Tanzania Journal of Science 48(4): 875-885, 2022
ISSN 0856-1761, e-ISSN 2507-7961
© College of Natural and Applied Sciences, University of Dar es Salaam, 2022

Knowledge, Attitudes and Practices on Urinary Schistosomiasis-Related Morbidity among Communities in Itilima District, Tanzania

Coletha Yohana[1*], Safari M. Kinung'hi[2], Bruno A. Nyundo[3], Peter F. Rambau[4] and Jared S. Bakuza[5]

[1]Department of Natural Sciences, Mbeya University of Science and Technology, Mbeya, Tanzania. E-mail: ycolletha@yahoo.com

[2]National Institute for Medical Research (NIMR), Mwanza, Tanzania kinunghi_csm@hotmail.com

[3]University of Dar es Salaam, Department of Zoology & Wildlife Conservation, Dar es Salaam, Tanzania. E-mail: bwenda2007@gmail.com

[4]Department of Pathology, Catholic University of Health and Allied Sciences-Bugando, Mwanza, Tanzania. E-mail: ra1972tz@yahoo.com

[5]Dar es Salaam University College of Education, Department of Biological Sciences, Dar es Salaam, Tanzania. E-mail: bakuzajared@yahoo.co.uk

**Corresponding author*

Received 16 Sep 2022, Revised 12 Dec 2022, Accepted 20 Dec 2022, Published Dec 2022

DOI: https://dx.doi.org/10.4314/tjs.v48i4.14

Abstract

Long-term infections by urinary schistosomiasis can result in urinary tract morbidities and increase the threats to public health. Information on the community's knowledge, attitudes, and practices (KAP) on various aspects of urinary schistosomiasis, caused by *Schistosoma haematobium* has been lacking in Itilima District, which is likely to perpetuate the transmission of the disease and its negative health consequences. This study assessed knowledge, attitudes and practices on schistosomiasis-related morbidities in Itilima District from February to June 2021. A cross-sectional survey using a structured questionnaire was used, and a total of 657 participants were involved in the study. A total of 575 participants (87.5%) had awareness on schistosomiasis compared to 82 (12.5%) who were not aware of the disease, and this variation was statistically significant ($x^2 = 369.938$, DF = 1, $p < 0.001$). The relationship between urinary schistosomiasis and its related morbidities was known by 111 (16.9%) respondents, while 546 (83.1%) knew nothing about it, and this variation was also statistically significant ($\chi^2 = 388.166$, DF = 1, $p < 0.001$). It can be concluded that knowledge of urinary schistosomiasis and its related morbidities among the communities was limited. This is possibly because knowledge of infection stages of *S. haematobium* that causes the morbidity requires an understanding of disease etiology. Therefore, this study recommends that interventions to impart knowledge on schistosomiasis and the associated morbidities should be implemented in Itilima District.

Keywords: Schistosomiasis, Urinary tract morbidity, Knowledge, Attitudes and Practices, Itilima District

Introduction

Urinary schistosomiasis is a public health problem, especially in rural settings of many countries in Sub-Saharan Africa where the disease is endemic (French et al. 2018, Exum et al. 2019). The most at-risk groups for

urinary schistosomiasis and its public health impacts include communities that are engaged in activities that bring them into contact with infested water without adequate protection such as fishermen, paddy farmers, and children (Parisi et al. 2019). Schistosomiasis-related urinary tract morbidity is often the consequences of long-term urinary schistosomiasis infections without treatment (Parkin et al. 2014). The disease is increasingly becoming a threat to public health especially when its complications develop to urinary tract morbidities such as bladder cancer (Rambau et al. 2013). Effective control of urinary schistosomiasis and its related morbidity requires the disruption of the parasite life cycle (Parkin et al. 2014, Parisi et al. 2019). The achievement of this milestone requires integrated control which in turn depends on the levels of knowledge, attitudes and practices that people have towards the disease (Odhiambo et al. 2014, Rassi et al. 2019).

Attitudes towards urinary schistosomiasis differ from one country to another depending on health education disseminated in particular communities (Rassi et al. 2019). The lack of proper community knowledge on schistosomiasis may cause the development of negligence and practices which perpetuate or maintain the disease (Sady et al. 2015, Angelo et al. 2019). Furthermore, since urinary schistosomiasis infections involve urogenital organs and painful urination, it is often perceived by the community as a sexually transmitted disease (STD), thus associating it with promiscuity and unfaithfulness in marriage (Odhiambo et al. 2014, Koffi et al. 2018). This causes fear and shame among infected people, and thus failure to attend hospitals for early treatment (Sady et al. 2015, Rassi et al. 2019). Moreover, the disease is also sometimes associated with soil-transmitted helminth (STH) infections, and that it is acquired through the consumption of contaminated food and drinking dirty or un-boiled water (Folefac et al. 2018).

