

## Research Paper

# Water, sanitation, and hygiene for schistosomiasis prevention: a qualitative analysis of experiences of stakeholders in rural KwaZulu-Natal

Chanelle Mulopo  and Moses J. Chimbari

### ABSTRACT

uMkhanyakude District in KwaZulu-Natal province is one of the districts in the six provinces in South Africa where schistosomiasis is endemic. While it is well established that schistosomiasis is a public health problem in the district and that efforts to prevent and control the disease have been made, very little has been done to involve stakeholders in the implementation of water, sanitation, and hygiene (WASH) strategies for schistosomiasis control. Hence, this study sought to document current WASH practices and explore how engaging diverse stakeholders can contribute to the prevention and control of schistosomiasis. Qualitative data were collected through eight key informant interviews with community leaders, nurses, community caregivers, and pre-school teachers; and four focus group discussions with community members during the dry season. The study adopted a grounded theory approach. Data were analyzed using the six steps of thematic analysis. Findings show that the key players in the promotion of water, sanitation, and hygiene were not clearly defined. Although effective implementation, promotion, and adoption of WASH can be fully achieved with the involvement of various stakeholders, we found that there was a limited collaboration among WASH stakeholders.

**Key words** | hygiene, knowledge, practices, schistosomiasis, water

**Chanelle Mulopo**  (corresponding author)  
**Moses J. Chimbari**  
School of Nursing and Public Health, College of  
Health Sciences,  
University of KwaZulu-Natal,  
Howard Campus,  
Durban 4001,  
South Africa  
E-mail: [cmulopo@gmail.com](mailto:cmulopo@gmail.com)

### HIGHLIGHTS

- This paper informs the reader about the experiences of stakeholders in the adoption of WASH in a low-income community for schistosomiasis prevention.
- The paper uses qualitative methods with a grounded theory approach to understand the stakeholder's perspectives.
- Findings show that the key players for the promotion of WASH were not clearly defined.
- Effective implementation, promotion, and adoption of WASH for schistosomiasis prevention seemed to be the responsibility of various stakeholders with little coordination, thus indicating limited stakeholder collaboration.

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## BACKGROUND

Sub-Saharan Africa is afflicted by a plethora of waterborne diseases including diarrheal disease and neglected tropical diseases (NTDs), commonly referred to as diseases of the poor (World Health Organization 2014; Campbell *et al.* 2018). Diarrheal outbreaks are common in poor countries that do not have access to adequate drinking water supplies. The outbreaks are usually severe, resulting in high morbidity and mortality (Cairncross *et al.* 2010). Schistosomiasis is the second most common NTD after hookworm with 93% of the world's estimated cases of schistosomiasis reported in Sub-Saharan Africa (Adenowo *et al.* 2015). Approximately 120 million people in Sub-Saharan Africa have schistosomiasis related symptoms and 20 million people experience hardship as a result of the chronic presentation of the disease (Utzinger *et al.* 2009). Limited access to water and sanitation is one of the contributing factors to the high prevalence of schistosomiasis in Sub-Saharan Africa. One-sixth of the world's population mostly in developing countries is infected with one or more NTDs (World Health Organization & UNICEF 2006; Mitra & Mawson 2017).

Transmission of schistosomiasis occurs when people suffering from schistosomiasis contaminate freshwater sources with their excreta or urine containing parasite eggs, which hatch in water to become larval forms called miracidia. Miracidia penetrate intermediate host snails where they undergo asexual reproduction transforming into another larval form called cercarium. Cercariae are shed from snails into water after at least 3 weeks from the time they enter the snails as miracidia. When people come into contact with water cercariae penetrate their skin, thereby infecting them (Anto *et al.* 2013). There are two forms of the disease, namely urogenital and intestinal schistosomiasis (World Health Organization 2020). Water, sanitation, and hygiene (WASH) is critical for prevention of schistosomiasis; yet such interventions have not been fully incorporated into schistosomiasis control programs (Campbell *et al.* 2014). Although mass drug administration (MDA) with praziquantel has clear benefits, people are easily re-infected after treatment if they come into contact with water containing infectious cercariae (Evan 2014).

