Chapter

Understanding Household Water Hygiene in Resource-Limited Settings in Kenya

Jude Robinson, Hamilton Majiwa and Olivia Howland

Abstract

Climate change means that many more people find themselves living in areas of environmental disadvantage, with water insecurity recognized as a major health issue. Local ecologies shape everyday hygiene practices in households as people respond to diurnal and seasonal changes in their external environment. Periods of water shortage paradoxically increase the risk of waterborne diseases such as cholera, exacerbated by reduced washing to conserve limited supplies. Unpredictable periods of drought and/or flooding compromise household income, and families cannot afford the basic resources they need to keep themselves and others clean. The risks of water borne diseases, such as typhoid, giardia and cholera, are reduced by strategies that improve the sourcing, storage, and treatment of drinking water in areas of environmental disadvantage. In this chapter we first outline global water insecurity in the context of climate change and the negative effects on people's physical and mental health. We develop our ideas by drawing on our fieldwork, specifically depth interviews with over 50 people living in Kware, Ongata Rongai outside Nairobi, Kenya, to consider how people negotiate persistent water insecurity in resource-limited settings. We conclude the chapter with reflections on the barriers and opportunities to improve water security and hygiene practices.

Keywords: water insecurity, everyday hygiene, health inequalities, water quality, climate change, poverty, gender

1. Introduction

The effects of climate change are already being felt everywhere and outstandingly, they are felt through water. According to UNICEF there is increased demand for water: low rainfall causes drought, and heavy rainfall and flooding can damage water sources and sanitation facilities, often carrying runoff and waste into streams and lakes and so contaminating the water supply. Climate change means that many more people find themselves living in areas of environmental disadvantage, with water insecurity is recognized as a major challenge to health [1]. Water is a global resource, recognized by the United Nations in their Sustainable Development Goals (SDGs) as Clean Water and Sanitation (SDG 6); with the hazards relating to changing patterns

of rainfall and rising temperatures crucial to Life on Land (SDG 15) and Life Below Water (SDG 14) as priorities for humans to achieve a sustainable future [2]. While people living in some areas of the world have suffered historically from long term water scarcity and/or periodic flooding, it is estimated that by 2030, around half the world's population will experience water insecurity [3]. Despite investments in infrastructure to store and conserve water, in recent decades areas of Europe, US, Africa, Asia and Australia have been adversely affected by changing rainfall patterns, leading to water insecurity and altered social and physical environments [4].

Here, we consider global water insecurity in the context of climate change and the negative effects that access to too much or too little water has on hygiene and on people's physical and mental health. Water insecurity is exacerbated by climate change, with elevated temperatures and unpredictable patterns of rainfall. High temperatures, lack of cloud cover and decreased rainfall lead to periods of drought, associated with an increased risk of subsequent catastrophic events, such as fires [5], dust storms [6] or the erosion of deforested and/or degraded land when rain eventually falls [7]. Drought leads to pressures on sites where water is found and there are tensions and conflicts between people and organizations who need to access water for drinking, hygiene, washing, industries and agriculture [8]. Episodes of extreme precipitation and flood events due to climate change contribute to lower temperatures, flooding and further environmental degradation [9]. These devastating effects are experienced by animals as well as people as they destroy landscapes and habitats [10], as well as settlements and wider infrastructure such as roads, bridges and sanitation systems [11]. Water insecurity and associated environmental degradation has adversely impacted on food security, leading to failure of successive harvests and the death of livestock, leading to long-term shifts in livelihoods as well as impacting on national economies [12].

