

How Do Rural Ethiopians Rate the Severity of Water Insecurity Scale Items? Implications for Water Insecurity Measurement and Interventions

Yihenew Tesfaye, Kenneth Maes, Roza Abesha, Sera Young, Jedidiah S. Snyder, Abebe Gebremariam, and Matthew C. Freeman

Recently developed scales aim to advance understanding of household water insecurity and inform interventions to address this critical global problem. The relative severity of items included in household water insecurity scales has been established as an inverse of the proportion of the population that reports experiencing the item. Here, we assess subjective perceptions of scale item severity among people who experience household water insecurity. In 2017, we surveyed 259 women in Amhara, Ethiopia, assessing both experiences of water insecurity and perceptions of item severity using a pictorial scale. The mean subjective severity of most items was at the high end of our pictorial scale. Subjective severity of items was not associated with whether or not a participant experienced the item in the last thirty days, with a participant's summary household water insecurity score, or with rural versus peri-urban residence, but was consistently associated with community of residence. Item severity as defined by the proportion of the population experiencing the item aligned with average perceptions of item severity, with one exception: drinking water that might not be safe. We discuss these findings' implications for water insecurity measurement, evaluation of interventions, and studies of the relationship between water insecurity and psychological distress.

Key words: household water insecurity, food insecurity, measurement, item severity, Ethiopia

Introduction

Household water insecurity is defined as a situation in which households do not have physical, social, and/or economic access to sufficient and safe water at all times for their various needs, including economic, cultural, psychological, social, and spiritual needs (Hadley and Freeman 2016; Hadley and Wutich 2009; Stevenson et al. 2012; Tsai et al. 2016; Wutich and Ragsdale 2008). In the last decade, several studies have developed and validated household water insecurity measures to further our understanding of the determinants and outcomes of water insecurity and to help institutions better respond to water insecurity (Hadley and Wutich 2009; Stevenson et al. 2016; Stevenson et al. 2012; Young et al. 2019). Several experience-based measures of water insecurity have thus been tailored to local social contexts, revealing important links between variation

in water insecurity and social position, social strife, political action, ecological change, household coping, mental health, and physical health (Boateng et al. 2018; Hadley and Wutich 2009; Jepson 2014; Jepson et al. 2017; Stevenson et al. 2016; Stevenson et al. 2012; Tsai et al. 2016; Wutich 2009, 2011, 2012; Wutich and Ragsdale 2008). A recent study has also developed a cross-cultural measure of household water insecurity, the Household Water Insecurity Experiences (HWISE) scale (Young et al. 2019). This line of water insecurity measurement and research has followed and intersected with similar efforts to measure and understand household food insecurity (Wutich and Brewis 2014).

Our focus here is on how researchers measuring water and food insecurity have constructed and operationalized the idea of severity. Severity is often treated as a fundamental quality of household insecurity, meaning that scales should be able to distinguish between households along a spectrum of insecurity from secure to severely insecure (Ballard, Kepple, and Cafiero 2013; Hadley and Freeman 2016; Hadley and Wutich 2009; Stevenson et al. 2012). Qualitative, ethnographic methods are used to develop items that are generally phrased, "In the past thirty days, did you or anyone in your household experience X because of a lack of water/food?," where "X" refers to cutting back on specific aspects of water use or food intake or being prevented from accessing water or food due to various reasons (Hadley and Wutich 2009; Stevenson et

Yihenew Tesfaye and Kenneth Maes are affiliated with the Department of Anthropology, Oregon State University, Corvallis, OR. Roza Abesha is an Independent Researcher based in Bahir-Dar, Ethiopia. Sera Young is affiliated with the Department of Anthropology, Northwestern University, Evanston, IL. Jedidiah S. Snyder and Matthew C. Freeman are affiliated with the Rollins School of Public Health, Emory University, Atlanta, GA. Abebe Gebremariam is affiliated with Emory Ethiopia, Addis Ababa, Ethiopia.

al. 2012; Young et al. 2019). Each “yes” response is typically treated as =1, and the “yes” responses of an individual respondent are added to create a score ranging from 0 to the maximum number of questions. The higher the score, the more severe the water/food insecurity situation in the household. Some researchers have used polytomous scores, such that a single item is scored as =0 if the participant never experienced the item in the previous thirty days, =1 if the participant experienced it “rarely” or “sometimes,” and =2 if the participant experienced it “often” (Deitchler et al. 2010; Young et al. 2019). The frequency an item was experienced in the past month (i.e., rarely versus often) is commonly assumed to correspond to the severity of the situation in a household.

Further, individual items in these scales are often assumed to represent experiences of variable relative severity. In other words, some items are assumed to pertain to experiences that indicate “mild” insecurity (e.g., not finishing chores due to time spent getting water), while others reference “severe” insecurity (e.g., going an entire day without drinking water), and others are intermediate (Hadley and Freeman 2016). People facing water and/or food insecurity are assumed to answer “yes” to milder items before the more severe items (Ballard, Kepple, and Cafiero 2013; Deitchler et al. 2010; Hadley and Wutich 2009). The severity of an item is assumed to correspond inversely to the frequency with which it is experienced in a population: items that are commonly experienced are less severe than items that are rarely experienced. Examples of this approach include the FAO’s Food Insecurity Experiences Scale (FIES) project (Ballard, Kepple, and Cafiero 2013; Cafiero et al. 2016), FANTA and USAID/FHI360’s Household Food Insecurity Access Scale (HFIAS) project (Coates, Swindale, and Bilinsky 2007; Deitchler et al. 2010), and the work of our colleagues in Ethiopia and elsewhere (e.g., Hadley and Freeman 2016; Stevenson et al. 2016; Stevenson et al. 2012).

There is discussion in this literature about limitations associated with the common practice of using unweighted items when calculating summary household water or food insecurity scores (i.e., assigning a value of 1 to all “yes” responses regardless of the severity of the experience). Specifically, researchers have raised concern that using unweighted items to calculate summary scores may underrepresent the severity of the situation in households that are experiencing items that are particularly severe (e.g., Swindale and Bilinsky 2006). This suggests the need to develop approaches to assign relative weights to scale items before calculating household summary scores.