The literature informs us that people with safe water and adequate sanitation have significantly lower odds of a

*Schistosoma* infection (Grimes *et al.* 2015). Access to water and sanitation in Sub-Saharan Africa is interwoven with environment, culture, economics, and human behavior necessitating the need for interdisciplinary research and policy interventions (Armah *et al.* 2018). Similarly, schistosomiasis transmission is deeply entrenched in social-ecological behavior (Grimes *et al.* 2015). Mulopo *et al.* (2020) reported on the influence of psychosocial factors on behavior associated with the risk of contracting schistosomiasis. Improving WASH infrastructure and behavior is a primary prevention method for the elimination and eradication of NTDs including schistosomiasis (Waite *et al.* 2017). This can be achieved through health promotion which is defined as 'the process of enabling people to increase control over, and to improve their health, health promotion promotes a holistic approach of empowering individuals and communities to take action' (World Health Organization 1986; Kumar & Preetha 2012). Furthermore, intersectoral action is one component of this definition which focuses on building healthy public policies and a sustainable health system (Hussain *et al.* 2020).

A wide range of innovative health promotion approaches have been applied in low-income countries. These include the Participatory Hygiene and Sanitation Transformation tool (PHAST), Community-Led Total Sanitation (CLTS), and Community Health Clubs (Waterkeyn & Cairncross 2005; Wanga *et al.* 2015; Hürlimann *et al.* 2018). These approaches, which are usually implemented as part of the community- and/or school-based interventions, have improved hygiene behavior and encouraged use of toilets. The provision of adequate toilets and getting people to use the toilets contributes to greater public health (Odongo-Aginya *et al.* 1996; O'reilly & Louis 2014; Hürlimann *et al.* 2018; Gichuki *et al.* 2019). However, the motivation of households to use the toilet stems from comfort, convenience, privacy, and dignity (Peal *et al.* 2010) and not necessarily from a conscious effort to have health benefits. Consequently, for increased utilization of toilets in the community, WASH interventions need to take into account socio-cultural factors (Routray *et al.* 2015).

WASH interventions have resulted in the reduction of the prevalence of diarrhea (Prüss *et al.* 2002; Fewtrell *et al.* 2005; Mara *et al.* 2010) as well as that of schistosomiasis (Ali *et al.*

1989; Chandiwana *et al.* 1991; Katsivo *et al.* 1993a, 1993b; Tanser *et al.* 2018). WASH interventions have been shown to be highly effective in reducing contamination of the environment with schistosome eggs and larvae for STH (Esrey *et al.* 1991). Given that the route of transmission for schistosomiasis is water based, it is important to disrupt the aquatic life cycle by avoiding contamination of water with eggs (Evan 2014).

In South Africa, 19% of the rural population do not have access to reliable water supply and 25% do not have access to basic sanitation (WHO & UNICEF 2017). Countries that have successfully eliminated schistosomiasis have either done so as a result of economic development that increased access to clean water or because of the limited number of transmission sites (Evan 2014). Access to WASH interrupts numerous transmission routes of NTDs (Strunz *et al.* 2014; Stocks *et al.* 2015). For the sustainable promotion of WASH programs in the context of schistosomiasis prevention community, a participation (bottom-up approach) is crucial (Madon *et al.* 2018) but there are challenges related to collaboration among different stakeholders (Waite *et al.* 2017). We carried out this study in a schistosomiasis endemic area in rural KwaZulu-Natal province (Saathoff *et al.* 2004; Manyangadze *et al.* 2016a, 2016b; Kabuyaya *et al.* 2017a, 2017b) with limited access to water and sanitation (Msweli & Ngobese 2013). The objective of this study was to explore the adoption of WASH through the involvement of a wide range of stakeholders and document prevailing practices and experiences with WASH in the context of schistosomiasis prevention in Madeya Village. Our findings will contribute to the WASH knowledge gaps in stakeholder involvement in the prevention of schistosomiasis in rural KwaZulu-Natal where focus has primarily been biomedical (screening and treatment). This study uses a qualitative bottom-up approach which places the community at the center in a way that one can better understand the roles that different stakeholders can play in schistosomiasis prevention.

## METHODS

### Study design and area

A qualitative study (Ulin *et al.* 2012) was conducted in Madeya Village located in uMkhanyakude district situated in Northern KwaZulu-Natal. The province is located on the east

