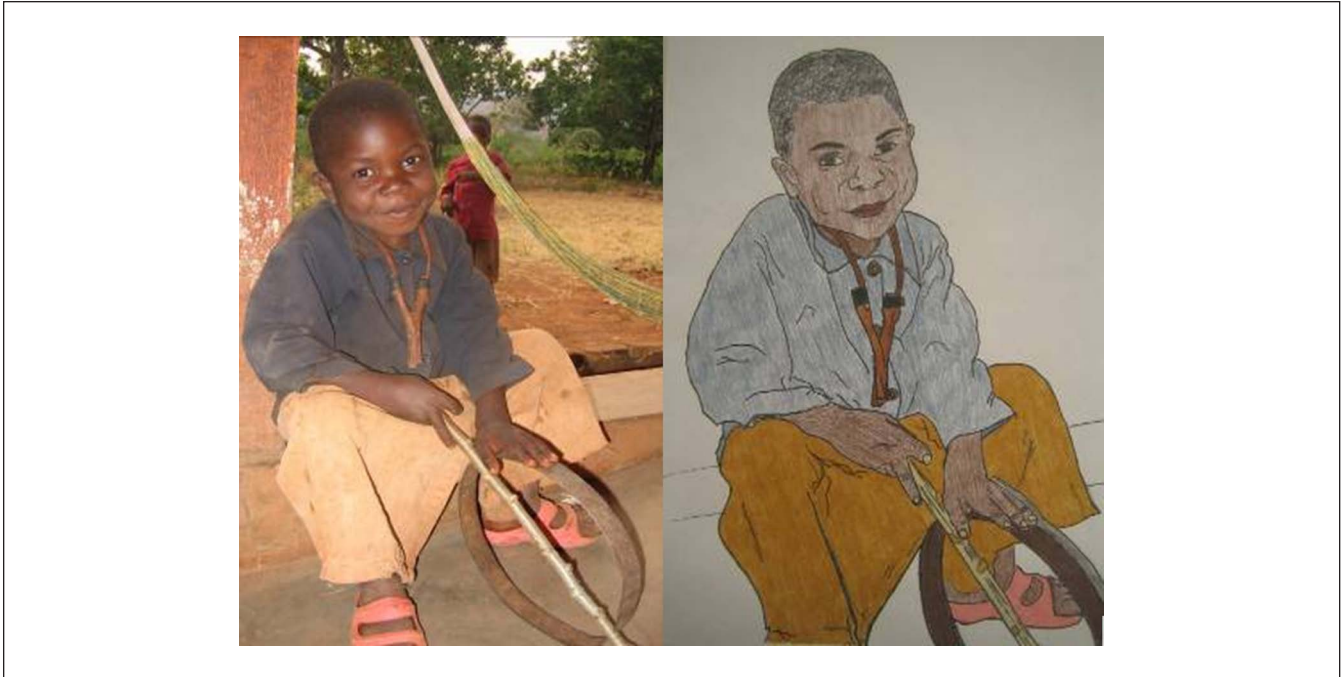


Figure 1. Example of producing a line drawing from a photograph.

lesson content (Figure 1). To encourage reflective practice, each lesson included an evaluation of the targeted learning objective.

Field testing was conducted in two stages. Initially, lesson design was evaluated in the Children's After School Achievement (CASA) program at Hope College, involving children from low-income families needing additional mentoring. Education and nursing students cotaught the lessons to different age groups. Using results obtained from the evaluation of the lesson objectives, students analyzed the effectiveness of each lesson and redesigned weak components. Additional culture-specific ideas were changed when the lessons were taught in Cameroon. For example, in the hand-washing lesson, the image of a portable toilet was used with the CASA children; the image of a latrine was used in Nkuv.