In Tanzania, the distribution of *S. haematobium* is focal and the parasite is known to be highly prevalent in the southern and southeastern areas of Lake Victoria due to availability of intermediate host snails (Lwambo 1988, Angelo et al. 2018). Itilima is one the districts in Simiyu Region located in this area, which is known to be endemic for urinary schistosomiasis (Angelo et al. 2018). Furthermore, information on knowledge, attitudes and practices on urinary schistosomiasis-related morbidity in the area is lacking. Such information is important in the planning and implementation of schistosomiasis control strategies. Therefore, this study was conducted to fill this gap by assessing the levels of knowledge, attitudes and practices on schistosomiasis-related urinary tract morbidity in Itilima District.

Materials and Methods

Study area and population

The survey was carried out in five villages, namely Sasago, Mwanunui, Budalabujiga, Mwamigagani and Mitobo selected from three wards Itilima District (Figure 1). The villages were selected based on health records from Itilima District Medical Office and reports on neglected tropical diseases in the area that indicated that the areas (villages) are potentially endemic for urinary schistosomiasis (Parisi et al. 2019). The district's climate is generally of a tropical type with average rainfall of 700-950 mm per year. The average temperature for Itilima District ranges from 29 °C during daytime to 19 °C at night as reported in Simiyu Region Investment Guide (SRIG 2017). The study involved adults and primary school children (PSC) aged 9 years and above.

Study design and inclusion criteria

This was a cross-sectional questionnaire survey conducted from February to June 2021. The study employed a multistage sampling whereby a purposive sampling procedure was used to select villages with an expected high prevalence of urinary schistosomiasis based on health records from Itilima District Medical Office (Singh and Masuku 2014, Parisi et al. 2019). Simple random sampling was used to select study participants. Questionnaires were

administered to participants by a researcher and trained field assistants. People were considered for inclusion in the study if (i) they were school children aged 9 years and above and had been living in the study area for at least one year consecutively and had not received praziquantel treatment over the last six months. This suggested therefore that the resident participants would have been involved in water-contact activities in the study area and that any *S. haematobium* infection harboured would have started releasing eggs, (ii) they provided signed consent to participate in the study, and (iii) they brought urine samples for urinary schistosomiasis examination (Hein et al. 2015, Parisi et al. 2019).

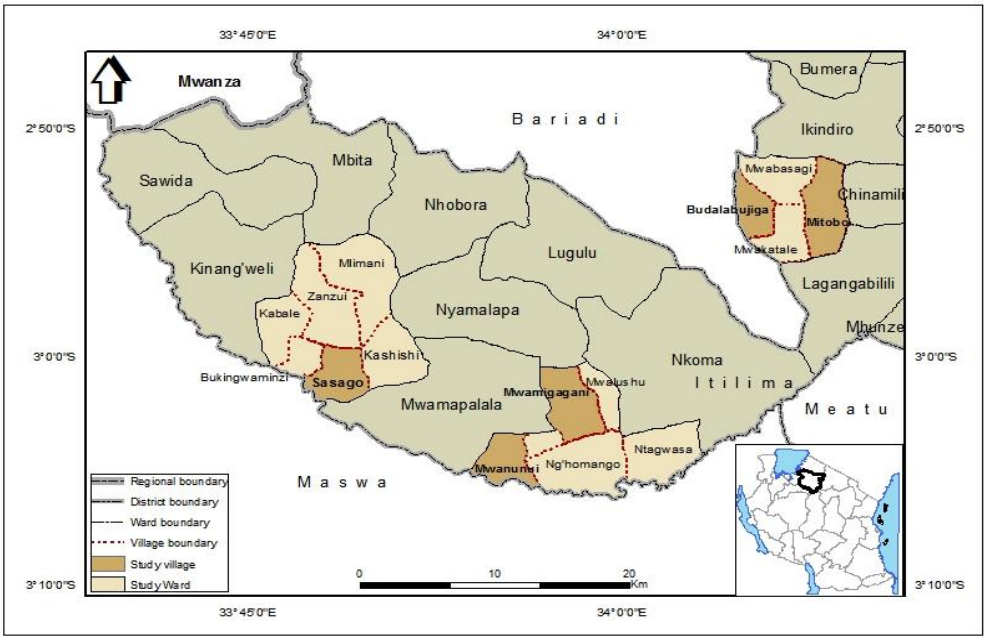

Figure 1: Map of Itilima District indicating its location in Tanzania and the studied villages.