coast of South Africa bordering three countries: Mozambique, Swaziland, and Lesotho. The district covers an area of 12,821 km<sup>2</sup> and has a population of over 600,000 people. Ingwavuma has a population of approximately 1,300 people. The area is arid and experiences water scarcity. It has limited infrastructure and experiences challenges with service delivery such as access to water. The area is surrounded by many water bodies including the Pongola and Ingwavuma Rivers, both major rivers in KwaZulu-Natal, as well as some ponds. IsiZulu is the primary language spoken in the area and the majority of the households are of a low socio-economic status (Leonard *et al.* 2017). Madeya village is part of Ingwavuma area in uMkhanyakude district, and has approximately 100–300 households. The area is serviced by one clinic and has two crèches (a nursery where babies and young children are cared for during the day) and one primary school. This study was part of a larger project, TIBA (Tackling Infections to Benefit Africa) that was being implemented in wards 16 and 17 of uMkhanyakude district (Manyangadze *et al.* 2016b; Chimbari *et al.* 2017). The aim of the larger project was to determine a baseline for prevalence, intensity and risk factors for schistosomiasis and soil-transmitted helminths (STH) in the study area. This study aimed to explore the experiences of stakeholders in the context of WASH promotion to prevent schistosomiasis transmission. Qualitative data were used to identify contextual and behavioral risk factors of schistosomiasis that may not be captured using quantitative methods, to inform the design of an intervention strategy for the prevention of schistosomiasis in poorly resourced communities.

### Study participants and selection of participants of the study

Five categories of stakeholders were selected to participate in this study. The clinic that serviced the community had five nurses and we purposively selected two nurses who were familiar with the study area and had worked at the clinic for more than 10 years. Two community caregivers (CCGs) who work in the community also participated in this study. There were only two crèches in the community, and therefore, we included one teacher from each crèche in this study. Two village headmen responsible for the well-being of the community were included in this study. In addition, all households in the

study area with children below the age of five (we included children below the age of five because they are the most susceptible to WASH-related diseases) were invited to participate in focus group discussions (FGDs); we asked the CCGs that worked in the community to invite household heads to participate in FGDs and the response rate was at 32% out of just over a hundred households.

### Inclusion and exclusion criteria

A consenting household member of 18 years and above whose household had a child below the age of five was eligible to participate in this study. We chose children below the age of 5 years because that age group is vulnerable to WASH-related diseases. The other stakeholders were identified for participation on the basis of their knowledge on WASH resources in the community and the strategic positions related to developmental issues in the community that they hold. We excluded households that had no children or that had children older than 5 years.

### Data collection procedures

Data were collected through key informant interviews and FGDs with members of the community. Data from semi-structured key informant interviews were used to refine FGD instruments. Data were collected in IsiZulu (local language) by researchers with experience in conducting qualitative research and knowledgeable about schistosomiasis. This study received ethical approval from the University of KwaZulu-Natal Human Social Science Ethics committee (HSS/0396/018D). Data were collected during a dry season spanning from August 2018 to November 2018.

### Key informant interviews

A total of eight key informant interviews were conducted with stakeholders. Stakeholders comprised of nurses, community health workers, village headmen, teachers, and the general members of the community. Key informant interviews were used to extract information on WASH conditions, experiences of stakeholders with WASH within their various institutions as well as barriers to WASH promotion. A semi-structured interview guide with the following themes was

used: provision of WASH services; role of the stakeholder; and local experiences with WASH issues. All data from key informants were captured on an audio recorder.

### Focus group discussions

Four FGDs were conducted with mothers (two groups) and fathers (two groups) of children aged below 5 years. FGDs were used to identify common practices in community regarding WASH as well as perceptions toward WASH. Each FGD comprised of 6–12 participants who were recruited purposively with the assistance of community research assistants to provide diversity in age, employment activities, and their location of residence within their neighborhood. A focus group guide was developed and refined using issues raised in the earlier key informant interviews, and covered the following topics: water sources and use, sanitation practice, and hygiene. All FGDs were recorded using a digital audio recorder with the consent of the participants.

### Data analysis

All interviews and FGDs were transcribed verbatim and translated into English. Data were analyzed manually (Basit 2003). Guided by the grounded theory approach (Strauss & Corbin 1994), we identified core themes and grouped them into broader conceptual processes to understand schistosomiasis risk factors in Madeya Village. Transcripts were analyzed using the six steps of thematic analysis described by Braun & Clarke (2006). The first step (1) was familiarization of the data through reading and re-reading the transcripts. The second step (2) involved systematic coding of interesting features of the data. A codebook with both inductive codes from the data and deductive codes from the topics in the interview guides and concepts from the literature was developed (see Supplementary Material). For quality assurance, an inter-coder agreement was conducted between the researcher and the research assistant to assess and improve consistency in coding data. Thirdly (3), the initial codes were collated to develop themes. The fourth step (4) involved reviewing the themes by checking if they related to the coded extracts and the entire data set. Furthermore, themes were defined and named (step 5) and lastly, a report was produced (step 6).