In the second phase of lesson development (May 2008), nursing and education students, and local translators, taught five health modules to 13 key women from the community, some of who were preschool and elementary teachers. Prior to teaching each lesson, the team discussed cultural aspects with local translators to ascertain what needed to be adjusted in the plans. For instance, as villagers had limited access to store-bought toothbrushes, one dental lesson instructed people to find a twig with which to brush their teeth. Women in the community told the students that the guava tree was the best source for this type of traditional toothbrush. This suggestion was incorporated into the teaching and maintained local cultural practice while validating the women's input. Following each lesson, the group debriefed to evaluate it and make further adjustments. Students learned the cultural

importance of awarding diplomas and T-shirts to those who participated in the class as tangible indicators of their new role as health educators in the village.

The village women developed an internal community structure to disperse their newly acquired health knowledge and began teaching in surrounding villages. Ownership of the educational structure and increased trust were evident when women requested additional lessons be developed about family planning and sexually transmitted diseases, intimate and sensitive topics in most cultures. These health modules were developed and implemented in May 2011.

Transferring responsibility for this health education was a slow process, in part because finding evidence of real change was difficult. In May 2009, during a planning workshop, Nkuv participants reported they had been teaching every other weekend to local women's groups. However, when the Hope students began in-home surveys to collect data of health indicators and evaluate implementation of health education, the interviewers discovered that no one was reporting any formal health teaching. The team discussed this unexpected finding with a translator. She recommended that students continue with the surveys and use the focus group discussions to help the women problem-solve the challenges they had faced in trying to teach groups of other women in the community. By taking this culturally sensitive approach, women were able to identify how they could implement small changes in health behavior, even if they could not follow all the ideas in a lesson. Students and faculty simply worked as facilitators during the discussions, which further encouraged the women to take ownership of health education

dissemination (L. Lodge and J. Rubin, trip reports, May 2009). The following barriers to dissemination were identified: lack of time to teach, no leadership in organizing lessons, illiteracy, and poor attendance. To address these problems, the Nkuv women elected a leadership group, which decided to meet once a month to plan teaching sessions in the community. In May 2010, a focus group approach was again used to review lessons. Each evening, women were invited to teach the lessons they had learned in May 2009. The translators who had worked with the team during prior trips had also become official health educators and were being hired by other nongovernmental organizations (NGOs) to teach health education using the developed health modules. The EWB-HC team worked with them to strengthen their teaching approach. This phase enhanced community collaboration and the women's support of each other (L. Lodge, trip report, May 2009). It also created the strong community structure advocated by Waterkeyn and Cairncross (2005) and demonstrated both community ownership and the effectiveness of women as agents of change.

The evaluation of this project involved two instruments: flash cards and a modified Knowledge, Practice and Coverage survey (KPC 2000). The flash cards were created by the team to facilitate conversation with illiterate Nkuv residents about important aspects of healthy living. They were simple line drawings of familiar objects and scenes: a fly, a pair of hands, and persons holding their bellies and squatting. The interviewer would show a card and ask what the woman knew about that image. One open-ended question was asked per flashcard, and women could give multiple answers. The question for the flash card with the "skinny" child was "What advice would you give the mother of this child?" To ensure reliability, each interviewer worked with the same translator. The answers were grouped into categories and coded accordingly. The KPC survey is a standard tool from the CDC that is used to evaluate health programs.

Data were collected from all families living in Nkuv with children below the age of 5 years. The number of families had increased over time, thus increasing sample sizes: 38 (2006), 46 (2007), 53 (2008), and 57 (2009) households. The number of children also increased from 55 (2006), 63 (2007), 75 (2008), to 92 (2009). Data were analyzed for descriptive statistics and cross-tabulations using the Statistical Package for the Social Sciences (SPSS), Version 16.0. These two instruments yielded interesting although sometimes contrasting results.

