Introduction

Around a third of the world's population lives without regular access to adequate sanitation and even good hygiene practices can be compromised so many people struggle to 'stay clean' in their terms (Shiras et al., 2018). While research on water, sanitation and hygiene (WaSH) tends to focus on the impact of environmental hazards and human to human contact for the transmission of disease, the WHO recommends extending the scope to a 'One Health' approach to extend the scope of inquiries to include animal to human transmission (and vice versa) to highlight the risks of zoonotic infections, such as COVID 19 (El Zowalaty & Järhult, 2020; WHO, 2017, 2020). The concept of 'One Health' acknowledges the inextricable links between the health of humans, animals and the environment, with the desire to understand and promote good health in all areas (Destoumieux-Garzon et al., 2018). While much of the research in One Health has been led by veterinary science, environmental sciences and biomedicine, there is a growing recognition of the value of including the theories and methods of social scientists in One Health research (Whittaker, 2015; Woldehanna & Zimicki, 2015). Informed by theories of risk and gender, in this paper we take an inductive, One Health approach to explore how women living on low income in Kenya manage household and personal hygiene and how they respond to any perceived risks to their health and that of their families posed by animals, their environment and other people.

Although many people in East Africa spend time in environments where animals are present, much of the research into everyday hygiene does not take account of the presence of animals and related hygiene practices in their studies (Momberg et al., 2020). Over 50% of people in Sub Saharan Africa live in urban or peri-urban settings often with rapid population growth and many bring animals with them to the cities to keep as a source of food and income (Alarcon et al., 2017). Across East Africa, many farmers keep livestock and many people are directly involved in routine aspects of animal husbandry (Fantu, Bart, Fanaye, & Taffesse, 2018). This

includes feeding, watering, assisting with births, treating sick animals, milking, and the slaughter, butchery and disposal of dead animals, and each of these everyday encounters present risks to animal and human health (Kamau et al., 2019). In a study of drinking water in peri-urban environments in Kenya, research found that the 67% of faecally contaminated drinking water was significantly associated with the presence of animals in the household compound (Barnes, Anderson, Mumma, Mahmud, & Cumming, 2018). Everyday hygiene practices can benefit the health of people and animals by creating productive and healthy environments that minimise the risk of zoonotic and other infections.

Place and environment are crucial as household activities take place within local ecologies, shaped by external factors including climate (Drysdale, Bob, & Moshabela, 2020). Keeping clean in times of rain is complex as while water may be abundant, local flooding can lead to household and animal displacements and loss or damage to property disrupting hygiene routines (Lal, Fearnley, & Wilford, 2019). Surplus water may lead to overflowing drains and the contamination of wells and sources of drinking water leading to disease in humans and animals and the pollution of soil (Angassa & Oba, 2007; Grasham, Korzenevica, & Charles, 2019). Both the quality and quantity of water are of critical importance to maintain hygiene, and many households struggle to acquire and afford the recommended 20 litres a day required for drinking and washing, and may drink water they deem suitable for washing as they cannot afford to buy drinking quality water, or forgo washing in order to drink (Collins et al., 2019; WHO, 2018). Rapid urbanisation and the growth of informal settlements means that sanitation facilities, such as drains, latrines, areas to wash and dry clothes may be absent at worst, and overused and poorly maintained at best, in peri-urban settings (Johnson et al., 2014). Other urban infrastructure and materials such as access roads, lighting, cooking materials and shelter may also be lacking, and people may struggle to accommodate family members and keep their possessions, including livestock, safe leading to overcrowding as animals and humans compete

for space (Berendes et al., 2018). Areas for animals to forage and graze are encroached on by other human activities, including the disposal of waste and open defecation, and other animals (rodents, bats and insects) are attracted by the presence of humans and livestock (Tadesse, Ruijs, & Hagos, 2008). Thus, the risks to human, animal and environment health are intensified in places where people have the fewest resources to mitigate them (Corburn & Karanja, 2016).

