



Water Insecurity In 3 Dimensions: An Anthropological Perspective On Water And Women's Psychosocial Distress In Ethiopia

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Abstract

Water insecurity is a primary underlying determinant of global health disparities. While public health research on water insecurity has focused mainly on two dimensions, water access and adequacy, an anthropological perspective highlights the cultural or lifestyle dimension of water insecurity, and its implications for access/adequacy and for the phenomenology of water insecurity. Recent work in Bolivia has shown that scores on a water insecurity scale derived from ethnographic observations are associated with emotional distress. We extend this line of research by assessing the utility of a locally developed water insecurity scale, compared with standard measures of water access and adequacy, in predicting women's psychosocial distress in Ethiopia. In 2009e2010 we conducted two phases of research. Phase I was mainly qualitative and designed to identify locally relevant experiences of water insecurity, and Phase II used a quantitative survey to test the association between women's reported water insecurity and the Falk Self-Reporting Questionnaire (SRQ-F), a measure of psychosocial distress. In multiple regression models controlling for food insecurity and reported quantity of water used, women's water insecurity scores were significantly associated with psychosocial distress. Including controls for time required to collect water and whether water sources were protected did not further predict psychosocial distress. This approach highlights the social dimension of water insecurity, and may be useful for informing and evaluating interventions to improve water supplies.

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Introduction

Globally, 884 million people drink water from unimproved sources (JMP, 2010). Disparities in the availability of safe water constitute one of the primary underlying determinants of global health inequalities. Sixty percent of child diarrhea deaths are attributable to unsafe water, sanitation, and hygiene (WASH) (Boschi-Pinto, Velebit, & Shibuya, 2008; Prüss-Ustün, Kay, Fewtrell, & Bartram, 2004), and the quality and quantity of water supply contribute to malnutrition and vector-borne diseases (Fewtrell, Prüss-Ustün, Bos, Gore, & Bartram, 2007). Water also has indirect influences on health: where water is collected from sources distant from the home, time and effort expended on water collection constrains income generating activities, contributing to vicious cycles of poverty (Blackden & Wodon, 2006; Krishna, 2010). Recognition of this has inspired the Millennium Development Goal to halve the number of people without sustainable access to improved drinking water. It has also led to a focus on *water insecurity* (UNDP, 2006) – which, in parallel with food insecurity, has been defined as “insufficient and uncertain access to adequate water for an active and healthy lifestyle” (FAO, 2004; Hadley & Wutich, 2009: 451).

The 3 dimensions of water insecurity – adequacy, access, and lifestyle – have received varying amounts of attention in research to date, with adequacy and access being studied largely by public health researchers (Billig, Bendahmane, & Swindale, 1999; Ford, 1999; Gleick, 1996) and the lifestyle or cultural component studied by anthropologists. The cultural dimension of water use has implications both for access/adequacy and for the phenomenology of

water insecurity. Historical and ethnographic accounts demonstrate diversity in water regulation and use across cultures (e.g. Lansing, 1987; Little & Leslie, 1999; Reisner, 1993; Thesiger, 2007 [1954]), implying different expectations and requirements for water. Ethnographic work also points to culturally specific understandings of water insecurity, such as the “suffering from water” documented by Ennis-McMillan (2001) in Mexico.

Following an approach that has proven useful in research on food insecurity (Frongillo & Nanama, 2006; Frongillo, Nanama, & Wolfe, 2004; Wolfe & Frongillo, 2001), some scholars have pointed to the value of developing water insecurity scales from the ground up, beginning with qualitative research on water use in a particular cultural context, and then adapting findings to the form of survey questionnaires, with answers scored as a metric of water insecurity (Hadley & Wutich, 2009). Rather than relying exclusively on proxy measures such as health indicators (e.g. incidence of child diarrhea or prevalence of child growth stunting (Checkley et al., 2004; Hasan et al., 1989)) or measures of physical access to water (e.g. time to source, quality of source, or quantity consumed (Whittington, Mu, & Roche, 1990)), locally grounded research can generate experience-based measures of water insecurity, reflecting local idioms of stress and suffering. The advantages of this approach are that it measures the experience of water insecurity relatively directly, and it takes account of the social context of water use. The validity of these measures can be evaluated by the extent to which they reflect (1) variability in water supply within communities in terms of quality, quantity, and access, (2) division of labor of water collecting within households, such as between women and men, and (3) independent measures of individuals' psychosocial distress.

This approach to water insecurity has been pioneered by Wutich, who in a series of studies in urban Bolivia showed how ethnographic evidence on water insecurity could be used to create a locally grounded scale of water insecurity. Wutich demonstrated that households with greater water insecurity as measured by a 9-point Guttman scale also had worse access to water; women – who bore the majority of the burden for collecting water – reported greater water insecurity than men; and water insecurity, but not per capita water use as recorded in diaries, was significantly associated with scores on a measure of emotional distress that included symptoms of anger, bother, fear, and worry (Hadley & Wutich, 2009; Wutich & Ragsdale, 2008). Taken together with ethnographic evidence (Wutich, 2009a), these findings suggest that water insecurity is determined not only by physical access and adequacy of water supplies, but also by the stresses inherent in negotiating with inequitable systems of water regulation.