Results

The data from the KPC survey were quantifiable and in predetermined categories. The majority of families each year stated that they treated their drinking water to make it safe: 76.3% (2006), 80.4% (2007), 70% (2008), and 72% (2009). In 2006, the majority of the respondents boiled water. By

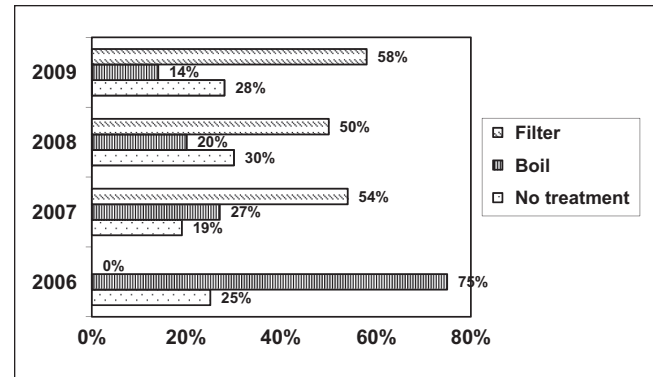


Figure 2. Percentage of households treating water, 2006 to 2009.

2009, filtering was the most frequently used water treatment (Figure 2).

At baseline, the incidence of diarrhea among children was 9/55 (16%) and 11/92 (11%) in 2009. In 2006, no mortality data were collected. During 2008, three children below the age of 5 years had died, but not due to diarrhea or malaria. In 2009, one 2-year-old child died from diarrhea, and 10 additional cases of diarrhea were reported among the 92 children: four of these children lived in three households with no filter. The team discovered in 2009 that the newer filters had not been built according to specifications and the flow rate was too fast, allowing more bacteria to bypass the filters. However, the incidence was lower in families who boiled or filtered their water (Table 1).

In 2006, almost all the families (94.7%) had soap in their households. In 2008, 88.7% of the households had soap. The rate for women washing their hands before eating improved (2.6% to 56.1%). There were no trends for other responses about when the women washed their hands: before feeding children, after defecation (self or child), or before food preparation (Figure 3).

The data from the flash cards provided additional information, depending on how extensive the women's answers were to the drawings. Their responses were then grouped into themes before being quantified.

Fecal-Oral Transmission

The majority of the women (98.2%) indicated that flies make people sick through uncovered food. Other responses given were that flies carried germs (32%), came from latrines (14%), and made uncovered water dirty (8%). To protect food from flies, they recommended covering food to stop flies (93%). Respondents clearly knew the link between flies, uncovered food, and illness, and they selected the appropriate strategy proposed in the health education lessons.

When asked about hand washing, a majority responded that they needed to wash hands after defecation (70.2%), before eating (56.9%), and after working (56.1%) All the

Table 1. Comparison of Diarrhea Rates Among Children Under 5 Years by Water Treatment (2006, 2008, and 2009).

	May 2006 (N = 55 children)	May 2008 (N = 74 children)	May 2009 (N = 92 children)
Cases of diarrhea	9 (16%)	17 (23%)	10 (11%)
No treatment of water	44% (n = 9)	17% (n = 17)	30%
Boil water	55% (n = 9)	6% (n = 17)	0%
Filter water	0%	9%	9%

women indicated that to keep water safe, families should cover the water bucket. Others added that families should place the drinking cup on top of the bucket (54%) or use a BioSand filter (14%). When shown the flash card of a family suffering from diarrhea, fewer women indicated that the family had not washed their hands before eating (8.9%). More women stated that this family's diarrhea came from unfiltered water (31.6%), flies/germs (35.1%), unsafe food (26.1%), uncovered food (42.1%), or stools not disposed in a latrine (31.6%).

Diarrhea

At baseline in 2006, 16% of the children ($N = 55$) had had diarrhea in the prior 2 weeks. Only 4% had been treated with homemade oral rehydration solution (ORS), a sugar/salt preparation. None had used prepackaged ORS. Pills or syrup were used more often (7%). In 2009, 11% of the children had diarrhea ($N = 92$). There was a drop in the use of homemade ORS (from 4% to 2%) and a slight increase in the use of prepackaged ORS (1%). None of the women responded that they had used pills or syrup. Of note, the most frequent response given by the women was not to treat their child's diarrhea. A cross-tabulation analysis indicated that 4 of the 10 children who had had diarrhea during the 2 weeks prior to the survey had been given homemade ORS. A similar proportion of women responded that they would advise another mother to give ORS. Only one mother stated that she had boiled the water prior to giving it to her child who had diarrhea. McNemar's test indicated there was a significant difference between knowledge and practice in the use of homemade ORS ($p < .000$), or the use of zinc pill or syrup ($p = .002$): women who had the knowledge were not giving the appropriate treatment.

