Research Paper

Understanding water-related emotional distress for improving water services: A case study from an Ethiopian small town

Vincent Thomas and Samuel Godfrey

ABSTRACT

This paper introduces the concept of emotional distress as a means of measuring the direct experience of inadequate access to drinking water in a small town in Ethiopia under the UNICEF-Government of Ethiopia urban ONEWASH plus programme. The paper explores a new perspective on the relationship between water technologies, water services, household socio-economic characteristics (as predictors) and mental health in its broad definition. Results indicate that water-related emotional distress is predominantly associated with the 'cost of water' and the 'size of household'. Quantity of water, reliability of the preferred source and accessibility were not significant predictors to emotional distress. Whether the household accessed a pipe into a compound or another improved source was not a significant predictor either. The safely managed target in the Sustainable Development Goal (SDG) 6.1 focuses on the affordability, accessibility and safety of water but does not explore the relation between cost and water-related emotional distress. This evidence offers a complementary approach to the 'affordability of water services' as it looks beyond the mere financial implications of water costs.

Key words | Africa, emotional distress, Ethiopia, urban, water supply

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INTRODUCTION

Global estimates indicate that half a million people die every year from preventable cases of diarrhoea directly caused by inadequate water services with more than half of the cases of diarrhoea in low-income countries being attributable to poor water sanitation and hygiene (Prüss-Ustün *et al.* 2014). Around 10% of the global burden of disease could be reduced through improved water services, better hygiene and improved sanitation (UN Water 2009). Improving public health is at the centre of water, sanitation and hygiene (WASH) interventions, while providing better water services is one of the strategic dimensions of WASH interventions. WASH research has shown the association between improved water sources, better 'water services' and improved health (Bartram *et al.* 2014). The majority of these studies focus on reducing water-borne diseases. Limited studies have explored the other dimensions of health, as defined by the World Health Organization (WHO): '*a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity*' (WHO 1946). This paper focuses on the mental and social well-being of health and the role that WASH services can provide. By contributing to understanding the association between water-related emotional distress and water services, water sources and household socio-economic characteristics, it contributes to answering the recent calls for a better understanding of the psychological impacts of WASH programming (Bartlett 2005).

doi: 10.2166/washdev.2018.167

While the impacts of poor WASH services are mainly measured through their negative consequences on biophysical illness, including diarrhoea, local communities often express their struggle with access to WASH services by describing emotional hardships (Ennis-McMillan 2001). Sultana (2011) argues that accessing resources, including water, is not just a material challenge, but also an emotional one. In a recent qualitative gender study, Sahoo *et al.* (2015) have unveiled women's experiences of psychological stress in the context of accessing sanitation. They described how women in India were affected by environmental stressors (e.g., 'discomfort at defecation site'), social stressors (e.g., 'lack of privacy') and sexual stressors (e.g., 'peeping'). Henley *et al.* (2014) found that chronic stress (measured by hair cortisol content) was significantly higher among people who reported feeling unsafe collecting water or using sanitation facilities in two Kenyan settlements. Focusing more specifically on water supply, Stevenson *et al.* (2012) measured the association between general psychological distress (measured as a score) experienced by women in rural Ethiopia, and water quantity, collection time and type of water source (improved versus unimproved). They found a significant negative association between water quantity and general psychological distress. In the context of the urban water supply of Cochabamba (Bolivia), Wutich & Ragsdale (2008) focused specifically on water-related emotional distress (operationalised as a score on a Gutmann scale) by measuring the occurrence of four emotions associated with the process of accessing water, including symptoms of 'fear', 'worry', 'anger' and 'bother'.

Contrary to Stevenson *et al.* (2012), Wutich & Ragsdale (2008) found no evidence of association with water quantity. They found, however, a significant association between water-related emotional distress and household economic and social assets. They also stressed the importance of predictability of supply (although it was not measured directly) as a contributor to emotional distress. Still in urban Bolivia, Wutich & Ragsdale (2008) found that experience of water-related emotional distress was significantly different for men and women. Bulled (2016) also measured water-related emotional distress as a score that included nine items that included 'happiness about water supply' and 'being worried with water cleanliness'. He found that emotional distress was correlated with 'water insecurity' (measured with an 18-item scale) and education. However, he found no significant association between water-related emotional distress and health behaviour, household income or age. He also found that 'water-related' emotional distress was correlated with citizens' actions and claims to improve access to drinking water. Water insecurity is further emphasised by Jepson *et al.* (2017), who note the need for a rationale water security framework that considers emotional distress.

These exploratory studies provide useful insights into understanding how improving poor access to water and sanitation is not only about physical health but also mental health. However, comparisons across studies and opportunities for synthesis remain limited, as each study defines and operationalises emotional distress differently. Furthermore, only on a few of the different indicators that define domestic water service for monitoring WASH interventions for better health have been included as predictors in correlation analysis.