Women, washing and hygiene

Women play a prominent role in household hygiene as much of the everyday washing of clothes, the cleaning of domestic spaces, food preparation and the management of hygiene resources falls to them (Dillip, Mboma, Greer, & Lorenz, 2018). Women also face gendered hygiene issues around the management of menstruation, pregnancy, postpartum bleeding and baby care (Schuster-Wallace, Watt, Mulawa, & Pommells, 2019). Concerns about physical safety may mean that women are forced to manage their hygiene in sub optimal ways, leading to increased risks of disease and infection for themselves and their communities (Caruso et al., 2017; Seidu et al., 2019; Winter, Dreibelbis, Dzombo, & Barchi, 2019). While much of the work with livestock is often carried out by men, women are involved in the routine care of smaller animals, such as chickens, and may be involved in milking and food preparation (Winter, Dzombo, & Barchi, 2019). Women are often the principle carers for the sick and their everyday hygiene practices affect the outcome for people suffering from infection and disease (Sharma, Chakrabarti, & Grover, 2016). Caring for the sick and ensuring the infant hygiene can place additional demands on water supplies, and many households on low income can suffer acute water insecurity that further compromises household health (Krumdieck et al., 2016; Stevenson et al., 2012). Young children learn about keeping clean from their mothers and other female carers, and so through these gendered roles women play a pivotal role in the intergenerational transmission of knowledge and understandings of cleanliness (Adane, Mengistie, Kloos, Medhin, & Mulat, 2017).

Risk perception and health

People living in such everyday situations of high risk make informed behavioural decisions, based on their knowledge, understandings and the resources available to them (Beck, 1992). Risk perception is therefore a relative rather than an absolute concept, as what is deemed high risk by some may not be regarded as risky by others. As many risks to health are 'new' and unknown, and exist within an increasingly uncertain world, understanding relative risk perception is key to understanding why people do or do not engage with recommended health and hygiene practices (Beck & Cronin, 2009; Tulloch & Lupton, 2003). People living or working in high-risk environments are forced to develop ways of assessing, mitigating and avoiding risk (Anthonj, Diekkruger, Borgemeister, & Kistemann, 2019). As ideas of what is 'clean' and what is 'dirty' are mediated by social, religious and occupational factors, perceptions of risk and resulting hygiene practices are influenced by culture as well as individual decisions (Douglas, 1992).

Methods

Here we use theories of risk to reflect on the findings from a one health research project, Everyday Clean, funded as part of *HORN - One Health Network for the Horn of Africa*, an international partnership funded through the United Kingdom Research and Innovation (UKRI) Global Challenges Research Fund (GCRF) to improve the health and wealth of the people of the Horn of Africa through the development of high quality research into one health. As part of the Everyday Clean project, *Usafi kila siku* in Swahili, we explored the everyday hygiene practices of women who live alongside animals in three contrasting one-health contexts in Kenya, to identify what could facilitate people achieve better standards of hygiene and so improve their health and reduce their risk of infection.

To understand how washing practices in low-income settings might be mediated by the immediate physical environment, we identified three potential sites for our study in advance of data collection: the peri-urban, low-income community of Ongata Rongai, on the outer edge of Nairobi in Kajiado County; Eastleigh, a low-/ middle-income urban community close to the centre of Nairobi; and the low-income rural community of Kasigau in Taita-Taveta County. Prior to conducting our research and before finalising the design of our study, we consulted with representatives of each of the three communities who were strongly supportive of the need for the study and approved of the study design. It was through these discussions that we recognised the critical important of water access, water quality and pricing to women on low income, and these issues were added to the topic guide for the study.

The initial topic guide we used to inform our discussions included questions around the washing of bodies, the washing of clothes and linen and general household hygiene issues, such as food hygiene and any occupational issues. As we are both trained anthropologists, we used inductive and exploratory methods and adapted the topic guide to the narrative flow of the conversation. Thus, no two interviews were the same, and we continued to adapt and refine our topic guide throughout data collection to reflect emerging themes that resulted from our ongoing analysis. These included more probing questions on the collection and use of rainwater, the presence of neighbourhood cats in homes and any pest control activities. We gained ethical approval for our study via the International Livestock Research Institute in Kenya and the University of Liverpool in the UK and obtained a Research Permit through registering with the National Commission for Science Technology and Innovation (NACOSTI) in Kenya.