In this article we advance understanding of the social dimension of water insecurity by developing a new scale of water insecurity and evaluating its relationship to an internationally accepted measure of psychosocial distress. Our assumption is that culturally specific norms and expectations regarding water use, as well as physical access constraints and adequacy of supply, inform the experience of water insecurity. We illustrate this approach through a case study in rural sub-Saharan Africa, an area of the world where water insecurity is of great concern, and where gendered division of labor in relation to water collection is widespread (Munguti, 2002; Ray, 2007; White, Bradley, & White, 1972). The research design included a mixture of qualitative and quantitative methods: qualitative methods for exploring the pathways connecting water and psychosocial distress in the study population, and quantitative methods for building a water insecurity scale and assessing its relationship to psychosocial distress. The hypothesis addressed by the study is that water insecurity, as measured by a locally developed scale, is independently associated with psychosocial distress, after accounting for food insecurity, quantity of water collected, distance from water source, and unprotected water sources.

Methods

Study setting

The study was carried out in rural communities in South Gondar zone of Amhara regional state, in Ethiopia. Water access in Ethiopia is strongly influenced by place of residence, with an estimated 81% of urban but only 11% of rural households having access to improved water sources (Gleick, Cooley, & Morikawa, 2009). Water availability is subject to seasonal variation, with rains between May and September (*Keremt*), shorter rains in February/March (*Belg*), and a dry season from October to February (*Bega*) (Kloos & Zein, 1992). The rural population is dependent on rainfed smallholder agriculture, with ox-drawn plows being the basis of the agricultural system (Hoben, 1973; McCann, 1995). At the time of the research reported here, in November 2010, food aid in the form of wheat from the USA was being distributed in the administrative center of Debre-Tabor. CARE, a non-governmental organization focused on poverty alleviation and women's empowerment, has conducted development programs including improvement of water supply in this area since 2000 and was involved in facilitating the logistics for this research.

Two phases of research were carried out in communities in South Gondar, the first being mixed methods, formative research (November–December 2009), and the second a quantitative survey (February 2010) (Fig. 1).

Questionnaire development and data collection

Phase I: formative research

The formative research employed methods of free listing, ranking, focus group discussions, and a household survey. Participants were women in five *kebeles* (the lowest local administrative units) within the *weredas* (districts) of Farta and East Estie. *Kebeles* were purposively selected based on advice from CARE, with the intention of capturing diversity in local ecology and access to water. Villages in 3 *kebeles* included in Phase II had previously received WASH interventions from CARE, and 2 *kebeles* were slated to receive interventions in the future.

Free listing and household survey

As a first step to developing an understanding of social norms and stressful life events (including but not limited to water concerns), we systematically sampled households ($n = 104$) using a skip pattern proportional to community size, and interviewed women who were either heads of household or wives of heads of household. The method chosen to elicit stressful life events was free listing, which involves asking respondents to list as many items as they are able that are relevant to a question which usually takes the form, “What are all the members of class X?” where the class could be animals, household tasks, or sources of daily stress (Borgatti, 1998). Our goal was to identify expressions or elements that related water to household work or other socially important domains, on the assumption that these elements, or inability to achieve them, may represent specific pathways through which water insecurity impacts psychosocial well-being. Following two “warm-up” questions about everyday activities and emotions, designed to ensure that they understood the style of questioning, women were asked to list (a) things that cause women to experience stress, (b) things that are necessary for “a good life”, (c) things that make a woman respected in the community, (d) things that characterize a good wife and mother, and (e) things a woman should do to keep her family healthy. In order to encourage candor, participants were asked to answer these questions not in terms of their own personal feelings but in relation to “the feelings of