Sample size estimation

The sample size was estimated using the following formula: $n = \frac{Z^2 pq}{e^2}$ (Singh and Masuku 2014) where: *n* is the number of expected study participants, *Z* is the score for a given confidence interval, *p* is a known or estimated prevalence of schistosomiasis-related urinary tract morbidity whereby, for the present study, it was 44.9% as reported by Rambau et al. (2013), *q= (1-p*) and *e* is the permissible error of estimation. The desired confidence level was 95% with a permissible estimation error of 5%. After computation, a minimum sample of 380 participants was required. However, using a random sampling method in the selected villages, a total number 657 people met the inclusion criteria and were enrolled in the study.

Ethical considerations and confidentiality

This study was approved by the Medical Research Coordination Committee (MRCC) of the National Institute for Medical Research (NIMR), Tanzania through ethical clearance certificate No. NIMR/HQR.8a/Vol. IX/3546. After selection of villages, the study objectives and data collection procedures were explained to local leaders, school administrators and participants before administering the questionnaire. The permission to access children was obtained from the school administration. Participants were informed that participation was voluntary and that there would be no reward

for participating in the study or coercion for withdrawing. Literate participants were asked to read and sign the consent forms, while illiterates signed the form using their thumbs. Participants were given adequate time to read the form and ask questions if any. Participant's socio-demographic characteristics were also recorded although all identifiers were excluded from the data to maintain confidentiality.

Data collection

Questionnaires were administered by the researcher and trained field assistants to avoid hurry in filling up by participants. The structured questionnaire had a range of questions including the overall awareness of urinary schistosomiasis and its related urinary tract morbidity, mode of transmission, signs and symptoms, treatment, prevention, and control measures.

Data analysis

Data were analyzed using SPSS version 20.0 for windows. Microsoft Excel was used to present and summarize data in the form of graphs, tables and percentages. Chi-square test was used to analyze an association between categorical variables. Multivariate regression analysis was used to analyze factors associated with an individual's ability to recognize, identify and respond to early signs and symptoms of urinary schistosomiasis-related urinary tract morbidity and prevention practices (Barrow et al. 2020). The p-value of ≤ 0.05 was considered statistically significant.

Results

The demographic characteristics of the study participants

The study involved 657 participants aged between 9 and 90 years and above. The overall mean age of the participants was 30 ± 18.122 years. A total of 450 (68.5%) of the study participants were adults and 207 (31.5%) were primary school children. Among them, 338 (51.4%) were females and 319 (48.6%) were males.

Community awareness of urinary schistosomiasis

Up to 575 (87.5%) of participants were aware of urinary schistosomiasis, while 82 (12.5%) were not aware of the disease ($\chi^2 = 369.938$, $p < 0.05$). A total of 340 (51.8%) of respondents obtained information on schistosomiasis at schools, while 300 (45.6%) obtained at home/street and 17 (2.6%) heard about it through mass media and hospitals. As shown in Table 1, only 17 (2.9%) of the respondents mentioned swimming or working in lakes and ponds/rivers with infested water as the sources of infections, which were correct responses. However, dirty water, coming into contact with human excreta, eating too much salt and having unprotected sex also were also perceived as causes and means for acquiring schistosomiasis. With regard to participants' knowledge about signs and symptoms, blood in urine (haematuria) was mentioned by 457 (69.6%) respondents, followed by stomach pain (40.0%), painful urination (30.4%) while 47(7.1%) participants did not know. Using medicine was mentioned by 320 (48.7%) participants as the preventive measure while about 189 (28.8%) participants did not know (Table 1). But, other perceptions on preventive measures such as avoiding too much salt were mentioned by 14 (2.1%) of respondents, cleaning body and clothes reported by 85 (13%) and 57 (8.7%) who mentioned avoidance of gatherings. A total of 487 (74.2%) respondents associated haematuria with urinary schistosomiasis infections. Other diseases that were associated with haematuria included malaria, which was identified by 7 (1.04%) participants, sexually transmitted diseases by 9 (1.31%) respondents and urinary tract infections by 20 (3.09%) participants. The snail as an intermediate host in disease transmission was known by 309 (47%) of the respondents, while 348 (53%) were not aware of it.