Nutrition

A majority of women (73.7%) stated that to prevent "skinniness" (a cultural term for malnutrition), children would need to eat beans/legumes. Other foods cited were green leafy vegetables (58%), fruits (53%), starchy vegetables (51%), dairy (42%), meat (39%), peanuts (32%), fish (21%), and a balanced diet (9%). The message emphasized in the malnutrition story was that beans/legumes or peanuts should be added to a child's diet. Even as low-cost sources of protein, they were not widely included in children's diets: 22.9% of

the women gave their children beans and only 3.5% gave peanuts. Although dry beans/legumes and peanuts are produced locally and were selected for this reason to be used in the story, they are cash crops. Thus, families were reluctant to use them as a protein source. Of the foods given the previous day to their children, the majority had given *foo foo* made with manioc and corn flour (73.7%) and *jama jama* made from manioc leaves (52.6%) or pumpkin leaves (29.8%) and oil (75.4%). There were no dietary shifts between 2007 and 2009.

Malaria

In 2006, 8 of 38 households had bed nets (21.0%), of which three were insecticide treated. The majority of parents in households that had bed nets (7 of 8) responded that their children slept under them. In May 2007, 15.2% of homes ($N = 46$) had bed nets, and fewer parents (3 of 7) stated children slept under the bed net. In 2009, 57.9% households (33 of 57) had bed nets. Cross-tabulation of the data indicated that in the homes where there were bed nets, the majority of the children had slept under them (24 of 33). In response to the malaria flashcard, 52 (91.9%) women stated that children could protect themselves from mosquitoes by sleeping under a bed net and/or by wearing clothes that cover their bodies (80.7%).

Sources of Health Education Information

About half of the women acknowledged they had received teaching from health educators, either in the village (32%) or at the hospital (21%) in Kumbo, the closest city. Several women mentioned both sources (17.5%) whereas 23% were not able to identify the source of their information. Focus group discussions as well as individual interviews indicated that more peer-to-peer teaching, rather than formal sessions, had occurred between the women who had been trained to use the modules and the women in the village with no health training. There was not enough difference among respondents to analyze the results for significance.

Discussion

To effect behavior change, new behavior needs to become normative. As recommended by Leininger, local cultural practices must be considered to determine which ones to