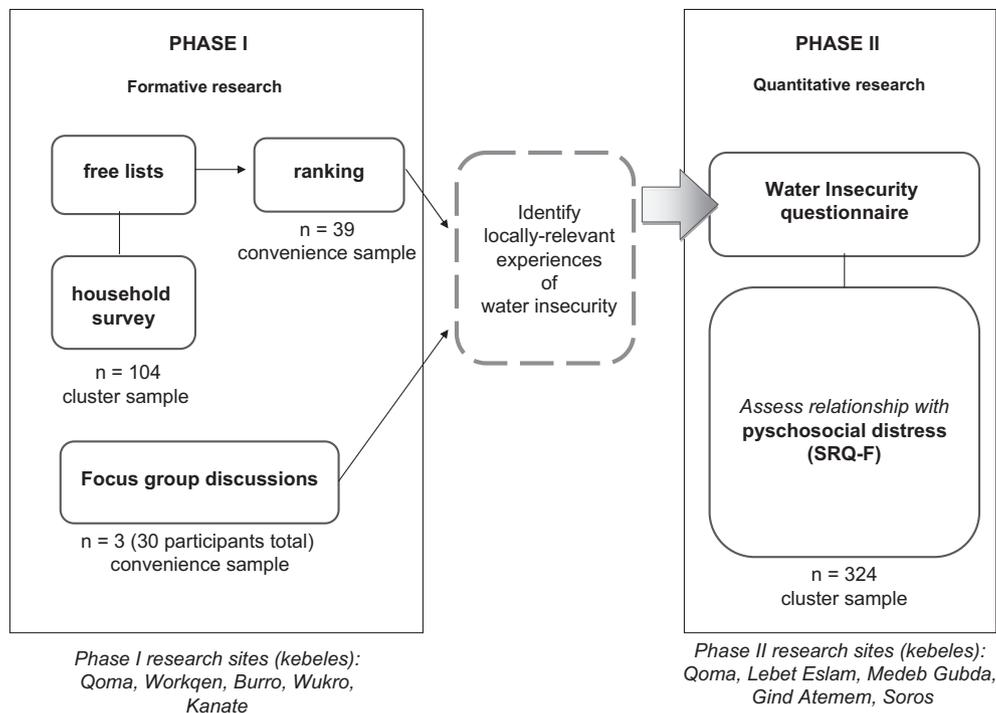


Fig. 1. Research design for investigating qualitative and quantitative dimensions of water insecurity in cultural context.

women in this community.” In order to avoid biasing answers toward water-related stresses, the study’s focus on water insecurity was not mentioned during the consent process for this component of the study. Rather, the research was presented more generally as intending to understand women’s views about happiness, stress, and daily activities.

Ranking of common sources of stress

In order to understand the relative importance of normative activities and qualities identified in the free lists, a convenience sample of 13 women each in 3 *kebeles* ($n = 39$) was selected for participation in a ranking activity (Weller & Romney, 1988). The items for ranking were selected from the free list questions “things that characterize a good wife/mother,” and “things a woman should do to keep her family healthy.” In addition to items nominated in the free lists, we also added items directly related to WASH, chosen *a priori* (e.g. “providing clean water for drinking”) in order to gauge the relative importance of water as a source of stress compared to other sources of stress. Because the majority of the study population was illiterate, ranking was carried out by means of paired comparisons: A data collector listed the 9 activities in pairs [$P(9,2) = 36$ separate pairings] and respondents were asked to choose, for each pair, which activity would be more “problematic” or “shameful” for a woman *not* to do. In order to avoid biasing responses based on the order in which the items were encountered, the order of the 36 pairs was randomized, and 4 randomizations were used in each *kebele*. This allowed us to infer, for each respondent, a rank order of importance for the set of 9 activities/qualities.

Focus group discussions

To generate rich data about experiences of water insecurity in women’s everyday lives, we convened focus group discussions (FGDs) in 3 *kebeles*, in each of which a convenience sample of 10 women participated ($n = 30$). An experienced FGD moderator led the discussions, which were audio-recorded and then translated from Amharic to English.

Phase II: quantitative survey

Data from the formative phase informed the construction of a structured questionnaire to assess respondents’ experience of water insecurity in the past 30 days. The survey also included questions about physical water access conditions, including time required to collect water (respondents’ estimates of travel time from home to primary source, and queuing time at source, in minutes), quantity collected (respondents’ estimates of household water use per day, in liters), and type of source (e.g. protected well, unprotected well, or river). Since water availability varies by season, we asked separately about rainy season and dry season water sources and water collection times. The questionnaire also addressed food insecurity (Swindale & Bilinsky, 2006); demographic characteristics of the household, including landholding and livestock assets; and division of labor and household decision-making (adapted from Balk, 1994). Finally, the survey included a psychiatric screening instrument, the Falk Self-Reporting Questionnaire (SRQ-F), which consists of 29 yes/no questions. The SRQ-F has been adapted from the standard SRQ and validated in Ethiopian populations (including the addition of 5 Amharic idioms of distress) and reflects a continuum of psychological disturbance ranging from mild to more severe depression, anxiety, and psychosis; values >7 may indicate psychiatric morbidity (Hanlon et al., 2008; Youngmann, Zilber, Workneh, & Giel, 2008; Zilber, Youngmann, Workneh, & Giel, 2004).

The quantitative survey was carried out in the same two *weredas* as Phase I but targeted different *kebeles* or (in the case of Qoma, the *kebele* that had exhibited the worst water access conditions) different villages within the *kebele*. The sampling scheme was cluster-based: villages within each *kebele* were purposively sampled to reflect varied water access conditions, and households within each village were then randomly sampled from complete rosters available at government health centers. Target respondents were either female heads of household or wives of the heads of household. Sample size was determined on pragmatic grounds, in order to include the maximum number of households given time and funding constraints.