## FINDINGS

Table 1 summarizes the results into two broad themes and sub-themes. Theme I focused on access to facilities, sub-themes: water (sources and practices), sanitation (basic

sanitation practices), and health care (access to primary health care). Theme II was on knowledge about diseases including schistosomiasis; this had the following sub-themes: health education and hygiene, handwashing practices among pre-school-going children, knowledge about WASH-related

**Table 1** | Summary of themes and sub-themes

Broad themes	Sub-themes	Key questions	Issues	Stakeholders and responsibility
Access to facilities, experiences and current WASH practices	Water sources and practices	Is the use of safe water sources being promoted and who is responsible for promoting the use of safe water sources?	Members of the community were mainly using unsafe water sources.	No stakeholders were identified that promoted the safe use of water in the community.
	Basic sanitation practices in the community	Is sanitation accessible and who promotes the use of sanitation? What are the behaviors or general practice of sanitation?	Sanitation was reported to be accessible at the household level. However, some members of the community (mostly children) still practice open defecation.	
	Access to primary health care	Is primary health care accessible?	The clinic was reported to be inaccessible due to the distance.	Nurses
Knowledge about diseases, including schistosomiasis	Health education and hygiene	Who promotes health education and hygiene and what strategy is used to promote health education and hygiene?	Health education and promotion was carried out using pamphlets and posters at the clinic. Furthermore, nurses promoted handwashing at the clinic by informing the patients about the importance of handwashing when they are visiting the clinic.	Nurses and trained community health workers
	Handwashing practices among pre-school-going children		Community health workers also provided health education about the importance of handwashing and boiling water during home visits.	Teachers and parents could be potentially people to promote handwashing among pre-school-going children.
	Knowledge about WASH-related diseases in the community	What are the experiences of stakeholders with WASH?	WASH diseases in the community.	Members of the community – poor knowledge about schistosomiasis and transmission routes among both members of the community and healthcare workers.
	Knowledge on schistosomiasis	What role do stakeholders play in preventing these diseases?	Poor knowledge on transmission routes of WASH-related diseases by members of the community.	Very few cases of schistosomiasis were reported at the clinic; hence, healthcare workers did perceive the disease as a problem in the community.

diseases in the community, and knowledge on schistosomiasis. The broad themes are further described below supported by direct quotes from the participants.

## THEME I: ACCESS TO FACILITIES

### Water sources and practices

Community members reported that they could not easily access safe water because most of the safe water sources were not operational. Some of the safe water sources were working but could go for several months without discharging water. Consequently, in the months when water could not be accessed at safe water points, members of the community used unsafe alternative water sources:

*'The clean water from the tap can go for 3 to 4 months without being available, that's why we have to dig at the river'*

– (village headman, male, 55 yrs).

Alternative sources commonly used included unprotected dug wells, the spring, and the river. Members of the community dug wells in the riverbed when the river was dry as well as in areas close to the river. The two springs used by members of the community were unprotected.

When asked whether water was treated before consumption, respondents reported that water treatment was not a common practice. Furthermore, since the majority of water sources were not protected, the water sources were often shared with livestock. Some parents believed that their children got sick because of consuming water from sources shared with animals:

*'the water which is available to us for consumption is often shared with other animals and our children get sick from drinking this water'*

– (unemployed, male, 45 yrs).

Members of the community covered dug wells with dry tree branches and hence believed that the water that they collected from the dug wells was safer and better than the water collected directly from the river. These dug wells around the river were reserved for drinking water (Figure 1).



Figure 1 | Water source reserved for drinking water.

### Basic sanitation practices in the community

For many years, there was limited access to improved sanitation in the community. However, since 2016 the government started providing households with improved pit-latrines (VIP). At the time of the study, coverage of the VIP latrines was at 100%, but the unimproved sanitation structures were still available at some households. Despite the availability of appropriate sanitation facilities, it was reported that some members of the community still preferred using the bush to defecate because they had been doing that for a very long time:

*'sometimes we go out there in the bush to do our business (defecate) especially when we are out there in the fields, because it's something that we are used to'*

– (unemployed, male, 28 yrs).

Members of the community also said that snakes found their way into the toilet structures; hence, they avoided using the toilets in some instances fearing that there could be snakes in the toilet. They encouraged children not to go to the toilets but to defecate in the yard and then adults would clean up after them. At a crèche, a teacher reported that sometimes a child would defecate on the premises and not inform them. In such cases, feces remained exposed in the environment.

### Access to primary health care

The community is serviced by a clinic located 8 km away. According to the community members, access to the facility was limited because of the long distance, and hence, they preferred to use a mobile clinic that was made available every week. Members of the community that stayed far away from the mobile clinic station felt disadvantaged as it was difficult for them to access the services provided.