We premise this paper on the importance of attending to the perceptions of people who experience water insecurity while refining household water insecurity scales for use in applied research and evaluations of interventions. Thus, we explore the implications of conceptualizing household water insecurity scale item severity based on the subjective perceptions of people experiencing household water insecurity. Notably, we investigate the possibility that people both experience certain scale items commonly and perceive these experiences as particularly severe or difficult in comparison to other aspects of water/food insecurity. Our study focuses on women in

rural Amhara, Ethiopia, experiencing variable levels of water insecurity and addresses the following questions: (Q1) Does perception of item severity vary within a population, and do some items have greater variability? (Q2) Do people’s perceptions of the severity of water insecurity items differ according to their residential community/locality, recent experience with that item, or household water insecurity score? (Q3) How does the perceived severity of an item compare to the prevalence of that item in a population? For instance, is it possible that some commonly experienced items are nevertheless perceived as relatively severe by people, contrary to the assumed inverse relationship between item prevalence and severity?

Methods

Study Setting

The study was conducted in three kebeles (Ethiopia’s lowest government administrative units, which typically encompass a handful of villages or hamlets) in West Gojjam and South Gondar zones of Amhara region, Ethiopia. The study communities are highly homogenous in terms of ethnicity (Amhara). In terms of livelihoods, approximately 80 percent of households solely rely on farming, while others combine farming and a small amount of non-farm income from day labor or trade/merchant work.

The 2016 Ethiopian demographic and health survey (EDHS) estimates urban households’ access to an “improved” source of drinking water at 97 percent, compared to 57 percent in rural areas (CSA and ICF 2016). According to the WHO and UNICEF (2017), “improved” water sources by definition have the potential to deliver safe water due to their intentional design and construction. “Improved” drinking water sources include protected wells, protected springs, and public taps or standpipes (CSA and ICF 2016). In general, there exist a variety of drinking and non-drinking water sources in rural Amhara, including in our study area, with primary household water source varying both within and across kebeles. These different sources include both “improved” and “non-improved” sources. “Improved” water sources in the study communities included hand-dug and machine-dug wells fitted with handpumps, springs protected with concrete housings and on-site taps, and village-level water distribution systems involving stand-pipes and power-pumped wells or protected springs. “Non-improved” water sources in the study site include unprotected wells, springs, creeks, and other bodies of water.

We collected data in rural and semi-urban districts where there was an ongoing water, sanitation, and hygiene (WaSH) intervention study funded by the World Bank (WB), the International Initiative for Impact Evaluation (3ie), and the Children’s Investment Fund Foundation (CIFF).¹ The intervention project facilitated our sampling and recruitment processes. However, we collected data only in communities that were not part of the intervention study (i.e., neither intervention nor control communities). In addition, we completed data collection before household-level intervention activities

took place in communities that were selected to be part of the intervention so that our study would be unlikely to impact the larger intervention project and vice versa.

Sampling

We purposively selected three kebeles for data collection after discussion with staff conducting the intervention mentioned previously. These informants identified these three kebeles as generally experiencing problems associated with access to “improved/protected” water sources.

Our target sample size ($N=250$) was determined by the Household Water Insecurity Experience (HWISE) scale development study (Young et al. 2019). Based on the total number of households in each kebele, provided to us by Health Extension Workers (HEWs, i.e., salaried female community health workers), we first calculated the proportion of households that needed to be selected from each of the three kebeles. We then used stratified (two-stage) random sampling to select households in each kebele. The first phase was focused on randomly selecting villages (Amharic: gott) within each kebele that would have high, medium, or low/no access to “improved/protected” water sources. In each kebele, HEWs and kebele administration staff were asked to use their judgment to identify gotts that have good, medium, and poor access to “improved/protected” water sources. None of these informants deemed any of the candidate gotts to have good access to such water sources. After listing the gotts deemed to have medium and poor access to “improved/protected” water sources, in each kebele, we randomly selected two to three gotts (based on total number of households in each gott) with poor access and one to three gotts with medium access, from a total number of approximately fifteen gotts in a kebele.

In each of the gotts, we then used a random number generator to select a sample of houses proportionate to the total number of households in order to arrive at a total sample of approximately 250 households (39.2%, 38.4%, and 22.3% in the three kebeles). In each kebele, HEWs provided a list of households by gott that had been prepared by the Carter Center Ethiopia for its trachoma and other health intervention activities. We used these lists as our sampling frame.

Among households in Amhara, as in much of Ethiopia, women take primary responsibility for water acquisition, allocation, and use (Stevenson et al. 2016; Stevenson et al. 2012). Thus, we sought to interview women who deemed themselves responsible for acquisitions and use of water in their household. Following the above procedure, we reached a sample of $N=259$ households across eighteen gotts.

Survey Measures

A structured household survey was administered by four trained enumerators to assess household sociodemography and experiences of water insecurity. The first author trained all enumerators over the course of three days, including a day of pre-testing the survey with rural women in areas adjacent to the

locales included in the survey. The enumerators and the first author also met at the end of each day of data collection to address questions about data quality. Enumerators recorded the kebele of the participants (here designated as kebele 1, 2, or 3) and whether the participant resided in a rural or peri-urban setting within the kebele (none of the participants lived in urban settings).

Water insecurity: Thirty-two candidate items used to develop the HWISE scale (Young et al. 2019) were included in our study. These questions ask about households’ experiences in the last thirty days with water access, adequacy, safety, and lifestyle (see Table 1). Answers were reported as the number of days the item was experienced.