In both Phase I and Phase II, teams of data collectors working in pairs conducted research activities in the local language, Amharic. All tools were translated from English into Amharic and then back-translated to ensure accuracy. Data collectors were women living in or near the towns of Debre-Tabor and Bahir Dar, who held diplomas in nursing. Preceding each phase of research, data collectors underwent three days of training on survey methods and research ethics. Ethical clearance for this study was obtained from the Institutional Review Board at Emory University, and all research participants provided informed oral consent.

Analyses

The analysis procedure included four steps: (i) analysis of qualitative and quantitative data to illuminate the physical and social ecology of water collection in the study communities; (ii) extracting information from free lists, rankings, and FGD transcripts to identify locally relevant dimensions of water insecurity for inclusion in a water insecurity scale; (iii) refining the water insecurity scale and assessing its internal consistency and convergent validity; and (iv) bivariate and multivariate analyses of the association between water insecurity and the SRQ-F measure of psychosocial distress.

Analysis of data on the ecology of water collection/use

Household surveys were analyzed using SPSS 18 for frequencies of descriptive information about water access conditions, and division of labor and decision-making related to household water collection.

Identification of locally relevant dimensions of water insecurity from free lists, rankings, and FGDs

Excel was used to calculate the frequency of free list items related to water use versus other areas of experience. Ranking exercise responses were analyzed using Excel to assess the ordering of the 9 items from most to least important, and the Similarities tool in UCINET 6 software (Analytic Technologies, 2011) was then used to quantify the degree of similarity among respondents' rankings – the level of cultural consensus – within each community (Weller, 2007). Consistent with convention, we considered an Eigenvalue ratio of first to second factors of 3.0 as a threshold for consensus (Romney, Weller, & Batchelder, 1986). FGD transcripts were coded inductively to identify water-related challenges and how women responded to them. Water-related items occurring in free lists and FGD transcripts were compiled to produce a list of experiences of water insecurity. This list constituted the basis of the water insecurity questionnaire used in Phase II.

Refinement of the water insecurity scale

Responses to the water insecurity questionnaire were first analyzed in terms of the frequencies of endorsement of each item. Next, in order to create a metric of water-related problems applicable to all households, we excluded items relevant only to a minority of participants (e.g. "reducing the amount of water provided to livestock," relevant only to those with livestock), and summed the remaining items. We assume that individuals who score higher on this scale are more water insecure. This process of building a water insecurity scale is conceptually similar to building locally appropriate food insecurity scales (Frongillo & Nanama, 2006). We assessed internal consistency of the scale using Cronbach's alpha. In order to determine whether the scale reflected water access and adequacy, we assessed convergent validity against three correlates: reported time required to collect water (an ordinal variable calculated from travel time to primary water source, multiplied by 2 to reflect round-trip, plus time queuing at the

source), whether the household's primary water source was unprotected (a proxy for risk of microbiological contamination), and quantity of water collected (reported liters collected per day, divided by number of household members). Given respondents' difficulties in estimating precise times required to travel to water sources in Phase I, responses in Phase II were categorized according to intervals (<5, 5–14, 15–29, 30–44, 45–59, 60–89, and >90 min). Since data collection occurred during the dry season, dry season water conditions were used in analysis, corresponding with the 30-day recall for psychosocial distress and water insecurity questions.

Assessing associations with psychosocial distress

The dependent variable, psychosocial distress, was calculated by summing each respondent's answers to the 29 SRQ-F questions, under the assumption that higher scores indicated greater psychosocial distress. In a similar manner, we constructed a food insecurity score by summing endorsements of 9 questions about food availability, eating habits, and experience of hunger (after Swindale & Bilinsky, 2006). We employed Pearson correlation and linear regression to examine whether water insecurity was independently associated with psychosocial distress. A first model adjusted for potential demographic correlates of psychosocial distress determined *a priori*, including age, marital status, household size (number of people cohabiting), socio-economic status (determined through principal components analysis of four variables representing land and animal holdings), and food insecurity. Subsequent models added covariates representing physical water access conditions, to determine the degree to which the experience-based water insecurity scale predicted psychosocial distress over and above measures of physical access to water. All models accounted for shared variance within villages, per the cluster sample design. Regression analyses were performed using SAS 9.2 (Cary, NC).

Results

Ecology of water use in South Gondar

As expected, responsibility for water collection in the study communities was held largely by women, although children – especially girls – also contributed. In Phase I, women were observed carrying water on their backs in earthenware pots (Amharic, *enseera*), secured with a rope around their shoulders, whereas children more often carried water in plastic jugs or jerrycans. In Phase II, 75% of women reported that they usually collected water, with smaller proportions reporting that a daughter (21%) or a son (2%) did so. In 54% of households, water collection tasks were shared by women and children. In response to questions about household decision-making, 93% of women claimed responsibility for decisions about where to collect water, and 98% said that they decided how much water to collect without consulting their husbands or other kin. This contrasted with the pattern for other household decisions (including how to spend money earned by either spouse, and whether to go to a clinic when a household member was ill), for which 60–80% of women responded that they and their husbands were equally responsible.