Table 1: Respondents' knowledge on urinary schistosomiasis and its related morbidity

Variables	n	%
Causes of urinary schistosomiasis		
Working in rain/ swimming/working in lake/pond/river	22	5.8
Dirty water and human excreta	333	62.9
Staying in sunshine and witchcraft	4	1.1
Unprotected sex and eating too much salt	99	20.3
Don't know	100	17.4
Mode of transmission		
Consuming dirty water/food and stepping on excreta	467	76.9
Swimming/working in lake/ pond/river	17	4.4
Having unprotected sex and eating much salt	163	36.2
Don't know	19	5.0
Preventive measures		
Using medicine and clean and safe water	589	89.6
Bathing at home and avoiding water with snails	184	32.4
Using toilet properly and provision of health education	117	25.9
Boiling water or leaving it in sunlight	111	24.6
Don't know	129	28.7

Community awareness on the relationships between schistosomiasis and urinary tract morbidity

In terms of knowledge of the relationships between urinary schistosomiasis and urinary tract morbidity among respondents, 111 of them (16.9%) were aware of it, while 546 (83.1%) were not aware (χ^2 = 388.166, DF= 1, p < 0.001). Multinomial regression analysis indicated that older age and education level had a significant effect on knowledge of schistosomiasis-related urinary tract morbidity. On the other hand, general awareness, infection status, and gender had no significant effects (Table 2).

Table 2: Multinomial regression analysis results on the factors associated with knowledge of urinary schistosomiasis-related morbidity

Variable	CI	OR	p-value
Age	0.955-0.979	0.967	<0.001
Gender	0.533-1.457	0.882	0.623
General awareness	0.523-2.320	1.101	0.800
Infection status	0.149-1.229	0.428	0.115
Education level	0.195-0.719	0.375	0.003

In addition, more than half (52.7%) of the respondents had information about bladder cancer. Among them, 267 (40.6%) mentioned schistosomiasis as the causative agent, other causes were mentioned less frequently while 343 (52.3%) participants did not know the cause (Figure 2a). About 346 (52.6%) of the respondents mentioned schistosomes as causative agents for urinary tract morbidity, while 225 (34.2%) mentioned schistosomes eggs. When asked about the signs of bladder cancer, painful urination was mentioned by 195 participants (29.7%), blood in urine by 175 (26.6%) participants, while majority of them (62.5%) did not know (Figure 2b).

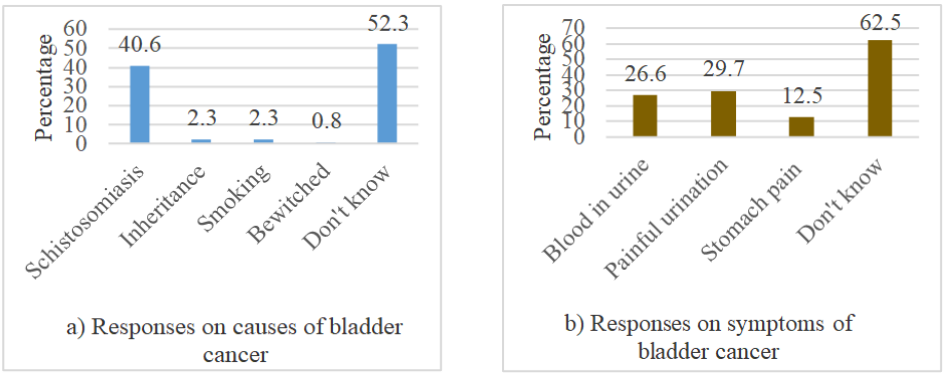

Figure 2: Participants' knowledge on causes and symptoms of bladder cancer**.**

Concerning the health impact of urinary schistosomiasis, body weakness and failure to work were mentioned by 461 (70.2%) participants (Table 3). As for the effects of schistosomiasis and related morbidity on education, absenteeism was the most cited effect (62.9%), while other effects were less reported (Table 3).

Table 3: Participants' responses on effects of urinary schistosomiasis

Variables	n	%
Health consequences		
Reduction in thinking	40	10.4
Sterility	227	34.5
Bladder damage and haematuria	221	60.3
Body weakness and failure to work	432	70.2
Effects in education		
Segregation	115	25.6
Absenteeism	413	62.9
Stopping studies	115	25.6
Failure in studies	120	26.7

Respondents' attitudes towards urinary schistosomiasis and its related morbidity

A total of 545 (82.9%) respondents preferred hospital treatment, 257 (39.1%) used traditional medicines, only 29 (4.4%) used medicines from accredited drug dispensing outlets while 31 (4.7%) did not know how schistosomiasis is treated. Regarding the reasons for the choices of treatments, 478 (72.7%) of the respondents mentioned effectiveness of treatments, while the belief of the sick person was considered to a lesser extent (6.3%). Fear of coming in contact with a bladder cancer sufferer was mentioned by 25 (3.8%) of the respondents. Regarding bladder cancer transmission from one person to another through touching, was mentioned by 153 (23.3%) of the respondents, sharing food by 46 (7%) participants, practicing unprotected sex by 344 (52.3%) respondents, while coming into contact with excreta of an individual infected with bladder cancer was mentioned by 89 (13.6%) participants.