Globally, there is enough fresh water for the current human and animal population, however it is unevenly distributed across regions and countries and other human actions contribute to its scarcity. Non-climatic events, such as human war and conflict destroy water infrastructures and/or reduce access to water sources and contribute directly to the forced migrations of people and livestock, which in turn place stress on the water supplies in the areas that they move to [13]. Water supplies are further compromised by historic and ongoing contamination from industry and agriculture, who are intensive extractors of water supplies [4]. Inequalities in water availability are compounded by poor water management, the over extraction of ground water driven by increased consumption and global population increases [14]. Population increases are highest in areas of the Global South where water is often a scare resource, but there are other socio-political factors that need to be considered as elites in the Global South do not suffer from the effects of water insecurity. An analysis of Day Zero, the recent water crisis in Cape Town, South Africa (2015–2017) suggests that contributing factors to differing patterns of water consumption were both racialized and classed, with white urban elites less affected by long term water shortages [15]. In addition, Black South Africans living in the poorest areas of Cape Town had suffered persistent water scarcity prior to 2015. Similarly evidence from the US and Canada found racial and geographic inequalities between the quality and affordability of water supplies between those classed as rich and poor in the Global North, debunking what they term the 'myths of household water insecurity' [16]. Deitz and Meehan [17] identify a lack of investment in water infrastructure, what they term 'plumbing poverty', as the reason why the poorest people in the US cannot always access clean water.

People require a minimum of 20–50 liters of clean water a day to meet their basic needs, and around 2 liters needs to be suitable for drinking, although the amount

depends on the person and the context [18]. While those in the Global North may use over 150 liters of water a day for washing, cleaning, cooking, drinking and flushing, other people, many of whom live in the Global South, have access to less than 20 liters of water per day. While access to piped water has increased globally between 2000 and 2017, it remains lowest in countries in sub-Saharan Africa and tends to be concentrated in urban rather than rural areas [19]. Disease and infection relate to water quality as well as water quantity, and van Vliet et al. [20] advocate the treatment of waste water as a vital means of increasing the availability and safety of water. There is emerging evidence that pathogens respond to increased temperatures and higher incidences of enteric (intestinal) infections are found in water as temperatures rise [21]. Periods of water shortage paradoxically lead to increased rates of waterborne diseases such as cholera, as pressure on water compromises choices of water sources and hygiene practices, and associated food shortages increases vulnerability to disease. Even short periods of drought may force people to migrate and congregate in areas lacking basic sanitary infrastructure [22]. There is evidence of gendered inequalities in terms of water access, with men better able to access water compared to women in the same communities and households [23]. Gendered and other intersectional inequalities persist within resources-limited communities, with pregnant women and children particularly vulnerable to the effects of drought [24, 25].

Climate change and water insecurity affect mental and well as physical health [26]. Periods of drought or flooding, and associated shifts in ecologies and loss of livelihood are associated with depression and anxiety for men and women [27]. The pressure on livelihood linked to water insecurity can mean that men need to leave their homes to look for work in urban areas or in other countries. This occupational migration puts undue pressure on the remaining household members, who take on additional roles and responsibilities and suffer from reduced opportunities [28]. Younger people may have to leave school to contribute their labor to the household or in local employment, with long term consequences for their future physical and mental health [29]. Migrant workers also suffer from poor mental health, associated with a loss of status, support and community, and they often engage in risky health practices such as drinking alcohol, taking drugs and gambling [30, 31]. Lacking access to the resources needed maintain a good personal appearance can impact on mental health and wellbeing [32]. Having access to water to wash clothes and bodies is essential for personal cleanliness, and personal hygiene is compromised by water insecurity when water for drinking and cooking is prioritized over other uses. Looking and feeling 'dirty' leads to social and physical exclusion from many areas of communal life necessary for social standing and personal dignity [33]. In these ways water insecurity affects individuals, household and communities.