We took a purposeful and pragmatic approach to sampling and worked closely with Research Facilitators in each of the three sites to identify women who were engaged in hygiene practices (washing, cleaning etc.), were aged 18 years or over and who were willing to talk to us. (Vasileiou, Barnett, Thorpe, & Young, 2018). Our sample is therefore illustrative and not

intended to define or represent a population. Drawing on the principles of thematic saturation to determine final sample size (Green & Thorogood, 2009) we started fieldwork on Ongata Rongai, and interviewed 11 women in peri-urban settings, before moving a few miles to the more urban environment of Eastleigh to talk to 4 women to explore washing and hygiene in an urban setting before moving to Kasigau to explore any differences between hygiene management and water access in a rural setting. While washing and hygiene practices were influenced in part by local infrastructure, we were quickly able to identify that infrastructure varied both within and between each setting, and what was more marked, were the similarities in the challenges that the women experienced. We therefore decided that we had reached thematic saturation after 18- 20 interviews as we encountered the same issues repeatedly across the settings (Baker & Edwards, 2012).

Following advice from the community representatives, all participants were offered a single gift of body and clothes cleaning products (soap, shampoo etc.) to the value of $10 USD, and these were presented at the end of the interview. We also offered them an instant photo as a 'thank you'. Our fieldwork combined ethnographically informed observations of the women's homes and surrounding areas recorded as fieldnotes with audio recorded interviews that lasted between 30 minutes to over one hour (Emerson, Fretz, & Shaw, 1995). 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. As accessing economic and practical resources is problematic for populations in any low-income setting, we explored how people adapted and monitored their practices according to their personal and domestic goals of cleanliness.

All interviews were audio-recorded and later transcribed, and those in Kikuyu and Kiswahili (N=16) were also translated into English. All interview transcripts were aurally checked in English/ Kiswahili by Olivia Howland. The transcripts of the English translations (n=20) were

imported into the qualitative data management tool NVivo and we used inductive methods to analyse our data, on a word by word, line by line basis, creating codes as we identified areas of interest (Bazely, 2013). Jude Robinson led the coding process with Olivia Howland adding comments and suggestions, and we discussed any negative cases, to reach a shared interpretation of the assigned codes (Pope, Ziebland, & Mays, 2000). Using a thematic approach, we combined and merged codes to move beyond our initial descriptive codes and categories to create more theoretical and analytical themes (Silverman, 2012).

We identified three intersecting macro themes in the data: (i) washing practices as emotional labour; (ii) water insecurity and hygiene; and (iii) perceptions of the risks of dirt and disease. In this paper, we focus on the theme around perceptions of risk and what is dirt and what is clean to explain the women's varied hygiene practices in a one-health context. We present our findings under the following headings: (i) visible dirt on bodies, clothes and household surfaces; (ii) animals as sources of visible dirt but not disease; and (iii) water as an invisible risk to health. Ideas of visible and invisible risks to health crosscut each of these areas of hygiene activities, as our findings suggest that while apparently clean water could carry risk, there was little or no recognition that visibly clean bodies or surfaces could carry bacteria or viruses that could harm their health or the health of others. We use these three sub-themes to structure of presentation of findings below.

As this is a qualitative study, our findings are only representative of our participants and not generalisable to wider populations. Following our inductive approach not everyone was asked the same questions in the same way, so we have not assigned numbers to the points we have foregrounded in this paper and have avoided 'quasi quantitative' indicators, such as 'most' or many' to avoid confusions with the reporting of significance in statistical studies (Maxwell, 2010). However, we have foregrounded the reporting of findings and use quotations that resonate across participants in the different households and settings. We have also indicated

instances where the views or experiences of one participant appear to be divergent from those of other participants and where there are differences between participants in different settings.