The choice of variables and frameworks for WASH monitoring are important for shaping our understanding of how improvement in WASH services contribute to improving people's health. Kayser *et al.* (2013) have underlined the importance of water technology, water quantity, water quality, accessibility, reliability or continuity, equity and affordability/cost, as the most commonly recommended indicators for measuring water services. Several studies have indicated how improvement in these indicators support better biophysical health. Indeed, better health has been shown to be related to water quantity (Stelmach & Clasen 2015), accessibility (Pickering & Davis 2012) or both (Howard & Bartram 2003). Unreliability of water sources has also been found to be indirectly related to poorer health (Pattanyak *et al.* 2005; Subbaraman *et al.* 2013). Episodic breakdowns have been shown to also have a significantly negative impact on health (Nygard *et al.* 2007; Hunter *et al.* 2009).

MATERIALS AND METHODS

The fieldwork took place in the town of Welenchiti (see Figure 1).

Welenchiti is located in the Oromia region, Ethiopia, 115 km from the capital city of Ethiopia. Ethical clearance

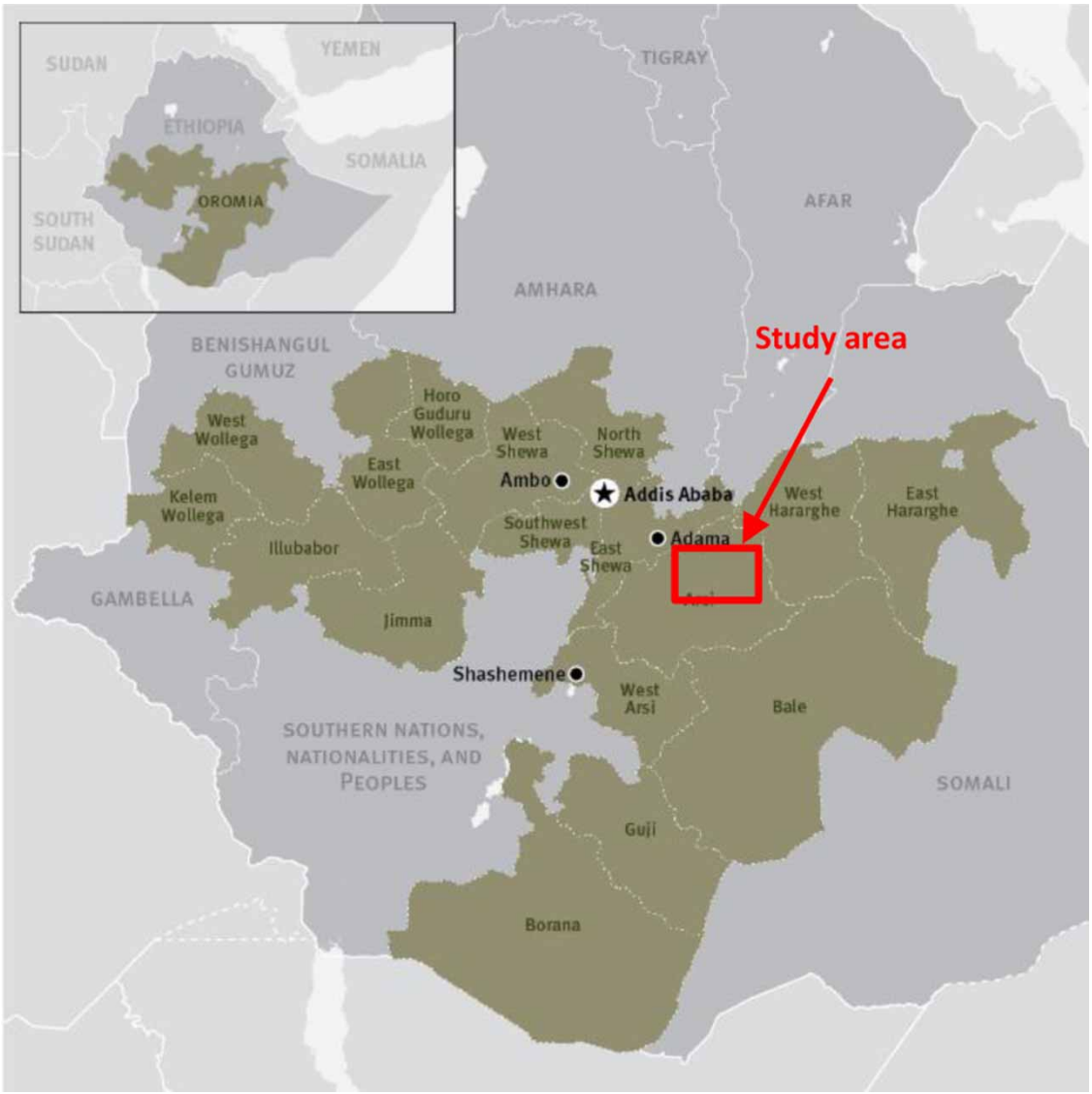

Figure 1 | Map of Welenchiti in July 2016.