2. Everyday clean/Usafi Kila Siku

We developed *Everyday Clean/ Usafi Kila Siku* to explore practices of health and hygiene in resource-limited settings in Kenya. Our research was funded by *HORN—One Health Network for the Horn of Africa*, and international partnership funded through the United Kingdom Research and Innovation (UKRI) Global Challenges Research Fund (GCRF) scheme. Our study was designed to understand how washing practices in low-income settings are mediated by social, economic and physical environments and to further understand the strategies people have developed to mitigate any perceived risks to their health. While the research took place across three

sites, here we draw on our research with 53 participants living in the peri-urban, low-income community of Kware in Ongata Rongai, on the outer edge of the city of Nairobi, in Kajiado County. We applied for ethical approval through the International Livestock Research Institute in Kenya, gained additional approval from the University of Liverpool, UK, and registered the project with the National Commission for Science Technology and Innovation (NACOSTI) in Kenya.

Kware is an informal settlement, 17 miles south of the centre of Nairobi and close to the eastern edge of the Nairobi National Park. There were a recorded 29,000 residents in the wider area of Ongata Rongai in the 2009 Census, which is now thought to have grown to around 40,000 residents in 2019. The area is ethnically diverse, and as well as the original Maasai, there are people who identify as Boran, Kalenjin, Kikuyu, Kamba, Kisii, Luhya and Luo. While people have settled on the old quarry site (Kware) since the 1960's, the original settlers were surrounded by green space and were able to keep livestock and get water from the nearby Mbagathi river. Over the last 10–15 years the rapid population growth has led to an expansion of informal housing, a reduction of green space and trees, with little additional infrastructure in terms of roads, services such as waste collection and drainage. Some houses do not have electricity, although others access generators and electricity supplies. Charcoal is the main fuel used for cooking and boiling water. Around 4–8 households share pit latrines within each compound, which overflow when flooded, and open defecation is a problem for the community. Water is accessed via boreholes where people can take their containers to buy water at between United States Dollars (USD) 0.20 to USD 0.50 for 20 liters, depending on availability, from water vendors who carry containers or use donkey carts to bring water to the community, and water tankers who bring water to stands on the main roads that run through Ongata Rongai. Some people collect water from the Mbagathi river, and from the smaller streams that flow in drainage ditches during the rainy season. Water is stored in large, repurposed plastic containers of 10–20 liters with handles (often termed 'jerrycans') outside and inside people's homes and transferred to smaller containers for use. There is limited waste (rubbish) collection from the settlement, and many people dump discarded items, which are then burned in situ.

2.1 Methods

Prior to starting the research late in 2019, we consulted with representatives from Kware, who were strongly supportive of the need for the study and approved of our responsive and exploratory study design. It was through these initial discussions that we recognized the critical important of water access, water quality and pricing to people living on low income, and these issues were added to the interview guide for the study. The research was originally planned in two phases, but this was extended to three phases due to the pandemic and the need to collect further data as new themes emerged from our ongoing analysis. The interview guide used for the first phase of data collection (P1) in December 2019 included questions on the resources needed for the washing of bodies, the washing of clothes and linen and general household hygiene issues, such as food hygiene and any occupational issues. We continued these lines of inquiry during the second phase of interviews (P2) in September 2021 and explored any changing hygiene practices and water access due to the ongoing COVID-19 pandemic. For the final phase of interviews in March 2022 (P3), we explored issues of trust around water supplies and issues of water security. As we are all trained anthropologists, we used inductive and exploratory methods throughout and adapted

our interview guide to the narrative flow of the conversation [34]. Thus, no two interviews were the same, and we continued to adapt and refine our thinking to reflect emerging themes from our ongoing analysis. As our research spanned the period of the COVID-19 pandemic, we actively considered how this affected our participants engagement with the project for P2 and P3, how community health interventions and national and international media campaigns may have shaped their understandings of health, hygiene and disease.