Each water insecurity scale item was coded as “0” if a participant reported never experiencing the item in the past thirty days, “1” if the item was experienced one to two days, “2” if the item was experienced three to ten days, and “3” if the item was experienced eleven or more days (following Young et al. 2019). We calculated household water insecurity scores by summing responses across nineteen of the original thirty-two items (indicated in Table 1). A subset of the original thirty-two items were left out of the household score because they had a large percentage of “not applicable” responses because they pertained to water ecologies that do not match the ecologies of our field sites (e.g., “In the last four weeks, how frequently has your household water supply from your main water source been interrupted?”). These items were not included in the water insecurity score or subsequent analyses. Another subset of items had small numbers of participants (ranging from one to eight) who replied “not applicable.” We interpreted these responses as the result of miscommunication between the participant and interviewer, with participants actually meaning that they never experienced the item. Thus, such responses were re-coded as “0” and retained for calculating household water insecurity scores (Table 1).

Subjective Severity of Water Insecurity Items: We investigated the subjective severity of thirteen water insecurity items (Table 3), which we selected based on our colleagues’ previous work in Amhara, Ethiopia (Stevenson et al. 2016; Stevenson et al. 2012). We assessed severity by reading the item, asking the participant, “How difficult or heavy would you say is this experience?”, and asking the participant to point to one of a series of images representing increasing heaviness or difficulty (Figure 1). We adopted this visual approach because the majority of women in rural Amhara are nonliterate, and pictorial scales have been used successfully in previous research (e.g., Maes et al. 2018). In Amharic, people use the term for “heavy” (Amharic: kebad) to mean difficult or severe. Water fetching often involves carrying a heavy load; at the same time, the images metaphorically capture the distress felt by women who experience poor water access. The image scale in Figure 1 was first shown to the respondent, with the enumerator explaining that she was going to ask the respondent about several water insecurity experiences.

Subjective severity of water insecurity experiences was analyzed in two forms: as a continuous variable ranging from one to four as depicted in Figure 1, and in a dichotomized form, with the maximum severity response

Table 1. English Language Water Insecurity Survey Items, Indicating Whether or Not Each Was Included in the Calculation of the Household Water Insecurity Score Survey and Comparison between Item Prevalence and Perceived Severity (For complete wording of items, see Young et al. 2019.)

Item	Included in Water Insecurity Score	Included in Comparison between Prevalence and Perceived Severity
1. Worried you would not have enough water for all of your household needs?	X	X
2. Worried about the safety of the person getting water for your household?	X	
3. Thought of leaving [name of kebele] because there was no water there?	X	
4. Water supply from your main water source interrupted?		
5. Not had enough water for your garden, crops, or fruit trees?		
6. Not had enough water to give to your animals and poultry?		
7. Time spent getting water prevented you or anyone in your household from earning money?		
8. Lacked money needed to buy water?		
9. Wanted to buy water but there was nowhere to buy it from?		
10. Time spent getting water prevented you or anyone in your household from caring for children in the household?		
11. Time spent getting water prevented you or anyone in your household from doing household chores?	X	X
12. Children in your household missed school because they were getting water?		
13. Not enough water in the household to wash clothes?	X	
14. Had to change what was being eaten because there wasn't enough water?	X	
15. Had to go without washing hands after dirty activities because you didn't have enough water?	X	
16. Not had enough water to wash the faces and hands of children in your household?		
17. Had to go without washing their body because there wasn't enough water?	X	
18. Day interrupted by your water situation, including getting or distributing water within the household?	X	
19. Problems with water prevented you or anyone in your household from attending social events?	X	X
20. Wanted to treat your water, but couldn't?		
21. Drank water that tasted bad?	X	
22. Actually drank water that you thought was unsafe?	X	X
23. Asked to borrow water from other people?		
24. Loaned water to anyone?		
25. Had problems with water that caused difficulties with neighbors or others in the community?	X	
26. Had problems with water that caused difficulties within your household	X	
27. Felt upset about your water situation?	X	
28. There was not as much water to drink as you would like for you or anyone in your household?	X	
29. There was not enough water to take medications?		
30. Did not get water where you wanted to because you were too sick or weak to get water?	X	
31. Went to sleep thirsty?	X	X
32. There was no water whatsoever in your household?	X	

(four) re-coded as one (denoting “maximum severity”) and all less severe responses re-coded as zero. This cutoff produced a more balanced distribution of responses. As we report in greater detail below, for most items, responses of “four” were generally much more common than lower responses.

Data Collection and Management

All data were collected in July and August 2017, which is the major rainy season in Amhara. Data were collected

electronically on mobile phones and stored securely using the freely available Open Data Kit² and then transferred into Microsoft Excel.

Data Analysis

To answer our first research question (Q1 above), we examined the mean subjective severity, standard deviation, and the proportion of responses from the pictorial scale for each of the thirteen water insecurity items. To answer

Figure 1. Pictorial Scale Used to Measure Households' Perceived Heaviness of Water Insecurity Items (reproduced from Bolton and Tang 2002)



Q2, we used Chi-square analyses to examine the relationship between participants' perceptions of item severity (in the dichotomized form described above) and (1) kebele of residence, (2) peri-urban versus rural residence, and (3) whether or not the participant experienced that particular item. We used t-tests to examine if participants' perceptions of item severity were related to their summary household water insecurity score. For these analyses, we used Bonferroni corrections for multiple comparisons as appropriate. For example, when examining associations across thirteen items, we set the alpha level at 0.004 (0.05/13). To answer Q3, we compared each water insecurity item's average subjective severity to the proportion of the population that reported experiencing the item and to the item's mean score. We conducted this part of the analysis with a subset of five water insecurity items (indicated in Table 1). Other items either had too many missing responses or had differences in wording between the water insecurity scale and the subjective severity module.³ These five items had broad ranges in prevalence (i.e., endorsement rates) and mean scores within our sample and comprise a broad spectrum of experiences. All analyses were carried out in SPSS version twenty-three (Armonk, NY).

Ethical Approval

This study was conducted as part of a parent study entitled "The Impact of Enhanced, Demand-side Sanitation and Hygiene Promotion on Sustained Behavior Change and Health in Ethiopia" and received approval from Emory University Institutional Review Board (IRB00076141; Atlanta, GA, USA) and the Amhara Regional Health Bureau (HRTT0135909; Amhara, Ethiopia). Oral informed consent was obtained from all participants before each interview.