was sought following standard procedures in Ethiopia. Letters of approval from both the relevant government department to undertake the research plus written household consent forms were administered. Welenchiti currently has a population estimated at 23,008 (the estimation is based on a projection starting from the 2011 data from the location municipality (population: 18,683) and population growth projections for the Oromia region from the 2007 census (population growth: 4.63%)) with an average population growth of 4.6% for the period 2010–2016. Sources of household livelihoods are diverse with around a third (36%) dependent on farming, with small business and trade sustaining another third (34%). Day labouring and formal employment (e.g., in government offices) are another significant source of livelihood (Adank *et al.* 2015). More than 49% of the household have livestock (average number: 3.7) that they water at home; 33% have an informal business requiring water (e.g., beer brewing, pot-making, cloth-washing); 7% have a small garden. In terms of public health, 'diarrhoeal diseases' represent 11% of the diseases recorded in the town's health centre in 2011–2012 (AYJEF Water Works 2013).

As shown in Figure 2, water production comes from six boreholes supplying four reservoirs (total capacity of 212 m^3). At the time of research, there were 1,544 pipe connections into compounds that were functional, at least occasionally. The pipe system also included 24 functional public taps (with very different levels of functionality).

The water supply pipe system is defined by the water utility and water users as 'deficient' (FGD; interview with senior water utility staff). A key issue is the intermittent nature of the supply due to recurrent electric power failures. The pipe system is also old, under-dimensioned and poorly maintained. All these issues combine to lead to very low pressure and low flow at the functional taps, while water can be accessed only during the night or up to the early morning hours. (It was observed that most households owning a pipe connection in their compound have now lowered the height of their tap mouth as the water head does not reach the normal height of taps.) Over the years, Welenchiti has not been able to fully address the challenge of balancing supply and demand, in the context of a fast growing urban population. Indeed, while the population has increased by an estimated 23% between 2011 and 2016, the production from boreholes has increased by only 11% average (Figure 3). As a consequence, regarding the pipe system deficiency, there were (at the time of research) 251 pipes into compounds and nine public taps that were considered dysfunctional or abandoned as they had not received water at all for years, even during the rainy season.

This research uses an approach developed by Wutich (2006) and includes four variables to measure water-related emotional distress as independent variable:

- 'Fear' (of running out of water)
- 'Bother' (with collection and/or management of water at household level)

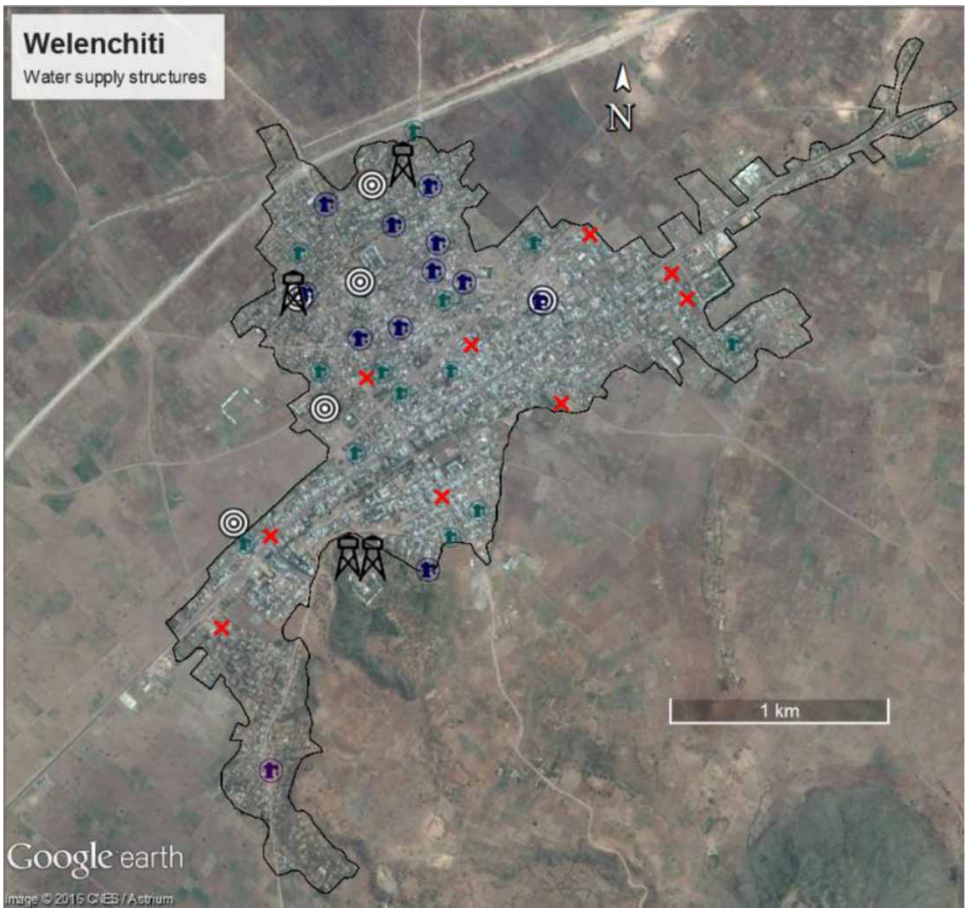

Figure 2 | Water supply structures in Welenchiti in July 2016.