*'The mobile clinic does not get close enough to us, we can conclude that we do not have a clinic'*

– (unemployed, male, 43 yrs).

However, mothers reported that they took children to the clinic when they noticed symptoms of diarrhea or observed rash on the skin:

*'We are struggling a lot in this area but when my child had a rash, I took him to the clinic for treatment'*

– (community caregiver, female, 35 yrs).

## THEME II: KNOWLEDGE ABOUT DISEASES INCLUDING SCHISTOSOMIASIS

### Health education and hygiene

The responsibility of promoting handwashing in the community has mainly been placed on CCGs and nurses. CCGs (recently re-named Community Health Workers – CHWs) are part of the South African health system and are trained by the Department of Health (DoH) and Non-profit organizations (NPOs). When this system was first put in place, the CCG's roles and responsibilities tended to focus broadly on individuals experiencing health conditions related to poverty, social inequality, and lifestyle, which included TB, diarrhea in children and malnutrition, and sexually transmitted infections (STIs). However, as the HIV epidemic in South Africa worsened, CCGs started providing basic care and support for people living with HIV in their families. CCGs conduct their duties within the home environment of members of the community or their clients. CCGs are lay workers and usually do not have a formal, professional healthcare qualification. CCGs provide health education

such as handwashing by going door-to-door in the community, whereas nurses provide health education at healthcare centers. Nurses provided healthcare services when the patients first arrived at the clinic. On a daily basis, nurses gave a talk on health promotion such as handwashing before consulting sessions with patients. They also provided brochures on handwashing and demonstrated to patients how to effectively wash their hands. However, nurses did not go into the community to promote handwashing:

*'We can't go out into the community but we teach them when they are here at the clinic on how to wash their hands. We tell them that they should wash their hands with soap'*

– (nurse, female, 50 yrs).

CCGs reached out to the community by going door-to-door to promote handwashing. However, they were not sure if members of the community practiced what they taught them:

*'As a CCG all I do is deliver information, I go home at the end of the day so I cannot guarantee that they will use it'*

– (community caregiver, female, 43 yrs).

CCGs taught the parents about handwashing when they went door-to-door and hoped that the messages they gave were used to protect children. They could not directly access the children because they were usually at school when they did their rounds:

*'We work from Monday to Friday, the children are either at crèche or school so we cannot talk to them. I have never taught children'*

– (community caregiver, female, 35 yrs).

CCGs said that they were not sure how much information on handwashing children were getting in schools:

*'Maybe they can give us some other time with the children so we can also teach them'*

– (community caregiver, female, 43 yrs).

CCGs expressed concern that not all children were taught about handwashing by their parents and they preferred that a handwashing intervention tailored for children

should be put in place to teach children about handwashing. CCGs argued that even though they provided information on handwashing, change on handwashing behavior could only be achieved through access to safe water.

During the FGDs, mothers indicated that they were responsible for teaching their children about handwashing; the fathers were not involved in promoting handwashing because they did not spend much time with the children:

*'We are the ones that tend to always be at home, the children are taught by us mothers'*

– (unemployed, woman, 28 yrs).

They indicated that whenever there is water available they help children to wash their hands making sure that the water was used sparingly:

*'We teach the children to wash their hands and we teach them to use water sparingly so that they do not waste it'*

– (unemployed, woman, 32 yrs).

### Handwashing practices among pre-school-going children

We found that there were no designated handwashing facilities in the crèche. However, teachers improvised temporary handwashing stations. During break time at a crèche, the teacher placed a basin with water (occasionally soapy water was used) in a designated place where children washed their hands after using the toilet. During class times, the basin was not available; hence, children washed their hands at a nearby *jojo tank* (rainwater harvesting and water storage tank) when they stepped out during class times to go to the toilet. Some children were observed going back into class without washing their hands. Similarly, at the household level, household members washed their hands in a basin. The basin was only made available on demand:

*'No there isn't a special place to wash your hands, you just take water and put it in a basin and wash your hands'*

– (unemployed, male, 42 yrs).

In addition, people also washed their hands at a *jojo tank* (rainwater harvesting and water storage tank) whenever water was available in the tank. Availability of water in the *jojo tank* was dependent on rainfall. Consequently,

people were only able to wash their hands at the *jojo tank* during periods of rainfall:

*'I use the jojo tank after it rains and that's how I wash my hands'*

– (unemployed, woman, 37 yrs).