In household demographic characteristics there was little variation among the communities in Phase II of the study, but in terms of water access there was considerable variation (Table 1).

The salience of water as a determinant of psychosocial distress

In data from free lists, rankings, and FGDs, a varied picture emerges of stress in women's lives, and the role of water as a source

Table 1
Demographic characteristics of participants and community water access conditions, by *kebele*.

	Gind Atemem n = 59	Qoma n = 59	Lebet Eslam n = 76	Medeb Gubda n = 88	Soros n = 42	Total n = 324
Household characteristics						
Mean age of respondents (SD)	38 (12.2)	39 (13.5)	40 (11.9)	38 (14.7)	43 (13.3)	39 (13.3)
Mean household size (SD)	5.6 (2.0)	5.4 (2.4)	5.3 (2.0)	4.9 (1.7)	5.7 (2.3)	5.3 (2.0)
Mean food insecurity score (SD) [scale 0–9]	1.9 (2.2)	3.6 (2.9)	2.8 (2.3)	3.0 (2.7)	4.4 (2.6)	3.0 (2.6)
Mean SRQ-F score (SD) [scale 0–29]	8.3 (6.3)	10.6 (5.8)	9.3 (5.9)	9.8 (5.6)	13.4 (6.4)	9.9 (6.1)
Household WASH characteristics						
Mean water insecurity score (SD) [scale 0–24]	4.9 (4.5)	11.0 (5.9)	6.0 (5.6)	3.1 (3.8)	9.0 (6.2)	6.3 (5.8)
%Households with latrine	85	51	75	32	52	58
Mean liters of water collected per person/day (SD)	10.5 (6.5)	12.0 (11.0)	10.4 (4.3)	10.9 (4.5)	10.0 (5.7)	9.9 (6.1)
%Using unprotected drinking water source for drinking in rainy season	61	81	50	56	74	62
%Traveling >60 min to primary rainy season water source	7	5	8	7	14	8
%Queueing >30 min at primary rainy season water source	17	7	29	1	29	15
%Using unprotected drinking water source for drinking in dry season	56	98	51	53	69	64
%Traveling >60 min to primary dry season water source	10	44	3	8	14	15
%Queueing >30 min at primary dry season water source	21	49	63	5	54	41
WASH intervention by CARE	Yes	No	No	Yes	Yes	–

of stress. In free lists of common sources of stress, responses related to water were relatively uncommon, and in two of the three *kebeles* where rankings were carried out, water-related stressors ranked low in importance – the exception being Qoma *kebele*, which had the most constrained access to water (44% of women traveling >60 min to dry season source, and 98% using unprotected sources). Eigenvalue ratios of the first to the second factor for each set of rankings were below 3.0, suggesting an absence of consensus on the general ordering of items. We therefore concentrated on frequency of mention of items in free lists as a measure of salience. The most commonly mentioned stresses were sickness/death and poverty (shortage of food, money, or other resources), but when asked about things women should do to keep their families healthy, hygiene practices were frequently mentioned (Table 2).

FGD participants identified multiple ways that unsafe or insufficient water is related to psychosocial distress for women in South Gondar (Table 3).

FGD testimony underlined the importance of cultural context in shaping personal expectations of water access and adequacy. As one woman recounted,

[Not long ago] a teacher came to teach in the school that is newly constructed here. Recently he resigned from the job, saying that he can't work in a place where there is no water to drink, or to wash his body and clothes. This is the condition that we are accustomed to live in for many years, but he cannot tolerate the problem even for a year. This is because he knows how water is available in other areas, but we tolerate the water scarcity because we don't know how people in other areas are getting water. We collect water from any place that we can find it.... Sometimes we get water and sometimes we do not.

Table 2
Free list data on sources of stress for women, and ways of keeping one's family healthy: top 5 items, and number of times mentioned.^a

Sources of stress	#	Ways of keeping family healthy	#
1. Sickness/death	53	1. Washing clothes	47
2. Shortage of food	32	2. Bathing oneself or children	46
3. Shortage of money	28	3. Preparing good/clean foods	35
4. Crop failure/damage	14	4. Cleaning utensils	29
5. Pregnancy/childbirth	12	5. Cleaning the home	17

^a Based on free list responses from 70 women to the questions, "Thinking of the women in your community, what are the things that might cause them to experience stress?" and "What are the things a woman is supposed to do to keep her family healthy?"

Women described both opportunity costs of water- fetching and disputes with husbands and neighbors over water. One respondent from Qoma highlighted the tension between fulfilling household chores and fetching water:

When we go for collecting water, we may or we may not get water but [either way] the work at home will not be done. ... Then when the time comes [to eat, if the food is not ready] he [my husband] will insult me and quarrel with me. [But] how could I prepare food before making dough and baking? ... If there were water, let alone making dough and baking, I could also wash our clothes. If there were water, I could even do my housework in the moonlight [instead of leaving home at night to collect or queue for water]. The water shortage is making our lives very difficult.

