Establishing a baseline for water, sanitation and hygiene knowledge, attitudes, and practices in rural Ethiopia

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Although improvements have been made since 1990, access to safe sanitation and improved water in Ethiopia remains low, contributing to the burden of preventable illnesses like diarrhea, trachoma and soil transmitted helminthes. In May 2012, the Ethiopia Outreach student organization, from the University of Texas Health Science Center at San Antonio, conducted a household survey to measure water, sanitation and hygiene (WASH) knowledge, attitudes and practices to better understand the social and structural determinants of health. While 65.4% of households reported having access to safe water and 100% reported having access to a latrine, only 6% of latrines were improved facilities. A knowledge score was created to determine individuals' understanding of sanitation, hygiene and disease transmission. The Knowledge Score is the sum (maximum score= 33) of all the correct responses for each of seven knowledge questions. It was determined that those who kept their latrines sealed, did not keep animals in their homes, had attended a community meeting within the last year and reported cell phone use had significantly higher knowledge scores than those who did not. This data provides a foundation for understanding the contributors to the burden of preventable disease in Aleta Wondo and a starting point for the design of further research and possible interventions.

Background

Globally, over 2 billion people have gained access to improved sources of drinking water (piped water, public taps, boreholes, protected wells and springs and rain water) and almost 2 billion have gained access to improved sanitation facilities (flush toilet, piped or septic system, ventilated improved pit latrine and composting toilets) since 1990. However, in 2014 more than 700 million people continue to use obsolete drinking water sources and 2.5 billion people lack access to improved sanitation. One billion of these also continue to openly defecate. Over half of the global population lacking access to clean water and approximately a quarter without improved sanitation live in Sub-Saharan Africa.[1] In Ethiopia, significant progress has been made to increase access to improved water and sanitation from 1990 to 2012. However, only 52% of the total population, 42% in rural areas, has access to improved water sources and 24% use an improved sanitation facility. Ethiopia ranks 5th on the list of countries with the highest number of people practicing open defecation with34 million).[2]

It is estimated that 2.4 million deaths (4.2% of all deaths) and 6.6% of the global burden of disease (DALYs) could be prevented through improved hygiene and access to safe water and sanitation.[3] The majority of the water, sanitation and hygiene (WASH) disease burden is dominated by diarrheal illness (53% of DALYs). These disproportionately affect children under the age of five, killing more young children each year than HIV/AIDS, tuberculosis and malaria combined.[4] The remainder of the burden is carried by diseases associated with malnutrition and parasites such as schistosomiasis, trachoma, filariasis and intestinal parasites. Poor access to sanitation leads to fecal contamination in the environment, which results in diarrhea and intestinal parasites including helminthes.[5] Giardia and tropical enteropathy, which significantly contributes to chronic malnutrition in children, are also perpetuated by similar means.[6] Additionally, limited access to water and education leads to poor personal and hand hygiene practices, which contribute to the spread of diseases like trachoma,[7] acute respiratory illnesses,[8] skin diseases and diarrhea.

The Ethiopia Outreach program is a partnership between medical students from the University of Texas Health Science Center at San Antonio and Common River, and a non-governmental organization based in Aleta Wondo with a goal "to create balanced, productive and self-sustaining communities for others to witness and replicate".[9] With one government health center managed by a registered nurse without a physician, Common River requested that the Health Science Center and Ethiopia Outreach provide primary care and public health services to the residents of Aleta Wondo. This particular area of Ethiopia struggles with several specific and preventable health problems such as trachoma, diarrhea and other preventable WASH diseases. Based on clinical experiences, it has been noted that infection with intestinal worms, which has been shown to stunt longitudinal growth, limit educational attainment and affect physical strength is also a common cause of diarrhea.[10] Both access to treatment with albendazole (or a similar drug) and knowledge of oral rehydration therapy for diarrhea appear to be limited in this population. To better understand the structural and social determinants of these WASH diseases, the current team completed a cross-sectional study measuring WASH knowledge, attitudes and practices in the Aleta Wondo community.

Methods

Using a cross-sectional study design, heads of household over the age of 18 were randomly selected to participate in a household survey in the Titara region of Aleta Wondo, Ethiopia. The population of Aleta Wondo is estimated at around 20,000, however there is insufficient data regarding the Titara region. The UTHSCSA IRB approved the protocol.