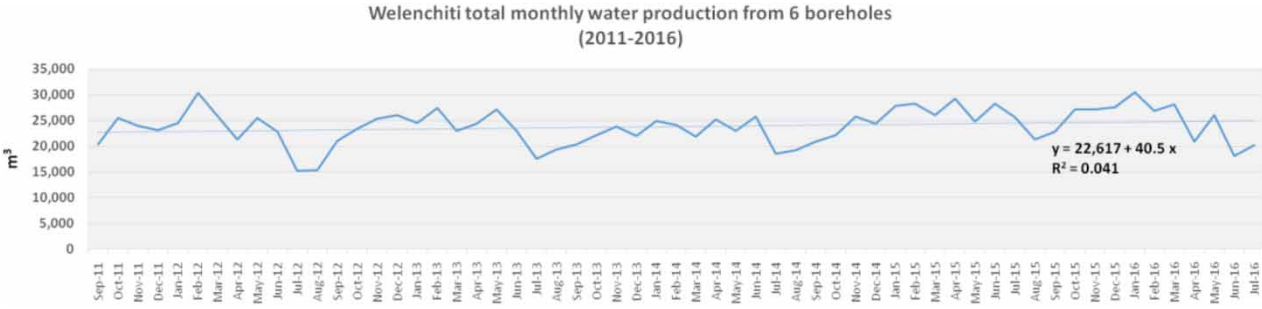

Figure 3 | Total monthly water production from six boreholes.

- 'Being upset with some inside the household' (regarding collection and/or management of water at household level)
- 'Being upset with someone outside the household' (regarding collection and/or management of water at household level).

The relevance of using those items, as proposed by Wutich (2006), was confirmed by preliminary informal discussions with water users from Welenchiti, who shared anecdotal experiences related to the process of water collection and use.

Data on water-related emotional distress experiences were collected as binary (Yes/No), while each answer was further probed to provide contextual illustrations. A water-related emotional distress score was calculated based on the number (ranging from 0 to 4) of water-related emotional distress experiences that were affecting the household.

We hypothesised that nine factors would be associated with water-related emotional distress: (1) water source type, (2) water quantity, (3) accessibility, (4) reliability, (5) cost, (6) household wealth, (7) household size, (8) gender of head of household and (9) highest level of education of household.

In terms of **water technology** for the main water source, Welenchiti households access drinking water either via a pipe into a compound, a pipe to a neighbour or a public tap during the rainy season. Following the JMP ladder approach we categorised the main water sources as 'pipe into compound' or 'other improved' source. **Water quantity** (expressed in litres per person per day) was estimated in terms of water containers as all water users collect and store water via containers (typically a 25-L jerrycan). The recall period for quantity estimation was the 7 days prior to the interview. For **accessibility**, we followed the recommendation of the JMP for post-2015 WASH indicators (WHO/UNICEF 2015), and the 'human right to water and sanitation' approach (UNCESCR 2003), which recommend measuring the total time spent on water collection. **Reliability** refers to *'the time which a point source is free from unplanned interruption due to breakdown or other causes'* (Kayser *et al.* 2013, p. 4822). Thus, the survey looked at whether a household managed to access its preferred water source the majority of the time over the recall period. The **cost** of water represents the amount of money that a water user had to pay per unit of water (m^3) consumed during the recall period.

We also analysed socio-economic variables as predictors to water-related emotional distress. **Wealth** was measured as a categorical variable based on ownership of assets that are locally considered being associated with better-off households. Education was measured as the highest level of education of household members and transformed into a binary variable ('primary education level or below' or 'secondary education level or above').

We conducted a multiple linear regression analysis to describe the extent, direction, and strength of the relationship between the nine predictor variables mentioned above and the water-related emotional distress score as our independent variable. This statistical test allows us to unveil the unique effect of each predictor on the independent variable even when the predictors are themselves interrelated. Predictor variables were further tested to assess the biasing effect of multi-collinearity, using tolerance and variance inflation factor (VIF) statistics (Table 1). We considered

that 'tolerance' should not be lower than 0.2 (Menard 1995) while VIF should not be greater than 10 and the average VIF should be not be significantly greater than 1 (Bowerman & O'Connell 1990). Statistical analyses were performed in SPSS v.23 (IBM 2015).

Primary data were collected through a household questionnaire and four focus group discussions (FGD). In the absence of a full sampling frame, we deployed optimisation methods adapted to such cases (Boesten & Chalabi 2006). To ensure an extensive geographic spread of the households, the town was divided into 399 household blocks (Figure 4).

Two hundred households ($n = 200$) were randomly sampled among those blocks with probability proportional to the size of blocks. Enumerators asked to interview the 'lady of the house' or any adult responsible for collecting water.