FGDs also illuminated feelings of shame at the idea of appearing dirty in the eyes of others, failure to perform customary acts of hospitality, and (in a small number of cases) suspicion of neighbors for stealing water.

The key messages to emerge from the formative phase were that water-related activities lie clearly within women's sphere of work, and that access to sufficient water, and water that is perceived as healthy, are connected by a diverse set of pathways to psychosocial well-being, including not only stresses related to time costs and physical illness, but also social conflict, shame, and failure to take part in customary communal events. These insights were carried over into the building of a water insecurity scale, which was then tested through a quantitative survey in Phase II.

Building a water insecurity scale from the ground up

By pooling reported experiences of water insecurity derived from free lists, the Phase I household survey, and FGDs, we assembled a set of 32 experiences of water insecurity. These were divided heuristically into 6 dimensions: (1) perceived sufficiency and safety of water supply, (2) obstacles to water access, (3) opportunity costs of water collection, (4) measures taken to economize on water use, (5) altered social interactions related to water, and (6) thirst. In order to adapt this list to the format of an insecurity scale (e.g. Swindale & Bilinsky, 2006), we framed each of these experiences in the form of a yes/no question, and used a time reference period of 30 days, i.e. "Have you experienced X in the last 30 days?" Rates of endorsement ranged from 45% of women not collecting water because of long queues to 3% of women who had gone a whole day without drinking (Table 4).

Table 3
Experiences of water insecurity identified in focus group discussions.

Water-related stress	Examples mentioned in FGDs
Direct stresses of water collection	<ul style="list-style-type: none"> • “the sun and dust during the day and the cold during the night” • Risk of accident/assault/rape en route to water source • Lengthy queues at the water source
Opportunity costs of water collection	<ul style="list-style-type: none"> • Constrained time for other family responsibilities (e.g. cleaning, cooking, breastfeeding, planting/harvesting) • Constrained time for communal events (e.g. weddings, funerals) • Sleep deprivation • Children missing school to help with water collecting (especially girls)
Water-associated illness	<ul style="list-style-type: none"> • Typhoid • Worm infections • Gastro-intestinal illnesses • Eye infections
Economizing on water	<ul style="list-style-type: none"> • Not washing hands/body/utensils • Reusing water from dish washing for other purposes: “We use dirty water to clean things.”
Use of undesirable/suspect water sources	<ul style="list-style-type: none"> • “We drink the water accumulated in furrows.” • “If we find water in the field, we drink it because we have no alternative.”
Relationships with husbands and neighbors	<ul style="list-style-type: none"> • Domestic disputes over time use • Domestic violence: “If he can’t wash his face and feet, he will beat me.” • Disagreements over priority in access to water: “We fight each other in the water queue.” • “Loans” of water to/from neighbors • Accusations of theft of water by neighbors • Avoidance: “We are becoming aloof with people.”
Shame	<ul style="list-style-type: none"> • Shame at appearing unclean to others: “When our children go to school, we send them with dirty faces.” • Shame at wearing soiled clothes • Shame at being unable to fulfill normative expectations of hospitality (e.g. offering drinking water to guests)

In further analysis, we focused only on those items in the scale that were relevant to the great majority of women in the study, to create a summed water insecurity score that was broadly applicable to every household in the sample. This meant excluding questions relevant only to women who were currently married, who had school-aged children, or who kept livestock or grew crops or vegetables. Of the 32 questions in the original list, 8 were thereby eliminated, leaving 24 questions, all of which had response rates of 93% or higher. The 24-item water security scale (range 0–23) was internally consistent ($\alpha = 0.95$), and was correlated with time required to fetch water ($r = 0.52$; $p < 0.0001$) and whether the household used an unprotected water source ($r = 0.28$; $p < 0.0001$). However, contrary to expectation, the scale was not correlated with the reported daily quantity of water collected per person in the household ($r = -0.01$; $p = 0.82$).

Association between water insecurity and psychosocial distress

Water insecurity was positively correlated with psychosocial distress ($r = 0.22$, $p < 0.001$; one sided test), indicating that women who experienced more water insecurity also reported more symptoms of common mental disorders.

In a simple multivariate model controlling for potential demographic correlates of psychosocial distress (Table 5, Model 1), water insecurity showed a small, significant association (coefficient = 0.18; $p = 0.017$): for every additional item endorsed on the water insecurity scale, SRQ-F scores rose by approximately one fifth of a point. In Model 2, we added food security, which was associated with psychosocial distress at a marginal level of significance (coefficient = 0.32; $p = 0.062$), and water quantity, which showed a significant negative association with psychosocial distress (coefficient = -0.12 ; $p = 0.020$), while the relationship between water insecurity and psychosocial distress remained fairly stable and significant (coefficient = 0.15; $p = 0.037$). When all three physical

water access conditions were included in a third model (Model 3), neither water collection time (coefficient = 0.08; $p = 0.613$) nor use of an unprotected water source (coefficient = 0.06; $p = 0.93$) was associated with psychosocial distress, but reported quantity of water collected remained a stable and significant predictor. In the presence of these covariates, the magnitude of the effect of the water insecurity scale was reduced slightly, and it was no longer significant.