As maps were not available, the interpreters, who were lifetime residents of the region, served as guides. Data was collected over five consecutive days by teams of three students and one interpreter. Homes were randomly selected for participation in the survey. Using the Common River grounds as a center point, each group visited every nth house (based on a randomly assigned number) moving outward along the main village roads. Upon arrival at a home, the interpreter would greet the household members and ask for the head of household and complete consenting procedures. Each group visited as many homes as possible during daylight hours while data was being collected. In the allotted time period, 52 home

visits were conducted.

Three interpreters, all of whom had worked with previous teams, were hired to provide translation services. They received two days of training during which the research team reviewed the survey line by line, by reading each question aloud and describing its specific purpose. The interpreters then repeated the questions in Sidama, the local language, and Amharic, the National Ethiopian language, to ensure proper translation of the survey. Finally, two groups tested the survey in four households to ensure that the questions were culturally appropriate and well understood.

The current survey was an adaptation of a WASH survey that combined direct interview questions with observations developed and initially utilized by Jason Rosenfeld, MPH in Zimbabwe.[11] The WASH survey measures basic demographics including age, level of education, occupation, number of children and community involvement. Questions were asked about water sources and drinking water practices, cleaning practices, latrine use, garbage disposal, rodent problems and sanitation practices. Finally, questions were asked about the survey respondents' preventative health knowledge of water, sanitation and hygiene. Observations included, but were not limited to latrine type, latrine cleanliness, presence of animals inside the home, animal or human feces on the property, standing water, kitchen cleanliness, kitchen ventilation, use of mosquito nets and standing water. The final observation included a member of a household demonstrating his or her normal hand washing practice.

To assess WASH knowledge, a series of seven questions were asked. Each had three to five correct answers (Addendum A). The Knowledge Score is the sum (maximum score= 33) of all the correct responses for each of the seven knowledge questions. The Hygiene Index (HI) is a composite variable of hygiene practices under development and testing by Jason Rosenfeld. Each dimension of the Index is an observable indicator of diarrhea transmission routes. Taken together the Index is meant to serve as a proxy for diarrhea illness transmission in the household.[11] The HI was created using the following subcategories: environment, kitchen hygiene, hand washing, drinking water, and sanitation/defecation (Figure 1).

Data Management

De-identified data was recorded by hand during each interview and separately entered into Excel by two team members. The two spreadsheets were compared using the program Differencia, and all mismatches were corrected by referencing the hard copy data. The database was then uploaded into STATA 11 for cleaning and analysis.

Results

The majority of participants were married (88.5%), female (69.2%) and had a mean age of 38.3 years. Most (71.2%) were literate, had on average six years of education (SD=5 years) and primarily spoke Sidama (76.9%). Mean household size was six, including an average of two male and two female children.

Several questions were asked to determine the level of household involvement in community activities and how people obtain their news and other information. It was found that 88.5% of respondents had collaborated with their community to solve a problem in the last year. An even greater number (92.3%) had attended a community meeting in the same time frame. Lastly, 80.8% of respondents had approached a community leader concerning a problem. The most common sources of news and information sharing were the radio (86.5%), television (57.7%), friends (21%) and cell phone (19.2%).

With regard to water sources and drinking water practices, the majority of households (65.4%) reported that they had access to an improved water source (piped water, protected spring or well and borehole). On average, households collected water three times daily, totaling an average of 2.7 buckets daily. In addition, 90.4% reported that they believed their drinking water requires treatment, but 32.7% admitted that they do nothing to treat their drinking water. Among those who treat their drinking water, the most common method was purifying tablets (38.5%) (Table 1).

Observations of households revealed that only 20% of kitchens were found to be dirty. A kitchen was labeled as "dirty" if food was left out uncovered, dishes were left unclean or animal waste was observed in the kitchen. Most households (56%) had some flies in their kitchen; however, 32% did not have any flies (Table 2).

The Hygiene Index was used to create a score representative of behaviors related to diarrheal disease transmitted via water, sanitation and hygiene. Interesting components of the index included that 51.9% of households had soap available for hand washing, but only 3.9% had a dedicated hand washing facility (Figure 1).

Regarding sanitation practices, each household had access to a latrine, with three households reporting use of a neighbor's facility. An unimproved, homemade pit latrine (a hole in the ground that was not sealed) was observed on 78% of properties, while improved pit latrines (latrine with a structure built around it, with wooden slats over hole) were observed at only 6% of properties. Latrines were noted to be clean (no waste observed outside the pit) in 46% of households, 18% were moderately clean (some waste observed outside of pit) and 8% were not clean at all (foul-smelling, waste observed

Figure 1 Hygiene Index Components. Observations regarding water, sanitation, and hygiene were categorized and assigned a value to produce and index for further analysis. For example, lack of garbage on the property provided one point in the environment category.