We took a purposeful and pragmatic approach to sampling and worked closely with our fieldwork assistants to identify men and women aged 18 years or over living in Kware, who were willing to talk to us about everyday health and hygiene [35]. Drawing on the principles of thematic saturation to determine final sample size we interviewed women from 11 households for P1. After our analysis of the P1 interviews, we resumed fieldwork in Kware for the two further phases, concluding that we had reached theoretical saturation after interviewing a further 42 people: 20 people in P2 and 23 in P3 [36]. The 53 participants included 35 females and 18 males, aged between 18 and 83 (see **Table 1**). The number of women included in our study reflects the gendered nature of social and economic roles, as many men were away from their homes during the day either at work or looking for work. However as gendered roles mean that women are often regarded as responsible for family and household hygiene, we do not regard this as a limitation of our study. Following advice from our fieldwork assistants, in P1 all participants were offered a single gift of body and clothes cleaning products (soap, shampoo etc.) to the value of $10 USD, presented at the end of the interview. For the second two phases of fieldwork (2021–2022) we were advised to give grocery store vouchers to the equivalent of $10, so that participants could decide on their immediate household needs.

The inductive and discursive interviews lasted between 30 minutes to over 1 hour and were audio-recorded with our participant's permission [34]. We followed the principles of informed consent, and after explaining the project to them in their language of choice we gave participants the opportunity to ask questions and then decline or accept our invitation to take part. Our research drew on theories of situated field ethics that focus on building trust and reducing inequalities between researchers and participants. We were responsive to our field assistant's guidance and our own judgments about the conduct of the research, and this shaped our approach to participants, the duration of the interviews and the direction of questioning etc. [37]. Our fieldwork included ethnographically informed observations of participant's homes and immediate surrounding areas, and these were recorded as fieldnotes [38]. We also gained consent to take photographs of home settings, household objects and spaces used for hygiene practices to gain a deeper understanding of resources and practices [39].

All interviews were later transcribed in the original languages (Kiswahili and English) and those in Kiswahili were also translated into English. All interview

Phases	Females	Males	Age range (years)
P1	11	—	18–58
P2	16	4	18–74
P3	8	14	18–83
Total	35	18	

Table 1.
Overview of participants.

transcripts were aurally checked and amended in English/ Kiswahili by Olivia Howland and Hamilton Majiwa. We imported the transcripts (English translations) into the qualitative data management tool NVivo (n = 53) to assist our analysis and to enable us to digitally share our ideas about the data [40]. Drawing on theories of inductive analysis, we created initial free codes by considering the content of each transcript word by word, and line by line. Jude Robinson and Hamilton Majiwa led the coding process with additional comments and suggestions from Olivia Howland. The agreed free codes were first refined, and then combined and merged to create theoretical and analytical themes [41]. We continues to discuss ideas, our coding and the nature of the themes throughout the three phases of data collection and analysis, considering any negative cases of alternative ideas, to reach a shared interpretation of our data [42].

2.2 Findings

Using the two intersecting themes of water security and water hygiene practices, we explore participants' knowledge and concerns, and the strategies they developed to mitigate the risks to their health. Ours is a qualitative research project and so while our interpretative themes represent the views of our participants, they are not generalizable to wider populations. Yet our depth approach enabled us to gain a sense of the range of strategies that people living in the same community have developed to mitigate the perceived hazards. Despite often living near one another, our participants responded to the same challenges in different ways, depending on the time, knowledge and physical and economic resources available to them at any point. It was evident that these responses were also seasonal, and that the local environment shaped water location and water hygiene practices. In the longer quotations of exchanges within interviews we present below, 'R' stands for respondent, and 'I' designates the interviewer.

As the research took place at three different time points, in December 2019, September 2021 and March 2022, we explicitly addressed how the ongoing COVID-19 pandemic may have altered hygiene behaviors and knowledge of disease. We did find evidence that behaviors had changed, particularly in the earlier stages of the pandemic in 2020, as more information and importantly, more resources were provided to the community. People described more frequent handwashing at the new handwashing stations and soap provided for residents, wearing masks and social distancing. By September 2021, much of the temporary infrastructure had been withdrawn from public places, and many participants said that they had resumed their former behaviors, and that nothing had changed. However increased knowledge of the importance of regular handwashing was mentioned by many participants and some described that they washed their hands more frequently than before the pandemic period:

> *Nothing has changed in fact the routine of hand washing has become more. Kw001 P2.*

> *Though for me I used to wash hands always in my household. But it has forced many people to take precaution and wash hands for sure. Kw002 P2.*

We found that in Kware, in common with many households worldwide, the sourcing and transportation of water and related household hygiene and health activities, such as washing, cooking and cleaning are largely performed by women, although we did find evidence that some men routinely helped with household chores.