Although children were taught about handwashing in school, handwashing behavior at the crèche was reported to be low. All the children at the crèche were on a feeding scheme. Some teachers reported that children ate food without washing their hands:

*'Yes, they can get taught at crèche as well but because of the water shortage they sometimes will give the children food without making them wash their hands, and then you find children getting sick because of these unhygienic circumstances'*

– (preschool teacher, female, 40 yrs).

*'Sometimes the children eat their lunch without washing their hands'*

– (preschool teacher, female, 40 yrs).

Sometimes water for handwashing was not available at the crèche if the person responsible for providing the water was either absent or forget to prepare water for the children to wash their hands during break time. When asked if children asked for water to wash their hands when it is not provided, the response was that they did not as they were not accustomed to washing their hands:

*'Children do not ask us for water to wash their hands when the water is not provided because it's not something they practice even when they are at home'*

– (preschool teacher, female, 40 yrs).

The teachers reported that most children washed their hands under supervision, so if there was no adult to tell them to wash their hands some of them would not do so:

*'There are times when I'm not around so sometimes they don't wash their hands because I'm not there to tell them to do so'*

– (preschool teacher, female, 45 yrs).

Furthermore, a teacher highlighted that handwashing is something that should be taught by parents at home.

### Knowledge about WASH-related diseases in the community

Diarrhea, skin infection, and schistosomiasis were the WASH-related diseases that the participants from the FGD said were common in the study area. Members of the community were able to link some of these diseases with water but could not clearly explain the transmission routes of the diseases:

*'We suspect that we get these diseases from water, especially schistosomiasis, it's definitely the water'*

– (unemployed, male, 52 yrs).

Some of them had the misconception (in the case of schistosomiasis) that they contracted diarrhea and schistosomiasis through drinking dirty water:

*'Diarrhea and schistosomiasis is caused by the dirty water that we drink'*

– (unemployed, female, 23 yrs).

Schistosomiasis was reported to be prevalent in both girls and boys, with the latter being affected more because they swam in the river more often than the girls did. During the FGD, it was reported that boys usually swim in the river when they accompany other members of the households that go to the river to collect water:

*'The children swim in the river because they go there to fetch water'*

– (unemployed, male, 34 yrs).

Members of the community indicated that adults were also suffering from schistosomiasis but to a lesser extent compared with children.

### Knowledge on schistosomiasis

Members of the community had poor knowledge on schistosomiasis transmission; they associated schistosomiasis with drinking dirty water:

*'I know that if a child drinks contaminated water it is likely for them to get Bilharzia'*

– (preschool teacher, female, 40 yrs).

Their knowledge of the symptoms of schistosomiasis was generally poor although some parents were able to identify symptoms such as the presence of blood in the urine:

*'They usually have blood in the urine when they urinate and that's how we know that the child is infected with schistosomiasis'*

– (village headman, female, 65 yrs).

The teachers seemed to know very little about schistosomiasis, claiming that no one had ever taught them about the disease. In contrast, they were very much aware of diarrhea. When asked what preventative measures they could take to prevent schistosomiasis, they said that they did not do anything because they had little knowledge about the disease:

*'We don't know much about Bilharzia but we are more educated about Diarrhoea ... We don't really do anything to prevent the disease because we are not really taught about it'*

– (preschool teacher, 45 yrs).

An immunization and deworming program for schools had been operational in the area for 2 years. It involved nurses going into the schools to immunize and deworm the children. The nurses indicated that when they got into the schools or the crèche they focused on immunization and deworming. They did not screen for schistosomiasis or educate the children about schistosomiasis. It was also noted by the village headman that since the inception of our research project through which children were screened for schistosomiasis, many people had become aware of the disease:

*'TIBA (research project) has come and taught us how to prevent schistosomiasis, so we now have an understanding on how people get schistosomiasis'*

– (village headman, male, 55 yrs).

## DISCUSSION

We found that the community did not have access to reliable safe water sources and that existing safe water sources were often not functional for prolonged periods. This resulted in community members collecting water from unprotected water sources which were usually contaminated. A study conducted in Uganda reported that consumption of raw water from unprotected water sources was the primary route of exposure to contaminated water (Agensi *et al.* 2019). Furthermore, members of the community shared water sources with livestock thus increasing the likelihood of using contaminated water. Similar results were reported in Ghana where ownership of livestock was significantly associated with drinking contaminated water (Wardrop *et al.* 2018).

The majority of the participants could not afford and were not knowledgeable about water treatment products; hence, they drank untreated water from the river, spring, and unprotected dug wells, putting themselves at a risk of contracting diarrheal diseases from drinking dirty water, or schistosomiasis through water contact. Previous studies have shown that covered water sources and treatment of water before consumption reduces the likelihood of diarrheal diseases (Grabow *et al.* 2000; Cairncross *et al.* 2010; Cha *et al.* 2015; Clasen 2015).