In the longer quotations of exchanges within interviews we present below, 'R' stands for respondent, and 'I' designates the interviewer.

Results

Fieldwork was undertaken over a six-week period until February 2020 with twenty women. Fifteen of the 20 women were married, and of these fifteen, two had separated from their husbands and one woman was widowed. One woman who lived with five children did not describe her marital status, and another woman with two children said she was single. The three other women were aged 18, 25 and 19 years and had not married or had children. The women were aged between 18 and 58 years. Almost all who lived in Kasigau had lived there for all or most of their lives, whereas those in the urban sites had moved around much more, had relatively fewer family ties, and their length of residence varied from a couple of months to a few years in their present accommodation.

The women in all three settings engaged with cleaning practices in the household, such as washing and sweeping. While some women were able to employ some daily help when they could afford it, others engaged in a more reciprocal system of exchanged labour or had younger family members to do some of the heavy work associated with washing and cleaning. Only one woman with young children completed all the domestic tasks in her household herself. All twenty women were living on low income, and described systemic financial hardship that often precluded them from buying basic necessities such as soap, water or washing materials (Nyasulu, 2010). Even when women had paid or unpaid help, they washed the clothes of infants and/ or more intimate items of clothing themselves, and always supervised the washing and cleaning tasks performed by their helpers.

Visible dirt on bodies, clothes and household surfaces

Women described how tasks of washing, cleaning, cooking and taking care of children were regarded solely or primarily as the tasks of for older girls and women, and they recounted how they managed time and resources, directed others to help them, and advised and helped others how to take care of themselves:

Doing the dishes, tidying up the house; cleaning up the house… taking a bath and making sure that everyone else has taken a bath… KW013

I have to ensure that the house is clean from the utensils, to the clothes and even mopping the house… It is hard because it takes time to wash the kids, then again the house. It's a hard task. KA015

The repetitive nature of tasks meant that women spent hours each day in domestic hygiene labour, which were undertaken throughout the day. Older women struggled with the physical demands of lifting and carrying, and so many women spent time assisting older women to care for their households or sent a grandchild to help:

Yeah, it's not an easy job. Washing every day is not an easy job… As she gets children, like our mother, because now we are grown up we help her do some of these things. For example, she can't clean the house, while we are here, we will help her do it. So, it depends on age too. As one gets older, if there are people who can help, she gets help. Also, our mother can't do the kinds of chores that she used to do when she was our age. KW005

The women were aware that others in their community judged them on their ability to keep their bodies and home clean. As all household were close together the boundaries between public and private were often blurred: the washing and drying of clothes took place outside, and people watched what women and their children were wearing:

If you are dirty, they see you… Even the neighbours, or people out there, as they pass, they notice that your children are clean, or 'that woman is clean!' something like that. Everyone sees it. If children or a certain family is not as clean and they say, "Huh! This one is dirty", what kinds of problems would that bring into someone's life? KW001

Visible cleanliness of bodies and clothes was associated with moral standing, and it was generally agreed that people would avoid visiting the homes or spending time with someone who was dirty. The apparent cleanliness of children was directly attributed to the mother, and so she experienced blame for any lapses in hygiene. This risk of blame and censure motivated women to engage in washing and cleaning activities. In the interviews, we explored whether people were afraid that dirty people may carry disease and that they risked their own health if they were close to them, but this did not always seem to be the case. The dirt was seen partly as a hygiene hazard but more as evidence of poor morals and 'laziness' by any women in the household, and so the fear was of moral contagion (Douglas, 1966):

What might it be like, for somebody maybe isn't able to be so clean, isn't able to be so smart, like would people talk about them, what would their life be like? Yes, they would be talked about them like they might not have many friends, and neighbours would stay away from them because they don't want to engage with them because they are not clean…They are not worried about getting sick; they are worried about engaging with them, and then, other people picturing you with someone who is dirty. EA008