As this participant recognizes, water is used for 'everything' for health and hygiene, including the preparation of many foods:

> *One only needs water since it is used for everything. That is why they say water is life. If we have water its fine since it is used for everything. If you don't have water you cannot even cook. We need water for everything. Kw004 P3.*

This participant describes the many times she uses water in a single day, with calls on her time to clean the communal washing and latrine area, to washing the bodies and clothes of infants sometime multiple times each day, and to spend time boiling water to avoid serious illness for her children:

> *You know the bathroom has to be clean. So you might clean but someone else won't. You get it? Things like utensils can't stay dirty neither can't the kid especially when he urinates on himself. I don't know how he got it but after complaining about stomach upsets, he was diagnosed with typhoid and it was because of the water, so since then, I normally boil it. For instance, if this kid goes out there for a minute, he'll come back with a cold or even chest problems because of the wind. For instance, this one has to be washed daily or whenever he messes on himself but the older ones take a bath at least ones a day. Kw018 P1.*

2.2.1 Water insecurity

Water insecurity was identified as a persistent problem for residents of Kware during all three phases of the research, reflected in discussions about the price of water, water quality and difficulties they experienced as they tried to access enough water for their daily household needs.

> *Sometimes one may not have money therefore lack water or at times you may have money and there is no water. Kw010 P3.*

> *Sometimes there is water shortage. Like yesterday there was no water then today it came and we fetched but then we are forced to ration use of water. We are at times not able to take a full bath for lack of it. Kw016 P2.*

There was clearly a hierarchy of water for many people, and they associated different water sources with different levels of risk and employed different storage and cleaning practices for their water depending on whether it was to be used for drinking, cooking or washing. While some knowledge of the levels of the relative risks was shared between households, practices varied according to income as some women simply could not afford the more desirable alternatives:

> *R: When it rains, we don't have to go fetch water. There is a drum where it drains into,*
>
> *That is the water I use for all purposes*
>
> *I: Is this water good for drinking?*
>
> *R: We have no choice but to drink the water. When there's water one must bathe and drink. Kw003 P1.*

Many participants described how they lacked the money to buy water at times and had to ration its use. Washing and bathing became less frequent, but at times, families were unable to afford to buy drinking water and relied on local sources for drinking. While everyone we spoke to knew of the need to boil water before drinking, the response from this participant suggests that local water sources were not always boiled:

> *If you do not have money to buy drinking water, you know there is water sold specifically for drinking. If you cannot afford, you just drink this one. When the child gets sick, you have to boil the water and give it while hot so as to kill the germs. It is not easy because I have to use kerosene or charcoal and it's expensive to buy. I use it sparingly Kw002 P1.*

Water pricing varied between sites and with the seasons and participants discussed the different options open to them on a daily basis, giving accounts of the many strategies that they developed to access water:

> *We go looking for it as far as the next road when there is none, there we are forced to buy drinking water only. Then we look for the donkey cart vendors to buy one for cooking, that means you have drinking water and that for cooking. Washing clothes, we go and borrow from the neighbour's borehole. Kw018 P3.*

Buying water from the itinerant vendors had the advantage that the water was brought to your door. This avoided the time and physical strength needed to make multiple trips to source water for intensive activities such as washing and was used by older or disabled people who could not carry the water themselves and did not have family close by. However this represents a more expensive option for them:

> *When there is no water there, I have a rough time because I cannot go looking for water. I ask a young man to go and buy some from the neighbours for me at 5/= then I pay him 10/= for every jerrycan he brings. Kw014 P3.*

> *Sometimes there is no water so we buy from donkey cart vendors who sell at between thirty shillings to forty shillings. Kw009 P3.*

Others described how in times of severe water and economic insecurity they would source local water from rivers and streams. They said that they would try to source from areas that looked cleaner, and would filter the water through cloth to let the sediment settle, but often were unable to boil the water and/or add purification tablets as they lacked money to access these resources:

> *I: Have you heard of people suffering from stomach problems after consuming water?*

> *R: Yes. It even happened in my house. We took them to hospital and it was because of water. The river water is not good. We only use it for washing clothes. Kw012 P2.*

2.2.2 Water hygiene practices:

Participants were concerned about water quality, but practices of water hygiene and perceptions of what constituted 'clean water' differed between households. The majority separated water for drinking from water for used for cooking, and some even differentiated between water for cooking and the water they used for different

cleaning tasks. Water for drinking was often stored in a distinctive colored or marked container, usually made of plastic, and was often stored away from other water storage containers to further mark the distinction:

> *As of now we collect rainwater, but when there is no rain, we get water from the junction. The rainwater is used for laundry or cleaning the house. We buy drinking water and for cooking we get from the junction. This is like a ghetto; you cannot just drink any water... It is a specific blue bottle with a neck meant for storing drinking water. I store it here in the kitchen. Kw007 P1.*

Many people sourced their drinking water separately to their cooking and washing water and would pay a higher price for what was termed 'mineral water'. While a few participants claimed to buy drinking water in plastic bottles, the majority took their own drinking water containers to a trusted vendor where they would pay to have it refilled:

> *R: We have separate ones for drinking water, cooking water and water for washing clothes.*
>
> *I: Do you get the water from the same place for all these?*
>
> *R: No. drinking water we have a container which we refill with mineral water, for cooking we store in its drum then for washing clothes we store outside in another drum... Mineral water is treated but the one from the borehole you are not sure if it is treated. You are not sure if it has been put any chemicals down there. For mineral water one is sure the water went through the right procedure and is safe for use. Kw001 P2.*

Many of these strategies were time-consuming for the women and as water had to be carried, labour-intensive as well if water needed to be transported over longer distances. Often people settled for the closest source of water, even if there were concerns over water quality:

> *I: Is it the same water you use for cleaning, drinking and washing?*
>
> *R: That is for drinking and cooking. Washing we have water over there. While we were digging the toilet we got water and that's what we use. Kw014 P2.*

Some participants, mostly women, talked about cleaning the containers for drinking water more regularly than other containers, sometimes using soap to do so. People who did not have sealable containers for their water and used buckets were aware of storage issues, and so used different buckets for different purposes and avoided letting their drinking water stand for too long. They described how green slime could form and discolor the water and they actively prevented this, particularly to the water containers that they had reserved for their drinking water. However other people took their drinking and cooking water from the same source as their washing water, but their hygiene practices differed:

> *R: Some [jerrycans] hold washing water, some hold cooking water while some hold drinking water.*
>
> *I: What peculiarity does the one holding drinking water have?*
>
> *R: I always clean it Kw006 P1.*

Others were less likely to clean their jerrycans and it could be longer than a month before they washed them, even though they will have been refilled many times during that period:

I: How often do you clean these water jerrycans?

R: I will not lie because at times I stay for long without washing them.

I: Would you say a week or two?

R: That or sometimes even after a month. Kw016 P2.

Others did not source their drinking/cooking water separately from the water they used for cooking and cleaning, but stored it in a distinctive container, suggesting that they more actively monitored the quality of this water more than that stored in the other containers:

I: Why is it important to separate these jerricans?

R: To differentiate drinking water from the other water. I put drinking water in this drum then the rest is set aside for washing and other chores.