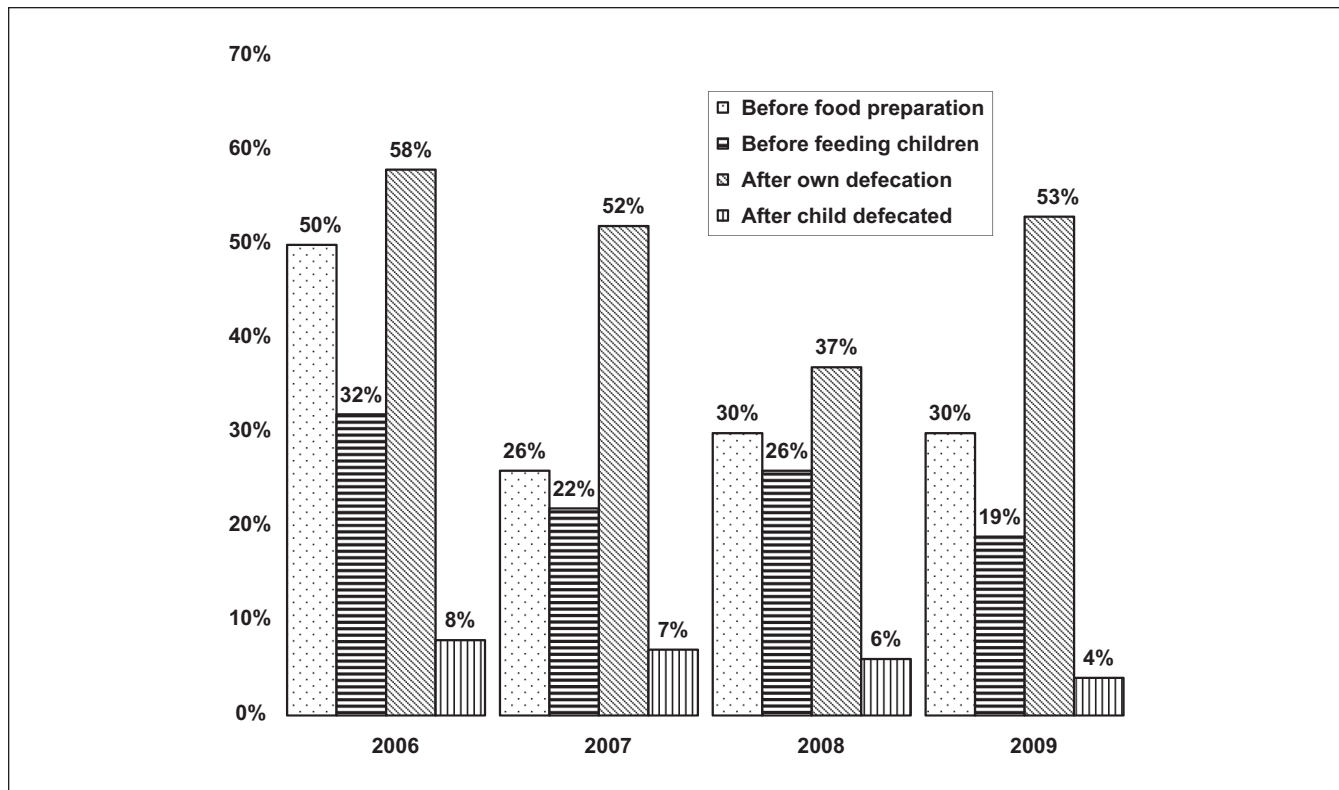


Figure 3. Comparison of hand washing, KPC 2006 to 2009.

preserve and which ones to repattern. For example, it is a local belief that mosquitoes as well as a certain kind of mango can transmit malaria. It was important for the students not to directly challenge this belief, as it would decrease their credibility. Instead, a discussion about malaria and nutrition was incorporated into the teaching, emphasizing that eating too many mangoes can cause diarrhea. The students stressed that diarrhea and malaria are two different illnesses. During a subsequent teaching session, the elected president of the newly formed leadership group, known to serve as a role model to women in the village, addressed the group. She reminded them that only mosquitoes can transmit malaria. Peer-to-peer education was becoming evident (L. Lodge, trip report, 2009).

The reflective practice during focus group sessions proved to be effective in obtaining ongoing community input from key women. For instance, in May 2010, women in the community decided to form a chicken cooperative to purchase cement for building slabs to place over their pit latrines. This participatory process was highly recommended by Smith et al. (2004), who not only stressed the importance of creating appropriate health education materials to address the lack of health knowledge but also the empowerment of women to become agents of change.

The importance of implementing theory-based strategies was frequently affirmed. It was culturally important for the women to save face when it was discovered lessons had not been taught in the community as they had reported. As the

team listened to the women debate possible solutions to their challenges, they became aware that this brainstorming activity had been omitted as part of villagers' training. Avoiding a confrontation preserved the cultural importance of saving face. Respecting local culture then led to the creation of a new leadership group to ensure the dissemination of health lessons. Although health knowledge among the women increased, nutritional practices had not changed. Very few children in Nkuv exhibited the signs of *kwashiorkor* (protein-deficiency malnutrition) described in the malnutrition lesson. As overt malnutrition is not pervasive in Nkuv; it may be necessary to further emphasize the use of peanuts or legumes as effective substitutes for bush meat (meat obtained through hunting) to prevent malnutrition from occurring.