There were fears of disease or poor health associated with dirt and odour and the women strove to keep their children free of mud. In the wet seasons, they often washed clothes every day to ensure that their children did not develop allergies:

During the rainy season like now, if the children go to the playground they come home muddy so those clothes have to be soaked and washed the following morning… I am afraid of bacteria… We are worried about maybe skin allergies, we are afraid of the dirt on the clothes… EA012

Many of the women we spoke to feared what were termed 'stomach problems' which included diarrhoea, and a few also mentioned cholera and typhoid by name. They were aware that younger children could be particularly at risk of disease as they played outside and touched the ground and/or had contact with areas of standing water when they played. However rather than talk explicitly about fears of faecal contamination in water or in food, or bacteria, they talked more generally about 'dirt' and 'odour' and their concerns were to remove any visible dirt (and odour) from clothes and bedding, to ensure good health:

Washing clothes for me takes about three or four in a week because I have children. There's one called cholera, itching, the child doesn't sleep well because they are in pain. I wash the younger ones, this one and this one. The other one and that one wash themselves. Because I'm done with all the work, when a child asks for clothes, they're clean. If you're not clean, you'll get sick easily especially the small people. KW002

This belief that keeping clean kept away disease was widely shared among the women and as well as washing visible dirt, they discussed other hygiene practices such as airing bedding and mattresses regularly, sometimes guided by smell as well as by visible dirt.

Animals as sources of visible dirt, but not disease

We tried to ascertain whether participants on the three sites cleaned surfaces or hands repeatedly if rats and mice and other animals were known to come into their homes, or they were handling livestock. Despite our rewording and repeating our questions, the women

asserted only visible dirt would need to be removed in such cases. Many households in Kware and Kasigau kept animals or lived in very close proximity to neighbours who kept them; hens, ducks, goats and sheep wandered through the housing areas to be brought in by their owners at night. Cattle were also present but tended to be kept outside the housing areas and so did not wander into houses or frequent the lanes between them. Livestock were not associated with disease, and so their presence was regarded as largely unproblematic, provided they did not do any damage:

There are livestock that come in, but they do not bring problems KW007

If there is nothing on the floor that it can mess with, it will just get in and leave. So you have to keep your food safe if accidentally the chicken gets in the house so it doesn't spoil anything. KA017

The women did chase livestock away if they saw them, but the priority was to sweep away the dirt from the floor and surfaces and to protect food and to make sure any rubbish was disposed of away from their house so that the goats couldn't disturb it:

There is a chicken house over there… Sometimes they might come in, but I make sure I clean up because they might shit and that might end up here … For instance, there is sheep and goats too, so when they come in if the dustbin is outside, they go through the trash, so we make sure that we take out the trash before they come because if you leave it out too long they make the compound dirty. KW001

In all areas, cats and rats were constant visitors to homes, and cats were often welcomed in as they regarded as harmless and a good means of pest control for insects and smaller rodents:

I: *Is there any time when maybe like cats or something like come into your apartment here?*

R: *Yes, they do. They do they give birth here. Yesterday when we took a cat, a mother and her five children out. She gave birth inside our clothes.*

I: *Does that make you worried about anything, don't they carry anything?*

R: *No, they don't.* EA008

While this woman did comment that cats can bring fleas and small insects into the house on the fur, this was tolerated as they liked to see and hear them, and would give them food:

Yes, there are some that belong to the neighbours. They come and go… They bring some small insects… There's a cat that comes around, when we go to sleep we hear it on the roof leaving. Then the kittens come and stay in the house. It's nice when at least there is something that comes to eat. KW002

While rats were not desirable in homes, they were regarded as a nuisance rather than as a health hazard and the focus was on removing droppings and protecting food sources:

I: *Do some of the livestock live in, or come into, the house even if it's just cats, rats, et cetera?*

R: *Yes*

I: *And what extra work do they give you?*

R: *Yes, sweeping after them!*

I: *And does this worry you because of diseases or just the dirt?*

R: *The dirt, diseases not so much.* EA011

The women often put poison out for rats and cockroaches but accepted them as a near constant presence in their homes after dark and did not associate any specific health risks with their presence:

R: *Rats you know are a must in the house… Even when you are asleep you hear the cooking bowls, pang! They get in… we give them drugs, but you still see another one back.*

I: *When they come in, do they worry you?*

R: *I just send them away to leave.* KW020

Provided pesticides were available, this woman felt able to deal with the problem of cockroaches as their removal was regarded as the end of the problem:

But she said that maybe cockroaches sometimes in this house … and then they chase it away so it just goes to the other house… okay, this is unhygienic, having cockroaches in your house that's the only thing, but it is not a big thing. She just has...what is it called, Doom… so she just sprays them off. EA010

This focus on visible dirt suggests that cleaning work and activities are stimulated by sensory signals (sight and odour) that alert women to the possible risk of disease or contamination. In the absence of visible dirt or odour, surfaces, bodies and clothes are deemed to be clean and are only cleaned if they 'look' dirty.

Water as an invisible risk to health

Most of the routine cleaning and hygiene tasks performed by women required sources of water. Getting water in the dry seasons was much more difficult and all women described how they altered their washing practices and priorities according to the seasons:

The water is used a lot but you are forced to use less. If you are washing utensils, you are forced to use very little because you can't leave dirty utensils… you have to do things like bathing, you must wash utensils because you can't use dirty utensils because they can bring you diseases. Like when you use dirty utensils, you can get diarrhoea, and stomachache. KA017

Women made daily assessments of the relative cleanliness of the different sources of water available to them and were clear that obviously dirty water, standing water and smelly water represented a risk to their health:

For instance, here in Kware, now that it's rained there is a possibility of having a break-out of diarrhoea for example… There is a lot of dirty water on the road… so there is worry. Also, there are lots of mosquitoes now because of the rain and all the stagnant water so there is a Malaria risk… From the rain it would mostly be diarrhoea and may be getting typhoid and vomiting. KW005

People were aware that drainage ditches and water courses were often used by people for rubbish disposal and defecation and preferred to avoid water from those sources. However, when water was scare, some women did take water from there, but would boil or treat it before drinking:

It's the dirt that is there, people pee there, they throw syringes in the river, they defecate there, when someone peels potatoes they throw the peels in there, the water is very dirty you can't consume it… Yeah cholera because of the dirt in there you must get sick. Yeah, that water, you don't know where they got it from, so you have to purify it yourself. KW004

Distinctions between the varying cleanliness of water were made within households, many of whom separated water for drinking from water for cooking, and some even differentiated between water for different cleaning tasks. Water for drinking was often stored in a distinctive coloured or marked container, usually made of plastic, and might be 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 can't just drink any water… It's a specific blue bottle with a neck meant for storing drinking water. I store it here in the kitchen. KW007

While the women living in Kware and Kasigau harvested rainwater and sometimes collected from rivers and streams in their local area, most preferred to buy drinking water from taps connected to bore holes in their local area:

We get drinking water from the tap. You cannot take rainwater, there are people that get throat infections, tonsils or flu when they take rainwater. So, when we get the rainwater, it's for bathing, washing utensils or washing… the tap water is kept for drinking KA017

As Eastleigh was more urbanised, many households had large tanks on their roofs that used water pumped from local boreholes. However, unlike residents from Kware and Kasigau, they did not drink this water, but bought bottled water from shops for drinking:

R: *We bought a drum we put it on top of our house, and we use the water every single day, and it doesn't go off, but the neighbour doesn't have because they can't afford the drum and the water.*

I: *And the water that you have on your tank is that one okay for drinking?*

R: *It's not okay for drinking but when you heat, you can drink. We only use it for cooking and laundry*. EA008

Women were aware that they could never really know whether the water was clean or dirty, as they knew that even clear water could be contaminated.