I: Do you treat the drinking water once stored in the drum?

R: No I just store it as it is. Kw015 P2.

Even though this water was identified as water for drinking, separation in terms of storage seems to be the only distinguishing factor and it was not treated in terms of boiling or the use of water purification tablets to improve it for consumption. As home water treatment requires both time and resource, the response from this participant suggests that they do not have additional money to source the water that they would ideally like to have in their home:

I: Do you boil water for drinking?

R. I feel it is safe to drink so I don't boil it.

I: Are you pleased with the quality of water you use?

R. Not as such. I feel it is safe because I can't afford the alternative but as the only option I choose to trust that it is safe for consumption. Kw008 P3.

Similarly, this participant did not use water from a different source, and did not keep a particular container for their drinking water:

I: When you are going to buy water, do you separate your jerricans, for example, a specific one for cooking and drinking?

R: No, the water is clean. Kw014 P2.

The majority of participants were mistrustful about water quality and referred to water from some sources not being 'clean' or being full of what they believed to be harmful 'chemicals'. Some of the water they bought that was piped from boreholes to sites in their community (tap water) was only used for bathing and cleaning:

> *R: We buy drinking water and the rest is used communally for chores.*
>
> *I: Why is it important for you to buy drinking water?*
>
> *R: This tap water is not trustworthy because at times it is not clean. Kw012 P2.*

Some participants also complained that the water quality varied, and they were constantly sourcing and resourcing a water supply that they trusted to be clean:

> *R: Sometimes I do not always refill. At times this other water tastes too much chlorine. I decide at times because this refilled water is better quality and well treated to prevent diseases.*
>
> *I: Are you worried that the other water may be contaminated?*
>
> *R: Yes. I just do not trust it completely. Kw006 P3.*

Most of our participants were aware that boiling water and/or treating water with water purification tablets made it suitable for drinking:

> *You cannot really say that this water is clean because you cannot really know its source. I don't normally use it for drinking and if I do, then I'll have to boil it Kw018 P1.*
>
> *With a child you do not just give any water anyhow. Say if the vendor brings water and you do not know the source and the child has to drink it, I boil.... but fuel is a challenge... I am not confident because it sometimes causes sickness. We do not use it because we like to but only because we need to for lack of options. Kw012 P3.*

Some had good supplies of water treatment tablets, often obtained from community health centers or the hospital if they had recently been there for treatment. Concerns about the quality of water and observations of the possibilities of contamination made people aware of the hazards of even piped water in their communities:

> *May be the precautions... is to ensure that kids don't get out of the gate because of the water... because if they go out and play they will obviously run in that water and it will be dangerous to them. So just making sure that they do not get out the gate is one of the precautions as well. And even the water that we drink we make sure that maybe we can put in Water Guard because you know... we buy water from a water tap, and the same water that we buy from there may be the same water running on the road... because of breakage of the pipes or something... so we make sure that the water is clean either by boiling or by putting Water Guard in the water just to ensure that we are safe. Kw005 P1.*

2.3 Barriers and opportunities to improve water security and hygiene practices

Access to water is a challenge in this community. Most households do not have piped water and they buy water from water kiosks or water vendors who supply the water on donkey carts when the water kiosks have no water. During our research period in 2019–2022, water was sold for between 5 Kenyan Shillings (KSH), equivalent to USD 0.05, and KSH 20 (USD 0.20) for a 20 liters Jerrycan. This challenge of accessing water and the cost involved may lead to challenges in achieving the desired standards of hygiene as indicated by the responses of our participants.