All three models had very low coefficients of determination (r -square = 0.13, 0.16, and 0.16, respectively); very little of the variance in psychosocial distress was captured by the variables in the models. This is a point to which we return in the discussion.

Discussion

In this paper we proposed a novel theoretical model linking women’s psychosocial distress to water insecurity, water collected, distance from water sources, unprotected water sources, and food insecurity. We used qualitative data to build from the ground up a water insecurity scale that would enable quantitative assessment of the theoretical model, and we showed that women’s scores on the water insecurity scale are associated with psychosocial distress. In this discussion we interpret our findings, acknowledge some weaknesses of the study, and offer thoughts on next steps in building water insecurity scales and assessing the full impacts of water insecurity on physical and mental health.

This study demonstrated that water collection is primarily women’s responsibility in rural South Gondar, and illuminated multiple pathways by which this responsibility may impact on women’s health. Use of heavy earthenware vessels for water-carrying, as opposed to the lighter plastic jerrycans used in other parts of Ethiopia and sub-Saharan Africa (Munguti, 2002; White et al., 1972) – together with the rugged terrain that characterizes the region – appear to make water collection in South Gondar extremely physically demanding. In addition to the energetic

Table 4
Percentages of women who reported stressful water-related experiences in the past 30 days ($n = 324$).^a

	%
I Perceived safety & sufficiency of water supply	
1 Worried that volume of water available would be inadequate for all needs*	33.7
2 Drank water that you thought might not be safe for health	31.9
3 Collected water from an undesirable/dirty source	21.0
II Obstacles to water access <i>did not collect water because...</i>	
4 The queue was too long	45.9
5 There was not enough water at the source	40.3
6 It was too far away/took too long	32.1
7 Was too sick/weak to collect water	20.7
8 It was too risky/dangerous	14.8
III Social interactions related to water	
9 Took water from someone else in village	36.3
10 Had someone else take water from your house because of shortage	36.5
11 Quarreled with a neighbor over issues related to water collection	11.1
12 Quarreled with husband over not completing household work*	18.4
13 Quarreled with husband over household water needs*	11.5
IV Opportunity costs of water collection	
14 Did not participate in church/funeral/wedding/kebele meeting because there were too many chores to do	38.1
15 Was unable to complete all work because of water collection	36.5
16 Slept very few hours because of having to go out to collect water	34.4
17 Did not cook a desirable food because there was not enough water	21.7
18 Kept a girl home from school to help with water collection*	18.5
19 Kept a boy home from school to help with water collection*	5.5
V Measures taken to economize water use <i>reduced the amount of water used for</i>	
20 Washing clothes	28.3
21 Bathing	27.8
22 Cleaning the house/plastering floor with cow-dung	24.3
23 Washing utensils	23.6
24 Washing hands/face/legs	23.6
25 Cooking	21.1
26 Drinking	20.8
27 Watering vegetables*	33.7
28 Watering staple crops*	30.5
29 Watering livestock*	29.4
30 Making beer/coffee*	16.6
VI Thirst	
31 Went to sleep thirsty	12.7
32 Went a whole day without drinking water	3.7

^a Items marked with asterisks had response rates lower than 98%. [1 (93%), 12 & 13 (81%), 19 (60%), 20 (56%), 28 (25%), 29 (60%), 30 (56%), 31 (73%)]. With the exception of question 1 (worry over adequacy of water quantity), these items were removed from subsequent scale development. All other questions had response rates of >97%.

demands and time costs of water collection, and the toll that water-borne disease takes on physical health (components of the access and adequacy dimensions of water insecurity), this study exposed a cultural dimension of water insecurity operating through strained personal relationships and shame at failing to meet normative standards of propriety and conduct.

These insights informed the development of a water insecurity scale, the scores on which were correlated with time required to collect water and use of unprotected sources. In regression models, the inclusion of water collection time and use of unprotected sources did not add to prediction of psychosocial distress when water insecurity was accounted for. Moreover, in Model 3 the magnitude of association was higher for water insecurity than for collection time and source, indicating that the water insecurity scale

provides additional information that is aligned with psychosocial distress. The absence of correlation between water insecurity and reported quantity of water collected, and the independent association between reported quantity of water collected and psychosocial distress, suggests that quantity of water collected per household member may contribute to psychosocial distress through a different pathway than the experiences of water insecurity included in our scale. However, the low coefficient of the water insecurity score (~ 0.15) demonstrates that it is a weak predictor of psychosocial distress, and the low levels of overall variance in psychosocial distress explained indicate that explanations require consideration of other factors not accounted for in our models.