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

They managed this risk as well as they could with the knowledge and resources they had and so reflected on the source, the storage and the intended use to determine whether it required boiling or other purification treatment:

Regarding water, what I can say is that the water we fetch is not dirty. But I wouldn't know because I can't really look into the water. Mostly, I won't lie, I drink it. But I make sure that if I fetch it today, it doesn't stay in the jerrycan for more than three days. I fetch it, drink it for about two days and then use the rest to clean dishes or for other household cleaning chores. I then make sure than I collect fresh jerrycans so that the water doesn't sit for three days in the jerrycan because if water is in a jerrycan too long it smells. Even when it sits somewhere for long, for instance outside, it smells. I can't use the water that's outside for cooking; I use it for washing, I make sure that I use up all water in two days. I don't go beyond three days because I know water expires. You shouldn't drink that water for too long. I don't wait till it's finished to stop drinking it, I prefer to drink water that is fresh from the tap. Even if I don't have much money, I make sure that I have the five bob [5 Kenyan Shillings] *for water* KW001

Discussion

Researching how people wash their bodies and clean their homes in relation to their local environment, which includes other people and animals, gives an insight into hygiene practices and what motivates people to stay clean. While it is encouraging that women laboured to remove the visible 'risky' dirt from their homes, clothes and bodies, their lack of awareness of other 'invisible' risks to their health on apparently clean bodies and surfaces suggests that more work is needed to link health risks in their natural environments and bodily hygiene (Konan et al., 2019). In many cases, women worked hard to prioritise resources to enable them to feed their families and to present a clean, and therefore 'good', appearance to the world. Their

motivation to wash and clean was therefore concerned with the very real risk of social censure and alienation if they were perceived as dirty in their community, with any benefits to their health ensuing as secondary benefits.

Theories of risk suggest that a lack of knowledge does not always explain why people chose to ignore a particular risk: the so called 'Perception Gap' theory fails to take account of the many incidences whereby people who understand a risk, may still chose a more 'risky' course of behaviour, based on people their own subjectivities, motivations and agendas (Lupton & Tulloch, 2002; Ropeik, 2012). A review of evidence for the COVID 19 pandemic found that amongst other factors, health care workers who had an understanding of infection and hygiene were more likely to use protective equipment and follow guidelines if they could clearly perceive the value to themselves or others of adhering to them (Houghton et al., 2020). Working with communities' motivations and values is increasingly recognised as a critical factor in the success of the design and implementation of interventions and pride in appearance offers a useful way to support people to adopt WaSH interventions (Aseffa, 2019; Beresford, 2007).

While some women associated contact with dirt with health issues, they were often vague about their concerns, and talked in terms of itching, allergies and stomach problems, rather than definite diseases. Women's hygiene and washing practices were only partly shaped by their understandings of how diseases and other risks to health are transmitted, and were also affected by seasonal, economic and social factors as well as their desire to be clean (Winter, Dreibelbis, & Barchi, 2018). The socio-economic factors included the cost of water and for some, the labour of transporting it manually to their homes, and these findings are consistent with known barriers to sanitation and hygiene interventions (Cook, Kimuyu, & Whittington, 2016). All women often spent a high proportion of their time in performing household tasks but competing priorities such a caring for children and livestock, working in fields (Kasigau) and offers of paid work (Kware) could also take them away from these tasks. Seasonality was a challenge

as in the rainy season, water was abundant and cheap but mud and standing water made extra work; or water was scarce and expensive, and therefore had to be carefully restricted for essential tasks.