Results

Sociodemographics

From a total of 259 households that participated in this study, 88 percent of the households were from rural communities, with the remaining residing in peri-urban areas. Households ranged in size from one to twelve total members (mean=5.0, SD=2.2), and 84 percent of households had at least one child member under seventeen years of age. Most study participants were women household heads who were responsible for collection, use, and management of water in their house. In a small number of cases (6%), the woman household head was not available, and so older daughters (eighteen years or older) or other women who collected and managed the household's water participated in the study. The mean age of the participating women was thirty-six years.

Drinking Water Sources

Primary drinking water sources differed both within and between kebeles in the study (Table 2). Kebele 1 had a larger percentage of households with standpipe access (29% vs. 1% in kebele 2 and 8% in kebele 3). Kebele 2 had larger percentages of households using an unprotected dug well (48% vs. 14% in kebele 1 and 7% in kebele 3) or an unprotected spring (39% vs. 10% in kebele 1 and 8% in kebele 3), and kebele 3 had a larger percentage of households using a protected bore hole well/dug well (36% vs. 8% in kebele 1 and 2% in kebele 2).

Subjective Severity of Water Insecurity Items (Q1)

The mean subjective severity of most of the thirteen items was towards the high end of our pictorial scale: only two experiences were rated less than three on average, with four being the maximum value. Mean subjective severity varied

Table 2. Primary Drinking Water Source Distribution (Percent) within and across Study Kebeles ($n=259$ Women in Rural Amhara)

Water Source, Percent	Kebele 1 ($n=99$)	Kebele 2 ($n=99$)	Kebele 3 ($n=61$)	Total ($n=259$)
Protected				
Piped water	6.1	0.0	8.2	4.2
Stand pipe	29.3	1.0	8.2	13.5
Bore hole well/Dug well	8.1	2.0	36.1	12.4
Spring	14.1	1.0	18.0	10.0
Unprotected				
Spring	10.1	39.4	8.2	20.8
Rain water	0.0	1.0	0.0	0.4
Surface water (pond, river, lake)	18.2	8.1	14.8	13.5
Dug well	14.1	47.5	6.6	25.1

across the thirteen items, from a low of 2.4 to a high of 3.9. Standard deviation of responses ranged from 0.3 to 1.1, with a mean of 0.7 (Table 3). “Going a whole day without water” was rated as the most severe item (mean=3.9, SD=0.3). The next most severe items were “drinking water that might not be safe” (mean=3.8, SD=0.4) and “going to sleep thirsty” (mean=3.8, SD=0.5). The least severe item was “borrowing water from a neighbor” (mean=2.4, SD=1.1).

Table 4 presents response frequencies from the pictorial scale for each of the thirteen items, demonstrating that there is substantial variation in perceptions for several items. For items with the highest mean subjective severity (e.g., “going a whole day without water”), we see highly skewed distributions of response frequencies, with a very large proportion of “four” responses from the pictorial scale, and very small proportions of “one” or “two” responses. Items with lower mean subjective severity (e.g., “borrowing water from a neighbor”) have more evenly distributed response frequencies.

Subjective Severity of Water Insecurity Items across Kebele of Residence and Experience of Water Insecurity (Q2)

In chi-square analyses of the relationship between participants’ perceptions of item severity and kebele (locality) of residence, one of the three kebeles consistently stood out, with greater proportions of participants in that kebele perceiving five out of thirteen items at the maximum level of severity (kebele 1 in table 5). Three of these items—“not finishing chores due to time spent collecting water,” “missing social events because of problems with water,” and “going a whole day without water”—were statistically significant at the alpha level adjusted for multiple comparisons ($p=0.004$, Table 5). As shown in Table 2, there were substantial differences in drinking water source across the three kebeles in our study. We examined water insecurity scores and the proportion of

Table 3. Perceived Water Insecurity Item Severity (Means and Standard Deviations), Derived from Response to the Image in Figure 1, Ordered from Lowest to Highest Mean ($n=259$ Women in Rural Amhara)

Item	Perceived Severity, Mean (SD)
Borrowing water from a neighbor	2.4 (1.1)
Doing less cleaning, etc. due to lack of water	2.9 (0.8)
Not finishing chores due to time spent getting water	3.1 (0.8)
Worrying about having enough water	3.1 (1.0)
Not cooking good food due to a lack of water	3.2 (0.8)
Losing sleep over water	3.3 (0.8)
Missing social events because of problems with water	3.3 (0.7)
Not collecting water because of distance, lack of time, etc.	3.5 (0.6)
Quarreling over water	3.5 (0.7)
Collecting water from dirty source	3.5 (0.6)
Going to sleep thirsty	3.8 (0.5)
Drinking water that may not be safe	3.8 (0.4)
Going a whole day without water	3.9 (0.3)

Table 4. Response Frequencies (Percent) of Subjective Severity for Thirteen Water Insecurity Items, Derived from Responses to the Image in Figure 1 (n=259 Women in Rural Amhara)

Items	Pictorial Scale Value			
	1	2	3	4
Borrowing water from a neighbor	24.7	27	27	21.2
Doing less cleaning, etc. due to lack of water	3.5	30.9	38.2	27.4
Not finishing chores due to time spent getting water	3.9	17.8	43.2	35.1
Worrying about having enough water	5.8	23.2	25.5	45.6
Not cooking good food due to a lack of water	1.9	18.1	39.4	40.5
Losing sleep over water	2.7	14.7	35.5	47.1
Missing social events because of problems with water	0.4	13.9	44	41.7
Not collecting water because of distance, lack of time, etc.	0.4	6.9	37.5	55.2
Quarreling over water	0.4	8.1	29.7	61.8
Collecting water from dirty source	0.8	5.4	33.6	60.2
Going to sleep thirsty	0	3.1	17	79.9
Drinking water that may not be safe	0	1.2	19.7	79.2
Going a whole day without water	0.4	0.8	5.4	93.4

respondents living in rural versus peri-urban settings to see if kebele 1 stood out from the others, as a partial explanation for its distinct pattern of perceptions, but it did not. In addition, we found no association between peri-urban versus rural residence and perceived severity for any of the items (data not shown).