Limitations

The sample size used in this study was determined by time and funding constraints, and it is possible that a larger sample might yield different results. Potential for error in measurement of psychosocial distress and water consumption must also be acknowledged. The SRQ was designed for psychiatric screening in clinical settings, and is therefore not an ideal measure for population surveys; and although the SRQ-F has been validated in Ethiopia, cultural insensitivity in the context of South Gondar is possible. The lack of correlation between water insecurity and reported water quantity contrasts with research in Bolivia showing that water consumption assessed by free recall is associated with water insecurity (Hadley & Wutich, 2009), and the independent association between reported quantity of water and psychosocial distress contrasts with evidence from Bolivia that water use as recorded in diaries is not associated with emotional distress (Wutich & Ragsdale, 2008). The method of estimating water quantity is consequential, and reported values, as used in this study, may be subject to recall bias (Wutich, 2009b).

One limitation of the water insecurity scale is that, since it includes not only “cultural” measures (e.g. not attending church because of water collection duties, and consequent feelings of shame) but also measures of access (e.g. not collecting water because the source was too far away) and adequacy (e.g. using an undesirable source), we cannot readily distinguish between these three dimensions of insecurity based on individuals’ summed scores. The multidimensionality of the scale, and the fact that the items are unweighted, also means that we cannot be confident that one person’s score of a given value represents the same intensity of water insecurity as does another with the same value. In these respects the unidimensional water insecurity scale developed by Wutich is to be recommended (Hadley & Wutich, 2009).

As this study was cross-sectional, we are unable to determine conclusively the direction of the relationship between water insecurity and psychosocial distress. It is possible that depression or anxiety could cause women to change their water collection and use patterns. However, the qualitative data from FGDs strongly suggest that women in South Gondar recognize the impact of water insecurity on psychosocial distress, and provide support for our conceptual model.

We also acknowledge the possibility of bias arising from our collaboration with CARE Ethiopia, an aid organization active in the study communities, which might have led respondents to tailor their responses to maximize the likelihood of receiving aid. We attempted to avoid this through communicating to participants before each interview an informed consent statement that made clear that no compensation would be provided for participation.

Implications for approaches to water insecurity

The aim of this study was not to explain women’s psychosocial distress as such, but to assess manifestations of water insecurity in

Table 5

Association of water insecurity with psychosocial distress (SRQ-F), adjusting for demographic correlates (Model 1) and physical water access conditions (Models 2 & 3).

	Model 1			Model 2			Model 3		
	Coeff.	SE	p	Coeff.	SE	p	Coeff.	SE	p
Water insecurity score	0.18	0.07	0.017**	0.15	0.07	0.037**	0.13	0.09	0.183
Intercept	2.27	2.02	0.271	3.15	1.99	0.125	2.73	2.45	0.276
Age	0.13	0.04	0.002 **	0.13	0.03	<0.001**	0.13	0.03	<0.001**
Married	0.46	1.01	0.655	1.67	0.69	0.023**	1.66	0.68	0.023**
Household size	0.09	0.21	0.664	-0.09	0.25	0.736	-0.10	0.26	0.711
Wealth/asset score ^a	-0.18	0.35	0.608	-0.04	0.35	0.909	-0.01	0.35	0.974
Food insecurity score ^b	0.26	0.18	0.161	0.32	0.17	0.062 *	0.34	0.17	0.055 *
Water quantity collected (liters)				-0.12	0.05	0.020 **	-0.12	0.05	0.021 **
Water collection time (ordinal interval)							0.08	0.16	0.613
Unprotected water source							0.06	0.93	0.951

**significant at $p < 0.05$; * marginally significant at $p < 0.1$.^a Wealth/asset score calculated from principal components analysis of area of land owned, and number of cattle, sheep/goats, and donkeys/horses (min -1.49, max 4.23, mean 0).^b Food insecurity measured as the sum of answers to 9 questions concerning experience in the past 30 days of worry about household food sufficiency, inability to obtain preferred kinds of foods, reducing meal size or frequency, and going a whole day without eating (min 0, max 9, mean 3.35).

rural Ethiopia, and to contribute to efforts by other social scientists to improve understanding of the lived experience of water insecurity by developing scales from the ground up (Hadley & Wutich, 2009; Wutich & Ragsdale, 2008). Our results suggest that this approach to conceptualizing water insecurity is warranted. With more research of this sort, commonalities among experiences of water insecurity across cultural contexts might emerge, opening up scope for the development of a more widely applicable water insecurity scale with stronger predictive properties. Nutrition researchers have been successful in developing such scales for measurement of food security, and have demonstrated their validity and their practicality for monitoring and evaluation of nutrition interventions (Hadley & Patil, 2006; Webb et al., 2006). Equivalent scales of water insecurity would be useful for gauging the effectiveness of water interventions. Such research is important as climate change and heightened competition for water resources threaten to increase water insecurity in future (Levy, Babu, & Hamilton, 2005). Since food and water insecurity often co-occur, it is important for future studies to measure both. Future studies of water insecurity should include both men and women, focus on maximally diverse cultural and ecological contexts, use alternative measures of psychosocial distress, and employ pre/post-intervention designs (e.g. assessment before and after provision of improved water supplies).

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