A similar gap between knowledge and practice was evident when analyzing diarrhea treatment data. There were fewer cases of diarrhea among children below 5 years of age between the start of the project in 2006 (16.4%) and 2009 (10.8%). In May 2006, two thirds of the women ($N = 38$) reported that they treated their water to make it safe and indicated that they boiled it (96.6%). No families had access to filtered water. Later data analysis revealed a sharp drop in the boiling water response. This may suggest that families were giving the desired answer to the interviewer, suggesting evidence of social desirability response bias (Polit & Beck, 2004). Because of the long-term commitment of the EWB-HC team and repeated trips to the community, trust developed and the impact of social desirability lessened.

Women became more candid in their responses and were willing to discuss family problems. The availability of filtered water from the Manz BioSand filters affected the incidence of diarrhea. In 2008, 81.1% of the children who had access to filtered water had no diarrhea; in 2009, it was 77.2%. It is well known that the incidence of diarrhea is also linked to proper hand-washing techniques and appropriate sanitation. Research shows that sanitation and good hygiene “alone are more effective in reducing diarrhea than improvements in either water quantity (20%) or water quality (15%)” (Waterkeyn & Cairncross, 2005, p. 1958). Data analysis showed a drop in hand washing before food preparation, but an increase in hand washing before eating. This may be an indication that hand washing before food preparation had become normalized and thus not given as a response to the open-ended questions. Hand washing before eating may be a newer idea to the community, and the higher response rate may indicate an increase in knowledge. For the prevention of malaria, women stated they needed to have their children sleep under a bed net. There was a steady increase in the presence of bed nets, from 21% (2006) to 57.9% (2009), as well as their usage, from 52.9% (2007) to 72.7% (2009).

Limitations

During this 7-year project, different sections of the KPC survey were selected and thus some data were not collected yearly. Although the same translators participated in collecting data and teaching, it was difficult to verify interviewer reliability. The KPC survey could have been translated from English into Lamso, the local tribal language, and then back-translated to increase reliability. Students could not immediately analyze the data in the field and therefore were unable to reinforce key areas for behavior change.

Some of the line drawings may have prompted women to answer in an expected way. For example, the question on how to keep water safe was used with a line drawing of an uncovered bucket. Other questions with line drawings were more open-ended and may have been a more accurate measure of the women’s knowledge. Establishing consistent relationships within the community was a challenge because the same group of Hope College students did not return each year.

Recommendations

1. When development programs are being envisaged, funders need to be willing to commit to long-term support in order to give teams time to develop trust with local people. As observed in this project, a 5- to 7-year timeline is crucial.
2. When involving students in cross-cultural service learning experiences, faculty must prepare them culturally. Debriefings during and after trips are essential to assist students to fully integrate these new experiences into their worldview.

3. When developing water programs, an interdisciplinary approach is vital to successful behavior change. Too often, water systems are constructed without any attention given to what new health behaviors should be taught in order for morbidity and mortality to be affected.
4. When developing health education modules, it is imperative that teams field test them so that content and communication processes respect local cultural practices.

Conclusions and Implications

Respect for the local culture, reflective practice, and emphasis on community empowerment are crucial to behavior change. The ongoing multiyear interdisciplinary model provided the continuity necessary for community ownership to occur. Participatory teaching, persistence, and empowerment of the women have resulted in a decrease of morbidity and mortality in children below the age of 5 years. While this is certainly due to an increased access to safe drinking water from the Manz BioSand filters, it is also due to education on proper clean water, handling clean water, and breaking the fecal–oral cycle through hygiene practices. Using two different data collection tools provided a more comprehensive perspective on the health behaviors in Nkuv.

This interdisciplinary project has resulted in better health for this small community in Cameroon, West Africa. It has allowed faculty to tangibly incorporate culture into their respective fields of engineering, nursing, and education. Perhaps more important, undergraduate students have learned the importance of pairing service learning and research that respect local cultures to foster a healthier global community.

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