Respondents' practices regarding urinary schistosomiasis and its related morbidity

As shown in Table 4, working in paddy was mentioned by 523 (79.9%) of respondents, while fishing was reported by 9 (1.4%) participants. Most (72.2%) of the respondents reported taking bath at home, while 352 (53.6%) of them took bath in rivers. Places to urinate/defecate during working hours included bushes mentioned by 353 (62.2%) of respondents, rice paddies by 179 (27.3%) and water sources by 287 (50.6%) respondents. About 303 (46.1%)

participants had a history of blood in urine (haematuria). Among them, 184 (60.7%) got treatment while 119 (39.3%) were not treated. The practice of visiting water sources was reported by 566 (86.1%) respondents. The frequency of visiting water bodies also varied. While about 301 (45.8%) respondents visited water 2–3 times, 9 (1.3%) of respondents reported visiting water bodies once per week on average. The responses for human behaviour responsible for schistosomiasis transmission included urinating/defecating in bushes mentioned by 238 (36.3%) of respondents, water sources mentioned by 157 (23.9%), lack of toilets in the community cited by 106 (16.2%) of the respondents, and 196 (29.8%) of the respondents who stated that they did not know any means of transmission.

Table 4: Practices by participants regarding urinary schistosomiasis

Variables	n	%
Water contact activities		
Washing clothes	284	50.2
Working in paddy	523	79.9
Fishing	9	1.4
Swimming and bathing	208	36.6
Fetching water	305	53.8
Water visit per week		
2–3 times	109	45.8
4–5 times	39	16.4
Rarely	57	23.9
Everyday	30	12.6
Once per week	3	1.3

Discussion

Sustainable control of schistosomiasis-related urinary tract morbidity requires an understanding of the communities' knowledge, attitudes, and practices (KAP) of the disease in endemic areas. Such information is useful in the planning and implementation of control strategies for urinary schistosomiasis and its morbidity (WHO 2015). In the present study, the overall awareness about urinary schistosomiasis was high, suggesting that residents in the area were familiar with the disease. On the other hand, knowledge on causes and modes of acquiring the disease was low. This might explain the fact that only few respondents identified working in lakes (fishing) and swimming in rivers, lakes or ponds as sources of urinary schistosomiasis. Previous findings from some African countries showed mixed results. For example, results from Kenya, Mozambique, South Africa, Uganda, Tanzania, Côte d'Ivoire and southern Mauritania indicated high levels of general awareness in the studied communities (Kabatereine et al. 2014, Dawaki et al. 2015, Sady et al. 2015, Salehe 2017, Koffi et al. 2018, Rassi et al. 2019, Angelo et al. 2019, Anyanwu et al. 2020). However, a low level of awareness on schistosomiasis was reported among residents in Nigeria, Malawi and Zimbabwe (Midzi et al. 2011, Poole et al. 2014, Awosolu et al. 2020). In addition, urinary schistosomiasis was associated with soil-transmitted helminthiases and sexually-transmitted diseases. Therefore, some participants mentioned drinking dirty or unboiled water, eating contaminated food, too much salt, stepping on human excreta and practicing unprotected sex as causes and means of acquiring urinary schistosomiasis (Sady et al. 2015, Koffi et al. 2018). However, these perceptions could further be explained by the painful urination symptom experienced by individuals suffering from both urinary schistosomiasis and sexually-transmitted diseases. Similar findings were reported by Adoka et al. (2014) in Kenya and Parisi et al. (2019) in Northwestern Tanzania.

The knowledge on infection stages that lead to urinary tract morbidity was lacking in surveyed communities. This is because most of respondents mentioned adult parasites as the causative agents of urinary tract morbidity, which is incorrect. On the other hand, heredity, smoking and witchcraft were not considered as potential risk factors for urinary schistosomiasis and its related morbidities in Itilima district.

The presence of blood in urine (haematuria), stomach pain, painful urination (dysuria), bladder cancer, sterility and anaemia were the correct responses on the signs and symptoms and health consequences of urinary schistosomiasis and its related urinary tract morbidity. This suggested that participants who were educated about the disease had correct knowledge, albeit in small numbers. This agrees with observations reported by French et al. (2018) in their review although the findings were contrary to those reported in other studies. For instance, Antwi et al. (2014) found that the above mentioned urinary schistosomiasis health consequences were not acknowledged by the community in Kumasi Ghana.