We examined the relationship between participants' perceptions of item severity (in the dichotomized form described above) and whether or not the participant experienced that particular item in the past thirty days. For these analyses, we examined a subset of five WI items: "worrying about having enough water for all household needs" (experienced by 55.2% of the sample), "not finishing chores due

to time spent obtaining water" (43.6%), "drinking water that might not be safe" (37.8%), "missing social events due to problems with water at home" (22.4%), and "going to sleep thirsty" (14.7%). Chi-square analyses revealed no differences in perceived severity between participants who experienced and did not experience the item in the last thirty days (Table 6).

Using t-tests, we examined if the subjective severity of items differed by WI score. Only one item revealed a significant difference: "going to sleep thirsty." Respondents who perceived the severity of this item at the maximum (four in our pictorial scale) had significantly lower WI scores (9.0 vs. 14.3, $p<0.001$).

Table 5. Subjective Severity of Water Insecurity Items across Kebele (n=259 Women in Rural Amhara)

Items	Percent of Participants Who Perceive Severity at Maximum (=4)			P-value*
	Kebele 1 (n=99)	Kebele 2 (n=99)	Kebele 3 (n=61)	
Borrowing water from a neighbor	19	27	15	0.140
Doing less cleaning, etc. due to lack of water	24	25	36	0.220
Not finishing chores due to time spent getting water	49	30	21	0.001
Worrying about having enough water	44	43	51	0.634
Not cooking good food due to a lack of water	52	34	33	0.018
Losing sleep over water	51	46	44	0.682
Missing social events because of problems with water	56	31	36	0.001
Not collecting water because of distance, lack of time, etc.	68	48	48	0.007
Quarreling over water	67	58	61	0.412
Collecting water from dirty source	64	58	59	0.668
Going to sleep thirsty	78	81	82	0.782
Drinking water that may not be safe	83	79	74	0.389
Going a whole day without water	100	86	95	0.000

*P-values based on Chi-square statistics

Table 6. Percentage of Participants Who Perceived Water Insecurity Item Severity at Maximum (=4 on Pictorial Scale), by Whether or Not Participants Experienced Each Item in the Previous 30 Days (n=259 Women in Rural Amhara)

Items	Did Not Experience	Did Experience	P-value*
Worrying about having enough water	57	52	0.48
Not finishing chores due to time spent getting water	62	69	0.22
Missing social events because of problems with water	58	59	0.96
Drinking water that may not be safe	20	22	0.62
Going to sleep thirsty	19	26	0.29

*P-values based on Chi-square statistics

Subjective Severity and Prevalence Rates of Water Insecurity Items (Q3)

We found that, in general, item prevalence (the proportion of the population that reports experiencing the item) is inversely related to mean subjective severity: more subjectively severe items tend to be more rarely experienced (Table 7). A similar pattern is observed when examining mean item scores, which represent the average frequency an item was experienced in the past month (0=never, 1=rarely, 2=sometimes, 3=often/always). However, there is an important exception to this pattern: “drinking water that might not be safe” is both relatively common (38% of participants said they experienced it at least rarely; mean item score=0.8) and perceived as highly severe (mean severity=3.8).

Discussion

Similar to household food insecurity scales, existing water insecurity scales consist of multiple items that index experiences of varying severity, which is assumed to be inversely related to an item’s prevalence: items that are commonly experienced are less severe than items that are more rarely experienced. Here, we tested this assumption against the subjective perceptions of people who experience water insecurity. This inquiry is motivated by the assertion that un-

derstanding the perceptions of people who experience water insecurity should inform efforts to measure and respond to this pressing global problem and human rights issue.

Using data contributed by women living in Amhara, Ethiopia, we asked how women’s average perceptions of the severity of water insecurity scale items compare to each item’s prevalence in their communities. For instance, is it possible that some commonly experienced items are nevertheless perceived as relatively severe by people? We found that, in general, there is an alignment between an item’s prevalence and the average subjective perception of its severity. This bolsters our confidence in the ability of item prevalence to accurately represent local perceptions of severity.

However, we identified an exception involving one item: “drinking water that might not be safe.” This item is commonly experienced in our field site (nearly 40%), which would suggest, by analogy with received thinking in food insecurity studies, that it is a less severe experience compared to, for example, going a whole day without water (Ballard, Kepple, and Cafiero 2013; Deitchler et al. 2010). However, in our study, “drinking water that might not be safe” was among the three items with the highest average subjective severity (along with going a whole day without water and going to sleep thirsty). This finding replicates the results of a previous (2015) survey using similar methods with a smaller sample of women (n=42) in another part of Amhara (Maes and Tesfaye 2015; Tesfaye and Maes 2016).

Table 7. Water Insecurity Item Prevalence, Mean Score, and Mean Subjective Severity (n=259 Women in Rural Amhara)

Items	Endorsement Rate	Mean Score	Mean Subjective Severity
Worrying about having enough water	55.2	1.1	3.1
Not finishing chores due to time spent getting water	43.6	0.7	3.1
Missing social events because of problems with water	22.4	0.4	3.3
Drinking water that may not be safe	37.8	0.8	3.8
Going to sleep thirsty	14.7	0.2	3.8

We also asked: do people experiencing water insecurity have variable perceptions of scale item severity, and do they vary in their perception of some items more than others? The subjective severity of most water insecurity items/experiences was in fact towards the high end of our pictorial scale. This confirms that experiences of restricted access to water—a fundamental biocultural necessity for humans—are generally perceived and experienced by women as very difficult (Stevenson et al. 2012; Wutich and Brewis 2014; Wutich and Ragsdale 2008). The experience with the lowest mean subjective severity was “borrowing water from a neighbor.” A recent study that compared water sharing in four countries in sub-Saharan Africa, including Ethiopia, suggests that water sharing with neighboring kin and non-kin is a basic household coping strategy (Brewis et al. 2019; Wutich et al. 2018). In other areas with restricted water access, water sharing creates tensions among neighbors, reproduces unequal power relationships, and contributes to conflict over water (Brewis et al. 2019; Sultana 2011).