None of the women we spoke to were concerned about the risk of zoonotic diseases or infection from the presence of animals in their homes or in the immediate area. Successive studies have shown that communities are largely unaware of the risk of infection from pests, such as Leptospirosis from rats (Boey, Shiokawa, & Rajeev, 2019); worms and other parasites from dogs (Nigatu, 2019); and allergen risks from insects such as cockroaches and the repeated use of insecticide sprays (Mehanna et al., 2018). The women appeared to accept the presence of pests, pets and some smaller livestock such as goats and chickens as unproblematic as long as they did not do any damage or leave dirt behind. Mud and animal dropping outside were a fact of life in the women's immediate environment but were regarded as smelly and unpleasant rather than risky or dangerous. Following Douglas (1966), as such dirt was simply 'matter out of place'; once animal faeces and mud were removed to the outside and visible traces on clothes, bodies and household surfaces are eradicated, any risk is effectively removed. This suggests more work is needed to explain to women about the health risks they face from pets, pests and livestock, and the hygiene and other strategies they may wish to employ to guard against them. In their discussion of 'visible' and 'invisible' work, Star and Strauss (1999) emphasise how it is people's perceptions rather than any reality that determines whether something is visible and real or not.

Understandings of these relative risk perceptions and WaSH may help explain the continued transmission of bacterial diseases in communities, such as typhoid and the spread of the recent viral COVID-19 pandemic, as our findings suggest that even people who were concerned about their own and their family's health did not prioritise the repeated washing of hands, bodies and surfaces that appeared to be clean. Lack of knowledge or understanding of risks is known to

affect people's motivation to follow advice or guidance. Successive research studies have found that people are less likely to follow guidance around handwashing and the use of water and sanitation facilities if they are unsure of the means of transmission of infection: recent examples include a study by Edoror, Oloruntoba, and Akinsete (2019) of understandings of Ebola in Nigeria; research conducted by Kaponda, Muthukrishnan, Barber, and Holm (2019) into cholera in Malawi; and a study of schistosomiasis in Zimbabwe by Mutsaka-Makuvaza et al. (2019).

The concepts of 'visible' and 'invisible' risks to health offer a useful way for health workers to conceptualise and better understand community concerns and priorities as they seek to address the challenges of communicating such 'invisible' health risks to people. The finding that many women recognised the potential health risks of drinking apparently clean water and many are careful to source, store and even treat water for drinking, suggests that women may be receptive to alternative presentations of the other invisible risks to health that are present in their local and household environments. Using the model of clear water as a commonly understood carrier of invisible health risks provides a potentially useful exemplar to enhance understandings of invisible disease transmission, including zoonoses, to make the invisible risks of apparently clean hands, bodies and surfaces more visible and 'real' to communities.

Conclusions

Our research considered whether including a one health perspective to explore the interaction of humans with animals could usefully extend the current scope of WaSH research and the design of WaSH interventions to improve human health. Our findings, that the women we spoke to rarely thought about the presence of animals as a potential health hazard and were unaware that their own hygiene practices could impact on animal health, suggest that there is considerable scope to include a one health perspective to understand the potential for the

transmission of zoonoses to improve human and animal health. Our study also explored whether the inclusion of inductive and qualitative methods and theory from social science could enhance understandings of behaviours and practice. Using observation and inductive interviews enabled us to understand everyday behaviours, concerns and motivations to research the complex social dimensions of health issues. As we were able to gain useful and original insights into how beliefs about cleanliness and dirt informed hygiene practices, we conclude that using social science methods combined with a one-health perspective offers important opportunities to enhance WaSH research and wider research into health.

While this is a small-scale, exploratory study, our findings that women were deeply invested in the health and wellbeing of their families and were concerned to protect themselves and others from illness suggests that there are clear opportunities to support them to make positive changes to their and their families' health. Understanding motivations/ barriers to achieving cleanliness and the association of cleanliness and care with self-esteem and social standing offer a secure foundation to inform the development of targeted interventions that take into account local context, resource and wider ecologies in the design of future interventions with the potential to improve human and animal health.

Given the potential for zoonotic infections, such as COVID 19, to transfer from animals to human and that disease always affect the poor most adversely, there is a clear call to action to develop better interventions to support improved hygiene for populations worldwide. Our findings suggest that using an exploratory one-health methodology with communities to gain deeper understandings of existing (emic) ideas of cleanliness, contamination and risks to health combined with (any) current knowledge around zoonoses and the visible and invisible risks of living alongside animal species, offers a new model for the design and content of future hygiene interventions.

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