The importance of parents and teachers in dissemination of health education was revealed among study participants in Itilima District. This can be explained by the large number of respondents who had obtained information from schools and home or street as also reported in studies conducted elsewhere in Tanzania (Salehe 2017, Parisi et al. 2019. On the other hand, the contribution of mass media as a source of health education was low probably because in rural settings only a few people own radios or television sets, thus hindering the flow of information. These findings corroborate those reported from Uganda (Kabatereine et al. 2014). Furthermore, the level of education and old age were crucial in understanding the relationships between chronic urinary schistosomiasis infections and related urinary tract morbidity. The observation corroborates that of other researchers such as Sady et al. (2015) who found that education level had positive impacts on knowledge, attitudes and practices towards schistosomiasis in Yemen.

The use of medicines for treatment of people infected with schistosomiasis, wearing of gumboots when working in water or rice paddies, effective use of toilets and provision of health education were suggested as preventive measures against schistosomiasis. This indicates that some people were taking initiatives to protect themselves from urinary schistosomiasis. However, in resource-poor countries, the implementation of these preventive measures can be difficult. These findings are in agreement with those reported from other areas (Person et al. 2016, Almazan et al. 2017) where people identified wearing of waterproof gadgets when working in water as sufficient protection against schistosomiasis.

The attitude that urinary schistosomiasis and its related morbidity cause disability rather than death was observed among study participants in Itilima District. Social discrimination of people suffering from schistosomiasis and its related morbidities was exacerbated by the belief that the disease can be transmitted through contact (i.e. touching, sharing food, practicing unprotected sex, and coming into contact with excreta of an individual infected with bladder cancer). There were positive attitudes toward hospital treatments for urinary schistosomiasis and its related morbidities in Itilima District. Medical check-ups performed in hospitals leading to effective treatments were the reason for choosing hospital treatment compared to traditional healers and home management. Similar results were observed by Dawuda et al. (2019) in Nigeria. Nonetheless, the current results are contrary to those reported in other studies such as Barrow et al. (2020) who found that, most people preferred traditional and self-medication over hospital visitation in the Gambia. These diverging results could be explained by variations in social, economic and availability of health facilities from one country to another (Kabatereine et al. 2014, Parisi et al. 2019).

The practice of visiting water sources was common among respondents. However, there was no significant difference in infection status among people with different water-

visiting frequencies. It was found that, fishing activity was practiced by few of respondents. This can be explained by the absence of large water bodies such as lakes and dams in Itilima District.. Other activities such as washing, fetching water, swimming or bathing in rivers have been attributed to the absence of tap water in villages (Rassi et al. 2019), which is the case in Itilima District. Defecating or urinating within rice paddies and other water sources were identified by most of the respondents as unhygienic practices which encouraged the persistence of urinary schistosomiasis. The results corroborate the findings reported by Salehe (2017) in Kilimanjaro region, Tanzania. Nevertheless, no alternatives were available for controlling the situation, since there were no toilets in the farms as also pointed out by Salehe (2017). Behaviour change may be possible if attractive alternatives such as adequate clean and safe water are provided to the communities, as also suggested by other studies (Donohue et al. 2017). Therefore, provision of clean and safe water for daily use and the implementation of other preventive measures can reduce the number of people coming into contact with infested water thereby facilitating the elimination of schistosomiasis in endemic areas (Gbalégba et al. 2017, Donohue et al. 2017).

Conclusions and recommendations

The current study has observed that knowledge on the causes, mode of transmission, prevention and control of urinary schistosomiasis was low in Itilima District. The presence of urinary schistosomiasis in the area is more likely the result of low level of community knowledge on the disease and persistent unhygienic conditions. Therefore, it is recommended that the Ministry of Health (MoH) and other key stakeholders should design and implement health education interventions involving all people in affected communities as part of schistosomiasis control in Itilima District.

Limitations/Weakness of the study

Financial limitations: the researchers could not include large number of villages in the proposed study area due to logistical and financial constraints.

Acknowledgements

The authors would like to thank Mbeya University of Science and Technology (MUST) for funding this study. We also thank the National Institute for Medical Research (NIMR Mwanza Centre) for logistical support and technical assistance during field work.

Declaration of conflict of interest

All authors declare that there is no conflict of interest.

References

Adoka S, Anyona D, Abuom P, Dida G, Karanja D, Vulule J, Okurut T, Matano A, Gichere S and Ofulla A 2014 Community perceptions of schistosomiasis transmission, prevalence and control in relation to aquatic habitats in the Lake Victoria basin of Kenya. *East Afr. Med. J.* 91: 232-244.

Almazan JU, Escala JE, Merida MAV, Permelona DR and Cruz JP 2017 Knowledge and preventive practices of rural residents against schistosomiasis in an endemic community in eastern Philippines. *J. Pract. Prof. Nurs*. 1: 002.