FGD were also conducted to better understand experiences of water-related emotional distress, and to triangulate with the findings from the quantitative analysis.

In order to better understand the specific context of the deficient pipe system, we collected and analysed secondary data from the Welenchiti water utility and conducted several interviews with its senior staff. These data also helped in triangulating results from the household survey, thus providing more confidence in our findings.

RESULTS

Water services in Welenchiti

The average water consumption during the rainy season was 24 L/p/d. As mentioned earlier, water-related emotional distress was measured during the rainy season. During that season, only 19 L/p/d is consumed from the town pipe system while the rest is consumed from household rainwater collection as a secondary source. Less than 4% consume more than 50 L/p/d, which is the threshold defined as the human right to water. (Note that this may be more of a reflection of a low demand rather than an insufficient supply). The average time to source was less than 3 minutes (one way) on average. However, due to the general deficiency of the town pipe water supply system, the time spent travelling to the source was dwarfed by the time spent on queuing and filling containers. On average, households spent a total time of 47 minutes for water collection.

Table 1 | Multiple linear regression predicting water-related emotional distress score from nine indicators

Predictors of emotional distress (score) ($n = 200$, $R^2 = 0.16$, $F = 4.1$, $p < 0.0001$	r	B	Std. error	β	t	Sig.	Collinearity statistics	
							Tolerance	VIF
(Constant)		0.251	0.43		0.58	0.560		
Quantity	−0.09	−0.002	0.01	−0.02	−0.28	0.783	0.81	1.23
Reliability	−0.13	0.154	0.19	0.06	0.80	0.425	0.68	1.46
Accessibility (total time water collection (min))	0.008	−0.001	0.00	−0.03	−0.42	0.677	0.96	1.04
Cost of water (PPP USD/m^3)	**0.29**	**0.124**	**0.03**	**0.37**	**4.31**	**0.000**	0.61	1.64
Type of source (pipe into compound/ other improved)	0.11	−0.117	0.21	−0.05	−0.56	0.578	0.64	1.56
Wealth (assets based)	−0.05	−0.176	0.16	−0.08	−1.10	0.275	0.83	1.20
Size of household	**0.23**	**0.144**	**0.04**	**0.24**	**3.22**	**0.002**	0.81	1.24
Gender of head of household	−0.05	−0.231	0.17	−0.09	−1.33	0.184	0.91	1.10
Highest education (up to primary/ secondary or above)	0.04	0.151	0.15	0.07	0.99	0.324	0.93	1.07

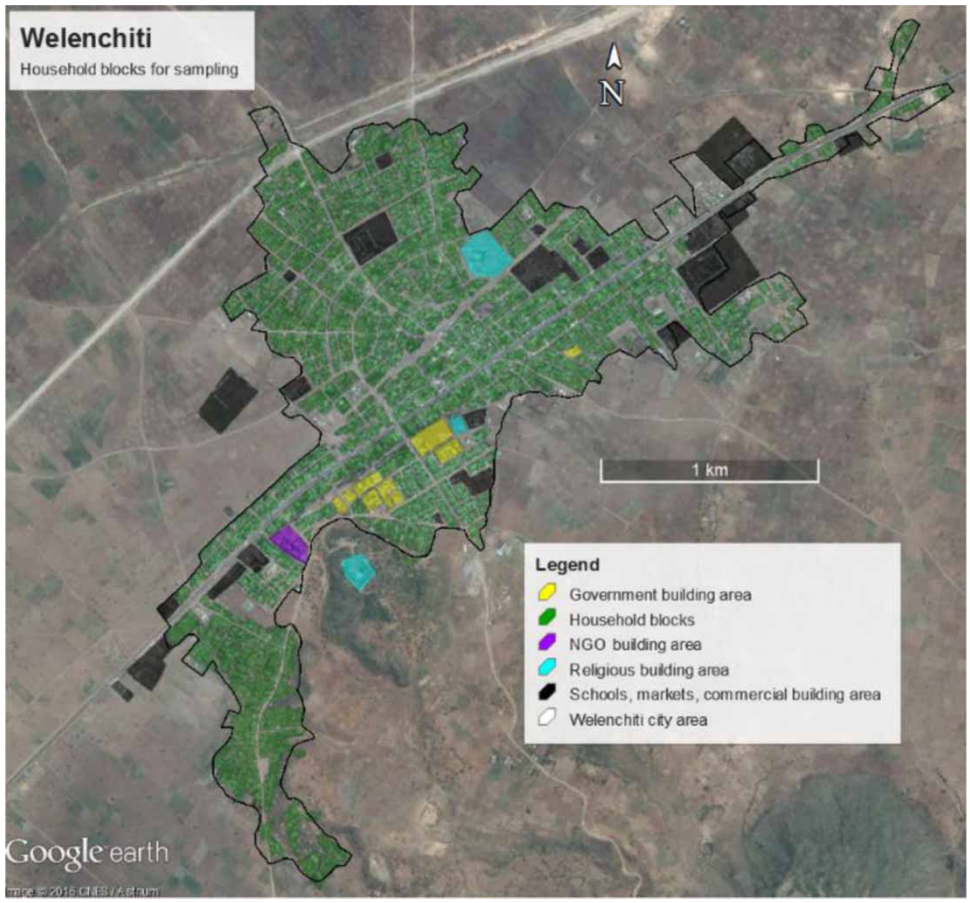

Figure 4 | Welenchiti household blocks for sampling.