Category	Indicator	Point Value
Environment	No, Garbage	1
	No, Animal Feces	1
	No, Standing Water	1
	Yes, Garbage Pit	1
Kitchen Hygiene	Yes, Clean Surfaces	1
	Yes, Clean Dishes	1
	No, Flies	1
	Yes, Food Covered	1
Hand Washing	Yes, Hand Wash Facility	1
	Yes, Use Hand Washing Facility	1
	Yes, Soap	1
Drinking Water	Yes, Water Cover	1
Sanitation/Defecation	No, Open Defecation	1
	Yes, Access to Latrine	1
	Yes, Clean Latrine	0.5
	Yes, Sealed Latrine	0.5
Hygiene Index = Sum Score		Max = 15

Table 1 Improved Water. The frequency of responses to questions related to improved water are displayed above. Percentages of the total are displayed in parenthesis. Standard deviations are displayed to the right of mean values.

Source	Frequency (%)
Pipe in Town	21 (40.4)
Stream	9 (17.3)
Spring	9 (17.3)
Protected Spring	1 (1.9)
Protected Well	3 (5.8)
Hand Pump/Borehole	9 (17.3)
Think Water Needs Treatment?	
Yes	47 (90.4)
No	5 (9.6)
Treatment Method	
Purifying Tablets	20 (38.5)
Nothing	17 (32.7)
Boil	8 (15.4)
Chlorine	7 (13.5)
Travel Time to Source in minutes	
Mean ± σ	11.5 ± 9.6
Min	1
Max	50
Times Collected Daily	
Mean ± σ	3.2 ± 2.1
Min	1
Max	10
Number of Buckets Collected	
Mean ± σ	2.7 ± 1.9
Min	1
Max	12

Table 2 Kitchen Hygiene. N represents the frequency of observations noted in the table. The percentage of the total is represented in parenthesis.

	N=Frequency (%)
Very Clean	18 (36)
Quite Clean	22 (44)
Dirty	10 (20)
None Visible	16 (32.0)
A Few Visible (1-5)	28 (56.0)
Many Flies	6 (12.0)

Table 3 Knowledge Score. The mean number of correct responses, standard deviation, and the range for each individual knowledge question, the composite knowledge score is displayed.

Variable	Mean ± σ	Min	Max
Oral Rehydration Solution	0.23*± 0.51	0	2
When to wash hands	2.44 ± 0.85	1	4
Diarrhea Transmission	2.13 ± 1	0	4
Skin Disease Transmission	1.56 ± 0.96	0	4
Worm Transmission	0.87 ± 0.89	0	3
Ways water becomes contaminated	1.35 ± 0.88	0	4
Safe water sources	1.60 ± 0.57	1	3
Knowledge Score	10.17 ± 3.16	4	19

outside pit). Only 10% of latrines were properly sealed, a measure which protects the environment from fecal contamination.

Table 3 displays the mean scores of the knowledge questions and the mean composite Knowledge Score. The lowest mean number of correct responses in a single category (0.23) asked participants to describe how to make an oral rehydration solution (ORS). On average, respondents were unable to correctly name one of three ingredients and the ORS's correct proportions, but they were aware of the availability of ORS sachets for purchase at the local pharmacy. Of note, knowledge of the transmission of parasitic disease was also limited in households; on average, survey respondents provided less than one correct response (0.87). The highest mean number of correct responses in a single category (2.44) asked participants to name five situations one should wash their hands. The mean composite Knowledge Score was 10.17 of a possible 33.

Table 4 describes associations between the Knowledge Score and various parameters from the survey calculated using a t-test. It was determined that those who kept a sealed latrine had a significantly higher knowledge score (mean difference= 3.05, p=0.04) than those who kept an open latrine. A higher knowledge score was also noted among those who kept their animals outdoors as opposed to indoors (mean difference= 2.55, p=0.02), and among those who had attended a community meeting (mean difference 3.44, p=0.04) versus those who had not. Additionally, the Knowledge Score was higher among those who used a cell phone (mean difference= 2.88, p=0.008) compared with those who did not.

Discussion

The purpose of calculating a Knowledge Score was to evaluate the overall understanding of water, sanitation and hygiene within the community and to provide a composite baseline score. The average score for this sample was ten out of a possible 33 correct responses. However, there is no value to use as a basis for comparison as this was the first time these concepts were measured and calculated in the area. Of the concepts that were measured to calculate the Knowledge Score, several findings warrant further exploration. These results suggest that respondents knew little about making a home-made ORS and preventing intestinal helminthes and parasites. However, most respondents knew appropriate times to wash hands.