We also found substantial variation in perceptions of severity of water insecurity scale items within a predominantly rural population. While the majority of participants perceived the severity of most items at the maximum (four), there were multiple items that were rated as a three, two, or one on our pictorial scale, depending on the participant. Some items had more variable responses than others, with standard deviations ranging from 0.3 to 1.1.

We further examined to what extent people’s perceptions of the severity of water insecurity items differ according to their (1) residential community/locality, (2) recent experience with the item, or (3) current household water insecurity score. Participants in one kebele (“kebele 1”) stood out from those in the other two kebeles, with significantly larger proportions of participants perceiving several items at the maximum level of severity. This was not explained by the experience of significantly more or less water insecurity in that kebele or by the proportion of participants residing in rural versus peri-urban settings. Though further study is needed to explain this pattern, one hypothesis is that people in different localities, through their social interactions and challenges with water access, develop shared perceptions of water insecurity experiences that are distinct from those of people living in otherwise similar, nearby locales. When we examined primary drinking water sources by kebele, we found that kebele 1 had a larger percentage of households with standpipe access. Further, kebele membership in rural Amhara (and in most parts of Ethiopia) is fundamentally important in peoples’ daily lives. Rural kebeles hold weekly and monthly meetings between local leaders and residents, in which various kinds of information and perspectives are shared. Citizens generally go to their kebele leaders and offices when they seek a government response or information. Shared identities and relationships with neighbors (who are not always kin) are shaped by kebele membership. Women who share a kebele also have many collective experiences and conversations while collecting water (Stevenson et al. 2012).

We found no significant differences in subjective severity between participants who did and did not experience a particular item in the last thirty days. This may be due to the possibility that many study participants experienced these items in the recent past but not necessarily in the last thirty days. We also examined whether or not household water insecurity summary scores were related to participants’ perceptions of the severity of water insecurity items. This was the case for only one item: “going to sleep thirsty.” Participants with lower water insecurity (WI) scores tended to perceive the severity of this item as maximally severe. Going to sleep thirsty is among the items with the highest mean perceived severity and the lowest prevalence among participants. However, it is not clear why participants with lower WI scores tend to perceive the severity of this item at the maximum.

In sum, people’s perceptions of the severity of many water insecurity items vary, and this variation is consistently structured by the community/kebele in which they reside but not by whether or not they experienced the item, how many water insecurity items they experienced in the previous month, or rural versus peri-urban residence.

These findings have implications for efforts to assign weights to items within water and potentially food insecurity scales. The common use of unweighted items in computing summary household water and food insecurity scores, in which a “yes” response to each item is coded as =1 regardless of any differential relative severity of the experiences, may underestimate severity in households experiencing greater insecurity (Swindale and Bilinsky 2006). One way to address this is to use item weights derived from the prevalence of the experience in a population, so that items that are experienced more rarely are assigned a greater weight to account for their relative severity. This approach could be problematic, however, since an item’s prevalence is not always an accurate estimate of average perceptions of item severity in a population. Instead of item prevalence, average perceptions of item severity in a population familiar with water insecurity could be used to assign weights to scale items. However, the fact that there is variation in how different women who participated in our study perceive the severity of water insecurity items means that such efforts could also be problematic. Specifically, using average perceptions as item weights across study participants would ignore the extent to which an individual’s perception diverges from the average, which could over or underestimate the amount of psychological distress the individual experiences as result of their difficulties with access. This in turn could result in underestimating the correlation between water insecurity and psychological distress. Thus, while using unweighted scale items is problematic, addressing this challenge is also complicated. The suitability of approaches to assigning weights will likely depend on the goals of the study.

Our study also highlights the potential unintended impacts of state and NGO-led efforts to educate people about the risks of drinking contaminated water in the absence of efforts to ensure access to clean water. Specifically, our finding that drinking

water that might not be safe is both commonly experienced and perceived as very severe by women in rural Amhara, may reflect that public health efforts in rural Ethiopia during the last several years have increased people's awareness of and concerns about microbial contamination of their drinking water (FMoH 2007, 2011; Workie and Ramana 2013), without providing sufficient resources to ensure continual access to uncontaminated drinking water (CSA and ICF 2016; Stevenson et al. 2016; Stevenson et al. 2012).

There has been some progress, however, in improving access to water in rural Ethiopia. In a recent study in another part of rural Amhara state, Stevenson and colleagues (2016) conducted a survey of water insecurity among 292 women before and after an external ecological intervention: the installation of spring water protection infrastructure by an international NGO and its local implementing partners. They found that water insecurity scores were about two points lower after the installation of the new infrastructure, in comparison to scores in control sites. The item/experience that saw the largest drop in prevalence was the same one that emerged as both common and perceived as relatively severe in our field site: "drinking water that might not be safe." Stevenson and colleagues (2016) further found that psychological distress levels were significantly associated with water insecurity scores yet that the intervention did not have a significant impact on participants' levels of psychological distress. Since this study measured psychological distress only a few months after the installation of new water infrastructure, it is possible that the psychological impacts of interventions that reduce peoples' concerns about drinking unsafe water may take longer to be felt (Stevenson et al. 2016).

This is somewhat encouraging since it suggests that typical water access interventions in our study area are effective at addressing experiences that are both prevalent and perceived as highly severe. At the same time, our study underlines the importance of achieving larger reductions in the prevalence (indeed, elimination) of consuming water that is unsafe or even feared to be unsafe since exposure to unsafe water carries risks of infectious disease and death, while consuming water that is feared to be unsafe and knowing that other household members are doing so are particularly distressing. Our findings thus demonstrate that household water insecurity is a complex human rights issue that involves experiences of distress as well as thirst, exposure to pathogens, and both real and perceived risk of infectious disease-related suffering and death (Wutich and Brewis 2014). Based on this conceptualization of water insecurity, we hypothesize that water access interventions in similar contexts will have larger impacts on psychological distress if they achieve larger reductions in experiences that are both commonly reported by people and subjectively perceived as highly severe.