Less than 41% of the household spent less than 30 minutes on average, as recommended by the human right to water.

The modes of payment vary depending on the source of water. While households owning a pipe connection in their compound pay a monthly bill according to a block tariff, the households which collect water from a 'pipe to neighbour' or a 'public tap' pay a fixed amount per container on the spot. The cost of water is highly dependent on the type of water source. While households owning a pipe into their compound paid on average 0.6 PPP USD/m^3, households who relied on a public tap paid on average 1.4 PPP USD/m^3. Those who got water from a pipe to a neighbour paid on average 7.5 PPP USD/m^3.

Close to a third (30%) of households did not rely on their preferred water source during the rainy season. Reasons include breakage or maintenance of a pipe into compound or public tap, or the temporary unavailability of a neighbour where water is usually collected.

In terms of type of water sources, a little more than a quarter (26%) of the households accessed drinking water from a pipe into their compound while the rest accessed water from other improved sources. No households had to rely on unimproved sources.

The results indicate that most households (64%) felt bothered with collecting water during the 7 days prior to the interview. This is the most common dimension of emotional distress that is experienced among Welenchiti households. FGD participants underlined that the over-arching reason is having to collect water at night. One in four households (25%) have expressed being afraid that they may run out of water over the 7 days preceding the interview. FGD indicated that, on one hand, households feared that water might be misused within the household. On the other hand, they also feared power cut events that might result in their usual water point losing its supply, making water access more challenging and more

costly. A similar proportion (24%) have experienced being upset with somebody in their household over usage of water, during the same period. Commonly cited examples were about disputes between parents and children as the latter tend to waste water during body washing. Children are also prone to dropping containers by accident. Parents tend also to argue about how water should be shared between livestock watering and other consumptive uses like clothes washing. Only a small proportion (5%) of households mentioned that they experienced being upset with somebody outside their household over usage of collection or usage. This happened typically during disputes while queuing at water points. Such events are rare during the rainy season, but FGD indicate that they are widespread during the dry season.

The average emotional distress score was 1.2, with 69% of the households experiencing at least one dimension of emotional distress during the previous 7 days (Figure 5).

Association between water-related emotional distress and water services

Results (Figure 6) from the multiple linear regression show that water-related emotional distress was not significantly associated with the type of source (according to the JMP ladder classification) (H1).

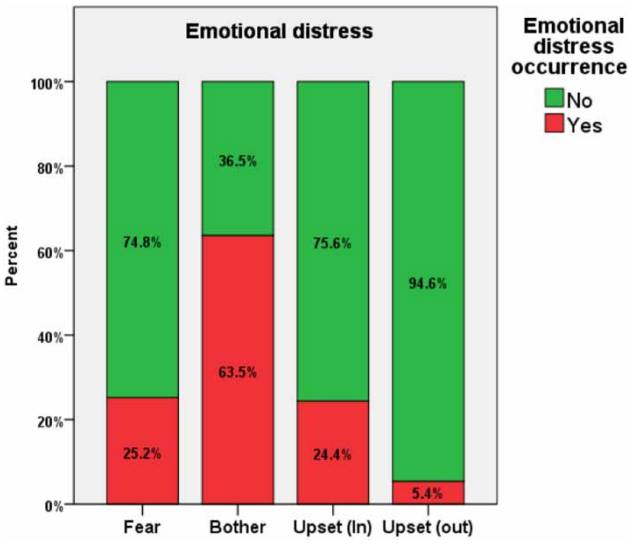

Figure 5 | Emotional distress at town level during the rainy season.

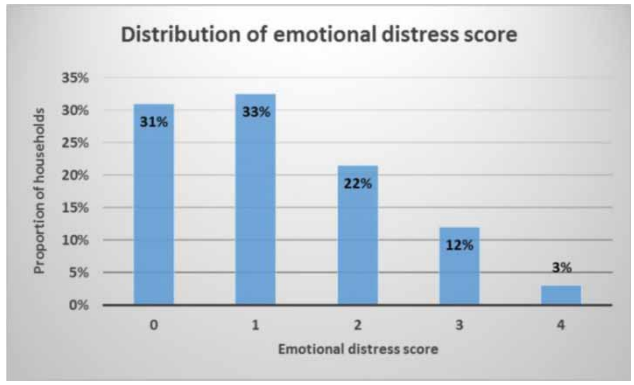

Figure 6 | Distribution of emotional distress.