Angelo T, Kinung'hi SM, Buza J, Mwanga JR, Kariuki HC and Wilson S 2019 Community knowledge, perceptions and water contact practices associated with transmission of urinary schistosomiasis in an endemic region: a qualitative cross sectional study *BMC Public Health* 19: 703.

Angelo T, Buza J, Kinung'hi SM, Kariuki HC, Mwanga JR, Munisi DZ and Wilson S 2018 Geographical and behavioral risks associated with *Schistosoma haematobium* infection in an area of complex transmission. *Parasit. Vect.* 11: 481.

Antwi S, Aboah KEK and Sarpong CKG 2014 The Unacknowledged Impact of Urinary schistosomiasis in Children: 5 Cases From Kumasi, Ghana. *Ghana Med. J*. 48: 228-233.

Anyanwu FC, Ramoteme M, Mabunda J, Henry A, Kwabena K and Nenzhelele F 2020 A quantitative assessment of the level of knowledge, attitude and practices of farmworkers regarding schistosomiasis in a rural community in South Africa. *Afr. J. Prim. Health Care Fam. Med.* 12: 2098.

Awosolu OB, Shariman YZ, Haziqah FMT and Olusi TA 2020 Will Nigerians win the war against urinary schistosomiasis? Prevalence, intensity, risk factors and knowledge assessment among some rural communities in Southwestern Nigeria. *Pathogens* 9(2): 128.

Barrow A, Badjie M, Touray J, Kinteh B, Nget M, Touray E, Kinteh SLS, Sillah SO, Darboe L, Jallow Y, Badjan M, Gaye M and Jatta SPS 2020 Knowledge, attitude, and practice of provincial dwellers on prevention and control of schistosomiasis: Evidence from a community-based cross-sectional study in the Gambia. *J. Trop. Med*. 2020: 1-9.

Dawaki S, Al-Mekhlafi HM, Ithoi I, Ibrahim J, Abdulsalam AM, Ahmed A, Sady H, Nasr NA and Atroosh WM 2015 The menace of schistosomiasis in Nigeria: knowledge, attitude and practices regarding schistosomiasis among rural communities in Kano state. *PLoS One* 10(11): e0143667.

Dawuda BM, Bala AY, Agbo JO and Agere IH 2019 Prevalence of urinary schistosomiasis, knowledge, attitude, perception and treatment practices in Fikyu Community, USSA Local Government Area of Taraba State, North Eastern Nigeria. *Int. J. Inn. Res. Dev*. 8: 278-284.

Donohue RE, Mashoto KO, Mubyazi GM, Madon S, Malecela MN and Michael E 2017 Biosocial Determinants of persistent schistosomiasis among school children in Tanzania despite repeated treatment. *Trop. Med. Inf. Dis.* 2(4): 61.

Exum NG, Kibira SPS, Ssenyonga R, Nobili J, Shannon AK, Ssempebwa JC, Tukahebwa EM, Radloff S, Schwab KJ and Makumbi FE 2019 The prevalence of schistosomiasis in Uganda: A nationally representative population estimate to inform control programs and water and sanitation interventions. *PLoS Negl. Trop. Dis.* 13: e0007617.

Folefac LN, Nde-Fon P, Verla VS, Tangye MN, Njunda AL and Luma HN 2018 Knowledge, attitudes and practices regarding urinary schistosomiasis among adults in the Ekombe Bonji Health Area, Cameroon. *Pan Afr. Med. J*. 29: 161.

French MD, Evans D, Fleming FM, Secor WE, Biritwum NK, Brooker SJ, Bustinduy A, Gouvras A, Kabatereine N, King CH, Polo MR, Reinhard-Rupp J, Rollinson D, Tchuente LT, Utzinger J, Waltz J and Zhang Y 2018 Schistosomiasis in Africa: Improving strategies for long-term and sustainable morbidity control. *PLoS Negl. Trop. Dis.* 12: e0006484.

Gbalégba NGC, Silué KD, Ba O, Ba H, Tian-Bi NTY, Yapi GY, Kaba A, Koné B, Utzinger J and Koudou BG 2017 Prevalence and seasonal transmission of *Schistosoma haematobium* infection among school-aged children in Kaedi town, southern Mauritania. *Paras. Vect.* 10(1): 353.

Hein IM, Troost PW, de Vries MC, Knibbe CAJ, van Goudoever JB and Lindauer RJL 2015 Why do children decide not to participate in clinical research: a quantitative and qualitative study. *Pediatric Research* 78: 103-108.