Knowledge regarding the preparation of a homemade ORS was the lowest scoring category within the Knowledge Score (average of 0.23 out of three correct responses). This is concerning considering the prevalence of diarrheal illness in the region. These findings appear to be consistent with the results of other studies. Figures from the 2011 DHS survey indicate that 16% (fourth highest amongst all regions in Ethiopia) of children under the age of five in the Southern Nations, Nationalities and Peoples (SNNP) region where Aleta Wondo is located, reported episodes of diarrhea within the two weeks preceding the survey.[12] In this same region, 25% of mothers provided fluids via an ORS packet and 7% provided fluids via homemade ORS, while 45.7% provided no treatment in the SNNP region.[12] The frequency of mothers treating their child's diarrhea with ORS packets increases to 45% in urban areas, while homemade ORS increases to 13%.[13] Aleta Wondo is a rural community with the nearest city approximately two hours away by bus. The difference in frequency of ORS usage between urban and rural communities likely results from the availability of both resources and information. The limited knowledge of homemade ORS in this sample is likely caused by limited access to health information and the government's focus on treatment of diarrhea with premade packets. Future studies should consider exploring how often residents of Aleta Wondo use ORS to treat diarrhea and the sources from which they receive any information about ORS.

Respondents also had limited understanding about the transmission and prevention of intestinal parasites. On average, respondents provided 0.87 correct ways to prevent the transmission of soil-transmitted helminthes out of five possible correct responses. Observations of household sanitation and hygiene practices provide some insight into this community's capacity to prevent helminthic transmission. While most households in our sample had latrines, very few met the WHO/UNICEF definition of 'improved sanitation', which requires the latrine to be constructed with a ventilation pipe and with a concrete slab that separates the feces from the environment. Keeping feces separate from the environment is integral to blocking the transmission not only of diarrhea, but also intestinal helminthes and other parasites as well. One gram of feces can contain around 10^4 protozoan cysts and 10-10^4 helminth eggs, so when feces are not sealed in a latrine these parasites can be easily spread throughout the environment.[14] The disposal of children's feces is equally important since many rural regions do not place particular emphasis on children using latrines.[15] From the DHS data, only 8% of children in the SNNP region use a latrine and 31% of those children's stools are disposed of in the open.[12] The current study did not inquire about the management of children's waste. Although open defecation was not directly observed, use of the unimproved latrines that were observed is no better than practicing open defecation. Improved sanitation is particularly important in preventing the spread of soil-transmitted helminthic infections, which contribute to substantial childhood morbidity from anemia, retarded growth and poor cognitive function.[15]

With regard to knowledge concerning hand-washing practice, respondents provided an average of 2.13/5 correct responses when asked when they should wash their hands to prevent diarrhea. While this was the highest average score, this knowledge did not appear to be reliably translated to improved hand-washing practices. Only two households had dedicated hand-washing facilities and twenty-seven (52%) households offered soap when surveyors requested permission to wash their hands. These observations are concerning considering the role that proper hand washing behaviors have in preventing disease. Hand washing with soap has been shown to reduce bacterial load to near zero,[15] can reduce up to 48% of diarrhea in children and decrease acute respiratory infections by 23%.[16,17]

One possible explanation for this apparent disconnect between hand washing knowledge and practice is distance to a reliable water source. On average, respondents reported walking 11.5 minutes to the nearest water source, while some households reported spending nearly an hour. The WHO has reported that the average time an African household spends collecting water equates to nearly 30 min per container.[18] Households in this sample reported collecting an average of three containers per day, which, extrapolating from the WHO estimates, equates to roughly 1.5 hours/day spent collecting water. The time required to collect water has an impact on household hygiene practices, as households that travel longer distances will typically collect less water. Having less water available forces households to make choices about water usage. In this sample, households collected and used an average of three five-gallon buckets per day (57 liters total). With an average of six people per household, the average water use is approximately 9.5 liters/person/day. The WHO estimates that a minimum of 7.5 liters per person per day is required for drinking, cooking and personal hygiene, although 50 liters/person/day is needed for all purposes including cleaning and laundry.[19] It is clear that respondents are just meeting the minimum daily requirements for water, which might explain why hand-washing facilities were not observed. While economic factors likely prohibit households from using soap for hand washing, it is possible that hand washing is not yet an established social norm that would encourage households to prioritize household water use and available resources towards soap.[20]

Several noteworthy associations emerged between the composite Knowledge Score and observed practices. As previously reported, higher Knowledge Scores were noted in households that sealed their latrines, those that did not keep animals inside their homes, those that attended community meetings and those that reported using cell phones to get their news. These associations are particularly interesting because they can be grouped into two different categories. Community meeting attendance and cell phone use can both be classified as social behaviors, perhaps indicating the value of a social network in the distribution of informa-

Table 4 Knowledge Score. The Knowledge Score mean difference is displayed for categories of interest.