Water-related emotional distress

This indicates that, contrary to expectations, households that accessed their water from a pipe into their compound were not less affected by water-related emotional distress. One of the reasons is that even households with a pipe into their compound were bothered with having to collect water during the night and spending a long time at their tap due to low flow. Furthermore, part of the emotional distress was shaped by water usage, post-collection.

Results show that water-related emotional distress was not significantly associated with water quantity (H2). This indicates that accessing a larger quantity of water did not act as a limiting factor to the intensity of water-related emotional distress felt by household members. This can be explained, in part, by the fact that water consumption is mainly driven by demand, and that higher demand (e.g., small business, water livestock) does not mean easier and safe access. As mentioned above, typical examples of conflicts are about highly consumptive uses which are often difficult to restrict (e.g., livestock).

Emotional distress was not significantly associated with the reliability of the preferred water source (H3). This is, in part, because during the rainy season, households can easily find alternative sources without feeling affected in the process. During the rainy season, the opportunity of collecting rainwater makes it also less stressful if the main water source is temporarily unavailable.

Emotional distress was not significantly associated with the accessibility of the main water source (H4). This indicates that a longer time spent collecting water did not

increase the intensity of emotional distress. This is consistent with FGD arguments, as participants did not mention time spent on water as a factor that was bothering them or a source of conflict (during long queues). The main element that bothered households was the fact that they had to collect water during the night or very early morning, which is independent from time spent on collecting water.

Results indicated that water-related emotional distress was positively associated with the 'cost of water' (H5), with a medium effect size ($r = 0.29$). FGD and household interviews have shed more light on this finding. Many households expressed that they feared that the household might run out of water because of the costs involved in acquiring more water. This is particularly true for households who access water from a comparatively cheaper source (e.g., pipe into compound) and which might have to collect additional water from a neighbour who charges a much higher price. During FGD, mothers explained that they sometimes got upset with their children who tended to overuse water during personal hygiene, citing the additional costs implied with replacing wasted water.

Emotional distress was not significantly associated with the wealth (assets based) of the household (H6). This indicates that, contrary to expectations, a higher level of wealth may not act as a limiting factor to water-related emotional distress.

The results indicated that water-related emotional distress was positively associated with the size of the household (H7), with a small-to-medium effect size ($r = 0.23$). Interviews and FGD revealed that conflicts within the household are more common in larger households which are often composed of many children. Respondents indicated that children are indeed more prone to 'waste' water during bathing or washing clothes. Furthermore, larger households usually consume more water overall while the number of people involved in water collection is not proportionally higher. This means more effort in collection which is a source of bother.

Water-related emotional distress was not associated with the gender of the head of the household (H8). In Welenchiti, the task of collecting water was not exclusively the responsibility of women, and daily direct observations showed that both men and women were involved in collecting water. It is perhaps important to note that we did not measure differences in experience of water-related emotional distress for men and for women. We only looked at differences between households based on the gender of the head of household.

Last, water-related emotional distress was not associated with the level of education of the household (H9).

Overall, the model for the multiple regression predicted 16% of the variance in water-related emotional distress.

DISCUSSION

Implications for monitoring WASH and health

Similar to the findings of Stevenson *et al.* (2012), we found that accessing improved sources and pipes on premises did not influence whether access is safe from water-related emotional distress (Figure 7).

In the case where 100% of the households would be considered as having access to 'safe' sources according to the WHO/UNICEF JMP water service ladder, this number would drop to 32% if the definition of 'safe' were to include a 'mental health' dimension. This is not to call into question the JMP ladder approach, but rather to emphasise the multidimensional importance of water in reducing all health-related illnesses.

An additional important finding is that variations in water quantity, accessibility and reliability were not

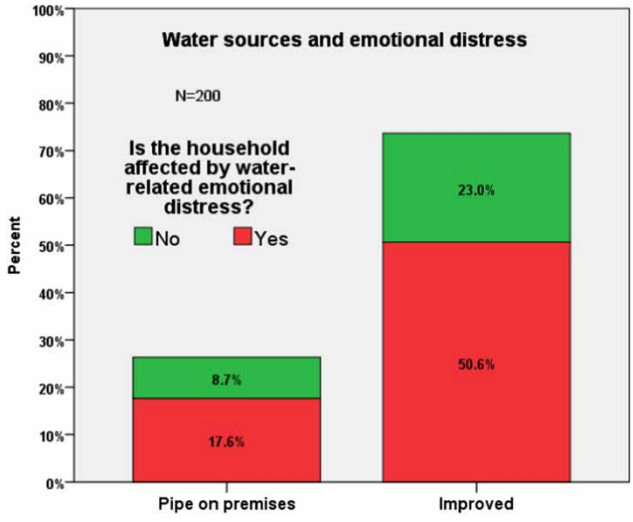

Figure 7 | Water sources and emotional distress.

associated with changes in water-related emotional distress. From a WASH monitoring perspective, such findings may bring into question the 'ladders approach' which implies that more water, higher accessibility (i.e., less time for water collection) and higher reliability mean better health (WHO water service framework) or better water services (IRC water services ladder approach) (WHO/UNICEF 2015; Adank *et al.* 2015, 2016). This might indeed be misleading (at least in some contexts) as more water, less collection time and higher reliability do not necessarily mean less water-related emotional distress.