Essentially, local ecologies shape everyday hygiene practices in households as people respond to diurnal and seasonal changes in their external environment. Living in areas of socio-economic disadvantage presents daily challenges to keeping clean. Periods of drought and/or flooding not only disrupt family hygiene practices but often contribute to a loss of income for the household, which means that families cannot afford the basic resources they need to keep themselves and others clean [43]. These accounts from multiple households of differing practices to secure water hygiene resonates with other research, which also found inequalities of water access even within informal settlements [44]. Inequalities of water access exist even within informal settlements [44], with those owning boreholes or those with relatively higher incomes having much better access to water (and potentially safer water) than those on lower incomes. Some participants reported using Water Guard, a liquid or tablet water treatment, yet for many, other needs took priority and they did not purify the water before drinking.

The issue of water quality was a concern for the study participants, and most did not trust the quality of the water. They used it only because they had no other options, due to access and/or financial constraints. Some participants boiled their water for drinking and added purification tablets to the water before using it to improve the quality, but others did not routinely do this. Participants had a good understanding of the risks involved in drinking untreated or un-boiled water but had little alternative due to constraints on their time, the cost of fuel, and/or their families disliking the taste. The risks of water borne diseases, such as typhoid, giardia and cholera, are reduced by strategies that improve the sourcing, storage and treatment of drinking water in areas of environmental disadvantage [45]. Participants recognized these risks but sometimes had to reduce washing of bodies, clothes and surfaces to conserve limited water supplies [46]. The COVID 19 pandemic led to increased water consumption [47] due to more regular hand washing practices and the need to wash surfaces regularly to avoid transmission. Yet in places like Kware, basic needs are prioritized over messages from global health advisories and recommendations may be disregarded by communities who cannot wash their hands or clean surfaces as often as they would like.

These complex issues of access to, and quality of, water are considered daily by women and men on lower incomes in Kware as they attempt to keep themselves, their families and their homes clean and healthy. Yet there is space within this narrative and context for opportunities to improve water security, health and hygiene. As we have demonstrated there is a good level of understanding of water and health, and the risks of using water from untrusted sources, but the primary issue is a lack of financial ability to access clean and safe drinking water. The organization of jerrycans for drinking, cooking and cleaning by some households is one positive way in which participants are actively prioritizing health within the constraints of their resources. Encouraging the boiling of water for drinking would further improve health as this is relatively inexpensive when compared to water treatment tablets or liquid (although

time consuming when domestic chores are many). Improving access through reliable borehole supplies would also improve health and wellbeing. Much of the issue of access to clean and safe water needs to be addressed from a structural perspective, with governments providing the much-needed infrastructure, as individuals and communities are constrained by finances and equipment and so cannot provide solutions on the scale required.

As climate change increases pressure on water resources for humans, particularly in urban settings, the need to improve the quality of existing resources will increase, as will the need to explore and identify new sources of safe water for human consumption. This is a global issue but by shedding light on local realities of water and hygiene, like those in Kware, we are better able to understand the challenges faced by communities and individual households on a daily basis in order to inform the essential interventions which are required to maintain the health and wellbeing of communities worldwide.

Acknowledgements

We would like to sincerely thank the people of Kware who gave up their time to talk to us, and the contribution of our fieldwork assistants, Abdia Guyo Arero and Martha Nyambura. We would also like to thank the Sub-Chief's Office in Kware for their active and engaged support for our study. We would like to acknowledge the advice and contribution of our co-researchers, Ann Munene, Danait Solomon, Dr Annie Cook and Professor Nicola Williams to the Everyday Clean project. Thanks too for the support from the HORN project onehealthhorn.net at the University of Liverpool and the International Livestock Research Institute (ILRI), Kenya, particularly the help of Mark Lutton, Nik Cooper and Vicky Kyallo. This work was supported by the UK Research and Innovation, BBSRC Global Challenges Research Fund, Grant number **BB/P029954/1.**

Author details

Jude Robinson[1*], Hamilton Majiwa[2] and Olivia Howland[3]

1 University of Glasgow, Glasgow, UK

2 University of Nairobi, Nairobi, Kenya

3 University of Liverpool, Liverpool, UK

*Address all correspondence to: jude.robinson@glasgow.ac.uk

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