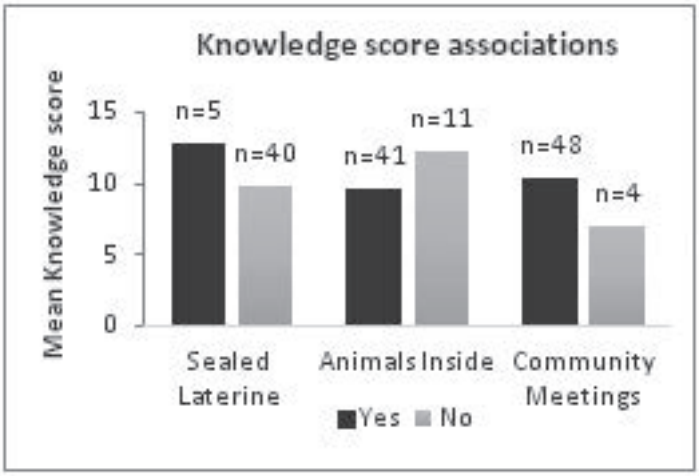
	yes			no			Diff		
	n	Mean	SD	n	Mean	SD	Mean	SE	p
Sealed Latrine	5	12.80	1.30	40	9.75	0.5	3.05	1.44	0.04
Animals Inside	41	9.63	2.67	11	12.18	4.09	2.55	1.02	0.02
Community Meetings	48	10.44	3.05	4	7	3.16	3.44	1.59	0.04
Cell Phone Use	10	12.5	2.86	42	9.62	2.86	2.88	1.04	0.008
Uses Soap	27	9.92	3.77	23	10.21	2.17	0.29	0.89	0.75
Full-time Employment	21	9.76	3.76	31	10.45	2.70	0.68	0.89	0.45
Animal Feces Present	21	10.14	2.43	29	10.14	3.56	0.19	.9008	0.84

tion, which mediate the social norms within a community. Sealed latrines and housing of animals can be categorized as possible surrogates for wealth. While it should be noted that wealth and its impact on WASH knowledge is a multifactorial concept, it is interesting that those who could seal their latrines and those who had shelter for their animals outside of the main compound had higher Knowledge Scores. These associations provide a place to begin further research with the goal of eventually designing an appropriate intervention to help alleviate the burden of preventable disease in Aleta Wondo.

This study had several limitations, most of which can be addressed and modified in future research. First, the sample size of 52 was relatively small. This was a result of limited time in the country, the length of interviews, and a limited number of interpreters. The study's findings were also limited in its generalizability outside of the Titara region of Aleta Wondo surrounding the Common River grounds. Since transportation during data collection was limited to foot, it was not possible to venture outside of this region and return before dark. Future groups may consider splitting groups by region and sending groups by bus. Finally, despite having skilled interpreters, the language barrier was still limiting. This particular issue is very difficult to avoid as it is unlikely that visiting researchers will become proficient enough in Amharic or another local dialect to conduct a thorough interview. If the study continues to use the same interpreters each year, it is reasonable to assume their skills will improve and reduce some of the bias.

The findings of this study indicate the need and potential for an intervention to address WASH knowledge and behaviors in Aleta Wondo. While it is not possible to define the precise details of that intervention with baseline data alone, ideas for the future are certainly not limited. Perhaps a Community Health Club (CHC) that focuses on teaching community members to take ownership of their own sanitation and hygiene would be beneficial. Such endeavors have proven successful in other regions of Africa.[21] CHCs in Zimbabwe focused on creating a "culture of health" in order to change the social norms related to sanitation and hygiene within a particular community.[21] These clubs were found to be a cost-effective, long-term strategy for improving hygiene behaviors.[22] Since a large proportion of the sample in Aleta Wondo had participated in community meetings, it is reasonable to consider this community as a possible fit for a community-based intervention such as CHCs. However, a more detailed needs assessment must be conducted before an intervention can be successful. While improved access to potable water is essential to long-term improvement, altering the social norms with regard to WASH practices in Aleta Wondo is an appropriate starting point to reduce the burden of preventable disease and improve quality of life for residents of the region.

Figure 2 depicts the findings described in Table 7. The mean knowledge score was greater among households that sealed their latrines, those that attended community meetings, and did not keep animals inside their homes.



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