It was not clear to members of the community who was responsible for the provision of water. The use of safe water sources was not common, mainly because of the limited safe water sources. The provision of safe water sources can be promoted through a collaboration between the municipality (water service providers), and the DoH with the involvement of prominent members of the community. This approach can encourage members of the community to use safe water sources provided that the municipality provides the water sources. Bisung & Dickin (2019), in a study conducted in West Africa, emphasized the importance of ownership and the responsibilities of all actors/stakeholders to play their parts in the management of WASH.

Although toilets were provided in the community, some members of the community still practiced open defecation. Banda *et al.* (2007) found that 30% of the participants that had toilets were still practicing open defecation. A study by

Coffey *et al.* (2014) conducted in India also reported a preference for open defecation among some community members. The sanitation program through which the municipality built toilets for communities did not have a health education component. Sara & Graham (2014) found that education may be an important factor in changing defecation practices; similar findings were reported in Tanzania (Mwanga & Lwambo 2013; Wanga *et al.* 2015). Moreover, other studies have also indicated that households that own livestock tend to practice open defecation because they travel long distances while tending to herds. This is because they could find themselves in places with no access to sanitation facilities (O'loughlin *et al.* 2006). Other studies (Sara & Graham 2014; Routray *et al.* 2015; Gupta *et al.* 2016) reported that households that still practiced open defecation even when they had a toilet were dissatisfied with their toilet. However, in the current study, the majority of participants indicated that they were happy with the toilets provided and that they were using them. They only encountered problems when they were out in the field or at church because places of worship did not have toilets.

Feces in the environment pose a public health threat to the members of the community but particularly to children who may come into contact with feces at crèche if the teachers do not notice when a child has defecated in the environment. Stakeholders such as the municipality can promote toilet ownership and use of sanitation facilities by including an education intervention to complement the infrastructure interventions. This means that while they are providing infrastructure they should also target behavioral change and work closely with the communities to understand their needs as well as promote acceptance of the infrastructure.

Although participants were able to link drinking untreated water and diseases, they had poor knowledge on transmission routes of schistosomiasis. The majority of individuals interviewed believed that one could contract diarrhea and schistosomiasis by drinking contaminated water. While this may be accurate for diarrhea, it is not so for schistosomiasis. Our findings are similar to those of a study on knowledge of waterborne diseases conducted in rural South Africa which reported good knowledge of waterborne diseases but poor knowledge on the

transmission routes of these diseases (Sibiya & Gumbo 2013). While the current study found that the majority of the participants associated drinking dirty water with diarrhea, Banda *et al.* (2007) in a study conducted in India found that only 12% of the participants in their study linked the two with the majority of the participants attributing diarrhea to heat, spicy food, ingesting hair mud, or mosquitos.

Our findings show that handwashing practice in the community was promoted using a knowledge-based intervention led by CCGs. However, CCGs had many responsibilities in addition to promoting handwashing. There was no structured handwashing intervention in the community. Furthermore, if members of the household do not visit the clinic, they are less likely to hear about handwashing. One CCG was allocated 60 households and they normally did not get to all the households. Therefore, there was a possibility that some people did not receive information on the importance of handwashing and why they should wash their hands.

The scarcity of water in the crèche resulted in children engaging in poor handwashing practices. Washing their hands in the same basin could expose some children to other pathogens washed into the basin by others. Furthermore, the handwashing basin was only available during break time. Hence, children that visited toilets during classes had limited opportunities to wash their hands. Parents and pre-school teachers can play an important role in promoting handwashing at the pre-school level. Our findings show that parents assumed that their children were taught about handwashing at school, while teachers felt that it was the responsibility of the parents to teach their children about handwashing. One way to overcome this issue is to ensure that handwashing is included in the pre-school curriculum. That way children would be taught about handwashing and their mothers could be involved by ensuring that children routinely washed their hands at home. This can be designed as part of homework in the school curriculum where mothers engage in activities with their children to remind them of the importance of handwashing.

Schistosomiasis prevention and screening programs tend to lean toward school-going children (Engels *et al.* 1996; Aagaard-Hansen *et al.* 2009; Brooker *et al.* 2009)

since the prevalence of the disease is shown to be high in this age group. However, our findings show that due to limited access to improved water sources in the study area, women are often in contact with fresh water bodies as they go to the rivers accompanied by young children to collect water for their household needs. Consequently, children under 5 years old are exposed to a higher risk of contracting schistosomiasis.