Our study had several limitations. Alternative methods could be used to gather data about the subjective severity of water or food insecurity items, which could generate divergent findings. One method is pair comparisons: asking participants

to choose which of two items is more severe. Another approach is pile sorting: asking participants to place items into piles categorized as, for example, mild, moderate, and severe (Bernard 2011). However, these approaches would be difficult with nonliterate participants. It would also be very helpful to gather qualitative data on peoples' perceptions of item severity, to provide a richer picture of the range of perceptions that exist in a population and across a set of items/experiences, and to explore how peoples' perceptions change and why they vary.

We did not closely examine relationships between perception of water insecurity item severity and household water source, per capita income, composition, or primary occupation, which means we were unable to test hypotheses that the differences in perceptions we found across kebeles could be due in part to differences in water source, income, or wealth across kebeles. Future study could test the hypothesis that women from households with higher incomes or that use certain kinds of water sources perceive water insecurity as more severe than others. This could have implications for the well-being of people experiencing water insecurity and their tendency to seek out certain solutions to their water access problems.

The number and diversity of people who participated in this study are also limited. Repeating our study with a larger sample of participants in different settings is necessary to confirm our findings and determine whether or not they hold across contexts and time. Finally, we asked about subjective severity on only a subset of thirteen items/experiences, and some of our analyses were limited to only five items.

Our findings nevertheless emphasize the importance of protecting peoples' universal rights to water—particularly access to clean, potable water—for the well-being of people, including the psychological well-being of women. Our findings also emphasize the need for holistic studies that use both quantitative and qualitative methods to better represent the experiences and perceptions of people burdened with water insecurity.

Acknowledgements

The authors would like to thank all of the women who participated in and contributed data to the study. We are grateful for the assistance of Mulusew Lejalem Belew, Kassahun Zewudie, Mulat Woreta, Resom Berhe, Siraj Mohammed, Maryann G. Delea, Gloria D. Sclar, Tigist Abebe, Yeserash Gashu, and Destaw Asnakew. We are also grateful for the assistance of multiple Health Extension Workers (HEWs), kebele leaders, Women's Development Army Leaders, and field guides. This study was conducted as part of two larger research projects: (1) the impact of enhanced, demand-side sanitation and hygiene promotion on sustained behavior change and health in Amhara Ethiopia (PI: Matthew Freeman), funded by the World Bank, 3ie, and CIFF; and (2) developing the Household Water Insecurity Experiences (HWISE) Scale, a cross-culturally validated scale to measure

water insecurity at the household level (PI: Sera Young), funded by IMMANA. The authors declare that we have no conflicts of interest.

Notes

¹<http://www.freemanresearchgroup.org/andilaye>

²<http://opendatakit.org/>

³The subjective severity items were developed by our Ethiopian research team based on previous study of water insecurity in Amhara, Ethiopia, while the water insecurity scale items were concurrently developed by a different group of researchers (the HWISE Consortium) examining water insecurity cross-culturally.

References Cited

- Ballard, Terri J., Anne W. Kepple, and Carlo Cafiero
2013 The Food Insecurity Experience Scale: Development of a Global Standard for Monitoring Hunger Worldwide. URL:<<http://www.fao.org/3/a-as583e.pdf>> (October 12, 2018).
- Bernard, Russell H.
2011 Research Methods in Anthropology: Qualitative and Quantitative Approaches. 5th ed. New York: AltaMira.
- Boateng, Godfred O., Shalean M. Collins, Patrick Mbullo, Pauline Wekesa, Maricianah Onono, Torsten B. Neilands, and Sera L. Young
2018 A Novel Household Water Insecurity Scale: Procedures and Psychometric Analysis among Postpartum Women in Western Kenya. PLoS ONE 13(6):e0198591.
- Bolton, Paul, and Alice Tang
2002 An Alternative Approach to Cross-cultural Function Assessment. Social Psychiatry and Psychiatric Epidemiology 37(11):537-543.
- Brewis, Alexandra, Asher Rosinger, Amber Wutich, Ellis Adams, Lee Cronk, Amber Pearson, Cassandra Workman, Sera Young, and Household Water Insecurity Experiences-Research Coordination Network (HWISE-RCN)
2019 Water Sharing, Reciprocity, and Need: A Comparative Study of Inter-household Water Transfers in Sub-Saharan Africa. Economic Anthropology Online ISSN: 2330-4847.
- Cafiero, Carlo, Mark Nord, Sara Viviani, Mauro Eduardo Del Grossi, Terri Ballard, Anne Kepple, Meghan Miller, and Chiamaka Nwosu
2016 Voices of the Hungry: Methods for Estimating Comparable Prevalence Rates of Food Insecurity Experienced by Adults throughout the World. Rome, Italy: Food and Agriculture Organization of the United Nations.
- Central Statistical Agency (CSA) [Ethiopia] and ICF
2016 Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia, and Rockville, MD: Central Statistical Agency and ICF.
- Coates, Jennifer, Anne Swindale, and Paula Bilinsky
2007 Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide. Washington, DC: United States Agency for International Development.
- Deitchler, Megan, Terri Ballard, Anne Swindale, and Jennifer Coates
2010 Validation of a Measure of Household Hunger for Cross-Cultural Use. Washington, DC: Food and Nutrition Technical Assistance II Project (FANTA-2), FHI 360.
- Federal Ministry of Health (FMOH) [Ethiopia]
2007 Ethiopia Health Extension Program. URL:<<http://www.moh.gov.et/es/web/guest/-/health-extension-program-in-ethiopia?inheritRedirect=true>> (October 4, 2018).
2011 National Sanitation and Hygiene Strategic Action Plan for Ethiopia, 2011-2015. Addis Ababa: Federal Democratic Republic of Ethiopia.
- Hadley, Craig, and Matthew Freeman
2016 Assessing Reliability, Change after Intervention, and Performance of a Water Insecurity Scale in Rural Ethiopia. Food Security 8(4):855-864.
- Hadley, Craig, and Amber Wutich
2009 Experience-based Measures of Food and Water Security: Biocultural Approaches to Grounded Measures of Insecurity. Human Organization 68(4):451-460.
- Jepson, Wendy
2014 Measuring “No-Win” Waterscapes: Experience-based Scales and Classification Approaches to Assess Household Water Security in Colonias on the US-Mexico Border. Geoforum 51: 107-120.
- Jepson, Wendy, Jessica Budds, Laura Eichelberger, Leila Harris, Emma Norman, Kathleen O'Reilly, Amber Pearson, Sameer Shah, Jamie Shinn, Chad Staddon, Justin Stoler, Amber Wutich, and Sera Young
2017 Advancing Human Capabilities for Water Security: A Relational Approach. Water Security 1: 46-52.
- Maes, Kenneth, Svea Closser, Yihenew Tesfaye, Yasmin Gilbert, and Roza Abesha
2018 Volunteers in Ethiopia's Women's Development Army Are More Deprived and Distressed Than Their Neighbors: Cross-sectional Survey Data from Rural Ethiopia. BMC Public Health 18(1):258.
- Maes, Kenneth, and Yihenew Tesfaye
2015 Competition, Cooperation, and Co-optation: Understanding the Rapidly Changing Context of Women's Water Use and Management in Rural Ethiopia. Paper presented at the annual meeting of the Society for Applied Anthropology, Pittsburgh, PA, March 26.
- Stevenson, Edward G. J., Argaw Ambelu, Bethany A. Caruso, Yihenew Alemu Tesfaye, and Matthew C. Freeman
2016 Community Water Improvement, Household Water Insecurity, and Women's Psychological Distress: An Intervention and Control Study in Ethiopia. PLoS ONE 11(4):e0153432.
- Stevenson, Edward G. J., Leslie E. Greene, Kenneth C. Maes, Argaw Ambelu, Yihenew
Alemu Tesfaye, Richard Rheingans, and Craig Hadley
2012 Water Insecurity in 3 Dimensions: An Anthropological Perspective on Water and Women's Psychosocial Distress in Ethiopia. Social Science & Medicine 75(2):392-400.
- Sultana, Farhana
2011 Suffering for Water, Suffering from Water: Emotional Geographies of Resource Access Control and Conflict. Geoforum 42(2):163-172.
- Swindale, Anne, and Paula Bilinsky
2006 Development of a Universally Applicable Household Food Insecurity Measurement Tool: Process, Current Status, and Outstanding Issues. Journal of Nutrition 136(5):1449S-1452S.