Kabatereine N, Fleming F, Thuo W, Tinkitina B, Tukahebwa EM and Fenwick A 2014 Community perceptions, attitude, practices and treatment seeking behaviour for schistosomiasis in Lake Victoria islands in Uganda. *BMC Res. Notes* 7: 1-11.

Koffi AJA, Doumbia M, Fokou G, Keita M, Koné B and Abé NN 2018 Community knowledge, attitudes and practices related to schistosomiasis and associated healthcare-seeking behaviours in northern Côte d'Ivoire and southern Mauritania. *Inf. Dis. Pov*.7: 70.

Lwambo NJS 1988 Transmission of urinary schistosomiasis in Sukumaland, Tanzania. Snail infection rates and incidence of

infection in school children *J. Helminthol.* 62: 213-217.

Midzi N, Mtapuri-Zinyowera S, Mapingure MP, Paul NH, Sangweme D, Hlerema G, Mutsaka MJ, Tongogara F, Makware G, Chadukura V, Brouwer KC, Mutapi F, Kumar N and Mduluza T 2011 Knowledge attitudes and practices of grade three primary school children in relation to schistosomiasis, soil transmitted helminthiasis and Malaria in Zimbabwe. *BMC Infect. Dis.*11: 169.

Odhiambo GO, Musuva RM, Atuncha VO, Mutete ET, Odiere MR, Onyango RO, Alaii JA and Mwinzi PNM 2014 Low Levels of Awareness Despite High Prevalence of Schistosomiasis among Communities in Nyalenda Informal Settlement, Kisumu City, Western Kenya. *PLoS Negl. Trop. Dis*. 8: e2784.

Parisi S, Mazigo HD, Kreibich S, Puchner K, Kasang C and Mueller A 2019 Factors associated with relevant knowledge of intestinal schistosomiasis and intention to participate in treatment campaigns: across sectional survey among school children at Ijinga Island on Lake Victoria, North-Western Tanzania. *BMC Public H*. 19: 1762.

Parkin DM, Bray F, Ferlay J and Jemal A 2014 Cancer in Africa. *Cancer Epidemiol. Biomarkers Prev*. 23: 953-966.

Person B, Ali SM, A'Kadir FM, Ali JN, Mohammed UA, Mohammed KA, Rollinson D and Knopp S 2016 Community Knowledge, Perceptions, and Practices Associated with Urogenital Schistosomiasis among School-Aged Children in Zanzibar, United Republic of Tanzania. *PLoS Negl. Trop. Dis*. 10(7): e0004814.

Poole H, Terlouw DJ, Naunje A, Mzembe K, Stanton M, Betson M, Lalloo DG and Stothard JR 2014 Schistosomiasis in pre-school-age children and their mothers in Chikhwawa district, Malawi with notes on characterization of schistosomes and snails. *Parasit. Vect*. 7(1): 153.

Rambau PF, Chalya PL and Kahima J 2013 Schistosomiasis and urinary bladder cancer in North Western Tanzania: a retrospective review of 185 patients. *Infectious Agents and Cancer* 8(1): 19.

Rassi C, Martin S, Graham K, Anna de Cola M, Christiansen-Jucht C, Smith LE, Jive E, Phillips AE, Newell JN and Massangaie M 2019 Knowledge, attitudes and practices with regard to schistosomiasis prevention and control: Two cross-sectional household surveys before and after a Community Dialogue intervention in Nampula province, Mozambique. *PLoS Negl. Trop. Dis.* 13: e0007138.

Sady H, Al-Mekhlafi HM, Atroosh WM, Al-Delaimy AK, Nasr NA, Dawaki S, Al-Areeqi MA, Ithoi I, Abdulsalam AM, Chua KH and Surin J 2015 Knowledge, attitude, and practices towards schistosomiasis among rural population in Yemen. *Parasit. Vect.* 8(1): 436.

Salehe FS 2017 Schistosomiasis occurrence and risk factor influencing transmission in different surface irrigation schemes in Morogoro and Kilimanjaro Regions, Tanzania. *Int. J. Trop. Dis. H.* 22: 1-15.

Singh AS and Masuku MB 2014 Sampling techniques and determination of sample size in applied statistics research: An overview. *Int. J. Econ. Comm. Manag*. 2: 1-22.

Simiyu Region Investment Guide 2017 The United Republic of Tanzania. The President's Office Regional Administration and Local Government Simiyu Region, page 5.

WHO (World Health Organization) 2015 Investing to Overcome the Global Impact of Neglected Tropical Diseases, Third WHO Report on Neglected Tropical Diseases; World Health Organization: Geneva, Switzerland, 2015: 154-191.