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## RECOMMENDATIONS

Members of the community need to be taught about water safety and different low-cost water treatment methods that they can use. They also need to be aware that covering a dug well with branches does not make water safe for consumption. Strong collaborations are needed between the municipality, the DoH, and the community, for the provision of water sources and the use of these water sources to prevent diseases such as schistosomiasis. There is a need for a structured ongoing handwashing intervention that includes activities tailored for children. This can be built in the already existing system of using CCGs, but should also include teachers and parents in the handwashing promotion campaigns. Additionally, handwashing promotion needs to go beyond knowledge-based interventions to include behavior change and provision of infrastructure.

This study has also highlighted the importance of health education in the provision of sanitation facilities. Furthermore, the provision of sanitation facilities in rural settings should go beyond household provision but also include facilities being provided at places of worship as well as in the fields where men herd cattle and women cultivate their crops.

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## CONCLUSION

The findings from this research highlight the importance of collaboration among stakeholders in order to bring about the effective use of safe water sources, use of sanitation facilities, and promotion of handwashing. Access to facilities such as water, sanitation, and health care was a challenge

and members of the community were not aware of the stakeholders who were responsible for the provision of these facilities. In addition, health care was deemed inaccessible due to distance. Knowledge on WASH-related diseases and schistosomiasis was found to be poor.

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## LIMITATIONS OF THE STUDY

This study was a cross-sectional study and, therefore, may not have been able to provide data for other times, for seasons. Time constraints and limited resources did not permit the researchers to prolong their stay in the study area and conduct observations. Due to the sampling technique (purposive sampling) applied in this study, caution should be taken in generalizing the findings to other contexts. The findings are not statistically representative of the greater population at hand, but they are qualitatively generalizable.

### Positionality statement (Chanelle Mulopo)

I view research from an interpretivism and constructivism paradigm. I believe the research subjects are co-constructors of knowledge in the research process. My research interest in water and sanitation stems from my own experience growing up in a developing country and having suffered from a waterborne disease early in my childhood. Access to water and sanitation is a huge problem in Sub-Saharan Africa and a cause of many preventable deaths. I have been studying the social and public health issues resulting from poor access to water and sanitation for the past 5 years. My study population of interest has been people living in poor communities (informal settlements and rural areas). I hope the findings of this research will highlight the water crisis in the study area and how this is impacting the community's health.

### Positionality statement (Moses Chimbari)

I am an eco-health tenet and, therefore, view health challenges holistically. My more than 143 journal publications, mainly on NTDs, are testimony to this approach. My advocacy for WASH as a sustainable means for controlling

schistosomiasis dates back to the 1990s when I was part of a research group that developed a model smallholder irrigation scheme (Mushandike Irrigation Scheme – Zimbabwe) which made safe water and appropriate sanitation a condition for the model irrigation scheme. In later years, I was able to demonstrate that the differences in schistosomiasis prevalence and intensity between Kariba (Zimbabwe) and Siavonga (Zambia) 10 km apart could be explained by improved WASH facilities for Kariba compared with Siavonga. It is this strong belief in the efficacy of WASH that motivated me to participate in Chanelle Mulopo's work.

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## ETHICAL CONSIDERATIONS

Ethical approval was obtained from the Humanities and Social Science Research Ethics Committee at the University of KwaZulu-Natal. Protocol reference number: HSS/0396/018D. All participants gave informed consent to participate in this study. This study ensured anonymity and confidentiality of all research subjects that were interviewed and those that participated in FGDs. All information collected during the course of this study is kept on the UKZN online database. The data management was dealt with in the context of the bigger project – all data (raw and processed) are kept at a central repository and can be made available should that be needed. Only the researcher and the supervisor have access to this information. All materials pertaining to this study will be stored at the University of KwaZulu-Natal (Howard College) for a period of 5 years as abiding with the University's ethical procedures.

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## CONSENT FOR PUBLICATION

Consent was granted for publication of any personal information for the purpose of this study.

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## COMPETING INTERESTS

The authors have no conflicts of interest to disclose.

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## AUTHOR CONTRIBUTIONS

Chanelle Mulopo conceived and designed this study, took part in the data collection process, developed the data collection tool, performed the analysis, and wrote all the first drafts of the paper. Prof. Moses Chimbari supervised the project and reviewed several drafts of the manuscript.

## DATA AVAILABILITY STATEMENT

All relevant data are available from an online repository or repositories (<https://drive.google.com/drive/folders/1BdEqT5lw2TracHRIrakfoWUMRMWAcA?usp=sharing>).

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