Note the fact that households consuming a high quantity of water are equally exposed to emotional distress as households that consume less is contrary to the results from Stevenson *et al.* (2012). However, it is consistent with the findings from Wutich & Ragsdale (2008), who argue based on their Bolivian case study, that '*water-related emotional distress develops as a by-product of the social and economic negotiations people employ to gain access to water distribution systems* […] *rather than as a result of water scarcity per se*' (p. 2116). The fact that accessibility is not associated with water-related emotional distress is consistent with the findings of Stevenson *et al.* (2012).

Another important result is that wealth is not a factor that influences whether a household is affected by water-related emotional distress. This is contrary to Wutich & Ragsdale (2008) but consistent with Stevenson *et al.* (2012). It is particularly interesting to note that the increase in the cost of water would affect households irrespective of whether they are wealthy or not. Thus, our findings indicate that the assumption (stemming from several studies) that better-off households are less likely to be affected by water-related health issues should be nuanced when the definition of health also includes a mental health dimension. Including emotional distress in WASH monitoring would thus be particularly useful for better understanding of inequality in access to water services across different wealth categories. However, one should also keep in mind that our study did not measure variation in intensity of stress, which might well be higher for poorer households.

From a water services monitoring point of view, the relation between cost and water-related emotional distress offers a complementary approach to the 'affordability of water services' as it looks beyond the mere financial implications of water costs. It also opens up opportunities to show that health can be impacted not only by 'quantity', 'reliability' or 'accessibility' but also by the financial implications of accessing water services.

Overall, the introduction of water-related emotional distress and the analysis of its association with multiple variables defining water services can be very valuable for baseline analysis. Indeed, it offers a refined diagnosis of which water service factors are most prominently shaping negative experiences of inadequate access to drinking water. This can support validating the prioritisation of WASH interventions. In the case of Welenchiti, focusing on reducing water costs seems to be a priority as far as reducing water-related emotional distress is concerned. Understanding the association with household socio-economic characteristics is also essential to better frame vulnerabilities among the beneficiaries of improved water services. For instance, the case of Welenchiti shows that wealth or gender of the head of household might not be the most relevant criteria for vulnerabilities as compared to the size of households.

Limitations

The size of our sample has largely been determined by resource and time limitations. It is not to be excluded that a larger sample size might have affected the results of the multiple regression analysis.

Data on water-related emotional distress were collected during the rainy season only. It is likely that experience of water-related emotional distress may vary during the dry season at a time when water demand is higher (including for watering livestock and gardening) and alternative sources such as rainwater are much more limited.

The association between water-related emotional distress and water services might also change with seasonality. In terms of gender perspective, we looked at variations of experience of emotional distress for the household and looked at differences based on gender of the head of the household. This is different to looking separately at the experience of men and women within the households (Wutich & Ragsdale 2008).

As eluded to earlier, our study did not measure variations in intensity of emotional distress for each of the four dimensions: 'fear, 'bother', 'being upset (inside the

household)' and 'being upset (outside the household)'. Thus, one should be cautious when interpreting results about the absence of correlation between water-related variables and socio-economic conditions of the household. This is particularly true for the wealth indicator. Although our findings indicate that richer and poorer households are similarly affected by water-related emotional distress, the results might be different if we had been able to measure variations in intensity of emotional distress dimensions.

The results of the association between water-related emotional distress and water services also show that the model has a relatively low coefficient of determination ($R^2 = 0.16$). In other words, only little of the variance in water-related emotional distress was explained by the variables in the model. Thus, inferring about water-related emotional distress only on the basis of the status of water services and measured socio-economic variables should be done with caution.

CONCLUSION

This study has contributed to support the pioneering work of Wutich (2006), Wutich & Ragsdale (2008) and Stevenson *et al.* (2012). It offers a complementary perspective to the mainstream WASH monitoring that relies on proxy measures such as physical health indicators (i.e., occurrence of diarrhoea) or measures of physical access to water (i.e., type of source, quantity, quality, accessibility, reliability). By focusing on mental health, the concept of emotional distress measures a more direct experience of inadequate access to drinking water and opens up a new perspective on the relationship between water services and health in its broad definition. For instance, while it is well documented that health is associated with quantity, quality, reliability and accessibility, this study underlines a new association that includes cost of water as a dimension of water services which also affects (mental) health. Further research is needed to provide more evidence of the association between water-related emotional distress and water services. Other predictors should also be considered in future research. This would help in further understanding and unveiling new perspectives on the underlying factors that influence emotional distress.

ACKNOWLEDGEMENT

Financial support from UNICEF is acknowledged. The views expressed in this paper are solely those of the authors and do not reflect the opinions of any organisation or government.

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First received 5 December 2017; accepted in revised form 6 February 2018. Available online 13 March 2018