- Tesfaye, Yihenew, and Kenneth Maes
 2016 Impacts of New Water Access Points and Social Engineering Projects on Women's Water Access and Use in Rural Ethiopia. Paper presented at the annual meeting of the Society for Applied Anthropology, Vancouver, BC, Canada, April 2.
- Tsai, Alexander C., Bernard Kakuhikire, Rumbidzai Mushavi, Dagmar Vořechovská, Jessica M. Perkins, Amy Q. McDonough, and David R. Bangsberg
 2016 Population-based Study of Intra Household Gender Differences in Water Insecurity: Reliability and Validity of a Survey Instrument for Use in Rural Uganda. *Journal of Water and Health* 14(2):280-292.
- Workie, Netsanet W., and Gandham N. V. Ramana
 2013 The Health Extension Program in Ethiopia. URL:<<https://openknowledge.worldbank.org/bitstream/handle/10986/13280/74963.pdf?sequence=1&isAllowed=y>> (April 22, 2019).
- World Health Organization (WHO) and the United Nations Children's Fund (UNICEF)
 2017 Progress on Drinking Water, Sanitation, and Hygiene: 2017 Update and SDG Baselines. URL:<<http://www.who.int/mediacentre/news/releases/2017/launch-version-report-jmp-water-sanitation-hygiene.pdf>> (November 18, 2019).
- Wutich, Amber
 2009 Intrahousehold Disparities in Women and Men's Experiences of Water Insecurity and Emotional Distress in Urban Bolivia. *Medical Anthropology Quarterly* 23(4):436-454.
 2011 The Moral Economy of Water Reexamined: Reciprocity, Water Insecurity, and Urban Survival in Cochabamba, Bolivia. *Journal of Anthropological Research* 67(1):5-26.
- 2012 Gender, Water Scarcity, and the Management of Sustainability Tradeoffs in Cochabamba, Bolivia. In *Gender and Sustainability: Lessons from Asia and Latin America*. María Luz Cruz-Torres and Pamela McElwee, eds. Pp. 97-210. Tucson: University of Arizona Press.
- Wutich, Amber, and Alexandra Brewis
 2014 Food, Water, and Scarcity: Toward a Broader Anthropology of Resource Insecurity. *Current Anthropology* 55(4):444-468.
- Wutich, Amber, Jessica Budds, Wendy Jepson, Leila M. Harris, Ellis Adams, Alexandra Brewis, Lee Cronk, Christine DeMyers, Kenneth Maes, Tennille Marley, Joshua Miller, Amber Pearson, Asher Y. Rosinger, Roseanne C. Schuster, Justin Stoler, Chad Staddon, Polly Wiessner, Cassandra Workman, and Sera Young
 2018 Household Water Sharing: A Review of Water Gifts, Exchanges, and Transfers across Cultures. URL:<<https://doi.org/10.1002/wat2.1309>> (April 22, 2019).
- Wutich, Amber, and Kathleen Ragsdale
 2008 Water Insecurity and Emotional Distress: Coping with Supply, Access, and Seasonal Variability of Water in a Bolivian Squatter Settlement. *Social Science & Medicine* 67(12):2116-2125.
- Young, Sera, Godfred Boateng, Zeina Jamaluddine, Joshua Miller, Edward Frongillo, Torsten Neilands, Shalean Collins, Amber Wutich, Wendy Jepson, Justin Stoler, and the HWISE Research Coordination Network
 2019 The Household Water InSecurity Experiences (HWISE) Scale: Development and Validation of a Household Water Insecurity Measure for Low- and Middle-income Countries. *British Medical Journal Global Health* 4(5):e001750.

Reproduced with permission of copyright owner. Further reproduction
prohibited without permission.