



RESEARCH ARTICLE

Evaluating community's knowledge on integrated malaria, schistosomiasis and soil transmitted helminth (STH) infections in a Lake Victoria island, Kenya: A mixed method approach [version 1; peer review: 1 approved with reservations]

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Abstract

Background: The burden of malaria, schistosomiasis and soil transmitted helminthes (STH) in the islands of Lake Victoria, Kenya, poses a considerable public health challenge. Although many studies have been conducted on the co-infection arising from these parasites, few have evaluated communities' knowledge of the same. Increasing the level of knowledge about a disease or preventive chemotherapy is important, but efforts need to be focused on community perception and understanding of the problem so as to encourage engagement with the proposed control measures. This study aimed at understanding a community's knowledge of malaria, schistosomiasis and STH in Lake Victoria island where an integrated preventive chemotherapy intervention was implemented.

Methods: This study was conducted in Ngodhe Island in Lake Victoria in Homa Bay County, western Kenya region between April and May 2016. The study adopted a mixed method approach where both qualitative and quantitative data collection was performed concurrently.

Results: A total of 239 people participated in this study. All the respondents reported that they had heard about malaria, 89.1% had heard about schistosomiasis while 87.4% had heard about STH. The majority of the respondents (93.3%) drew their drinking water directly from the lake and 80.3% reported bathing in the lake. Out of all the respondents, 96.2% knew about the ongoing preventive chemotherapy. Most respondents (94.1%) said they would participate in a preventive chemotherapy again, while 0.4% was not sure. The majority of the respondents (86.6%) reported that integrated strategy is the most effective approach to control the three infections in the Island.

Conclusion: The findings show a very high knowledge about these diseases. Although this study found majority of the respondents are aware

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of the co-infection of malaria, schistosomiasis and STH, their behaviors such as bathing in the lake exacerbates the problem.

Keywords

Knowledge, malaria, schistosomiasis, soil transmitted helminthes

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Background

In most developing countries, the problem of malaria, schistosomiasis and soil transmitted helminth (STH) poses a considerable challenge and contributes to the high burden of diseases. These parasitic infections, grouped under Neglected Tropical Diseases (NTDs) including malaria have been found to affect millions of people in sub-Saharan Africa. Studies have shown that these parasitic infections show a similar geographic distribution and that poly-parasitism of *Plasmodium falciparum*, schistosomiasis and STH infections have been reported to be co-endemic in various epidemiological settings in Africa^{1,2}. Poly parasitism acts in multiple ways to adversely impact human health such as through immune suppression, nutrient malabsorption, chronic blood loss, anorexia, inflammation, dyserythropoiesis and haemolysis and subsequently hepatosplenomegally^{3,4}. These lead to poor cognitive development, retarded growth, and general ill health and death⁵⁻⁷. The burden of poly parasitism besides having a toll across all ages portends worse outcomes for maternal and child health causing anaemia in pregnancy, low birth weights, preterm deliveries and still births^{5,8-10}.

In Kenya, the threat of malaria infection is very high with >70% of the population at risk, particularly in specific endemic zones in western and coastal regions¹¹. Malaria accounts for an estimated 12.2% of total recorded deaths and 20% outpatient consultations and hospital admissions¹². Although malaria transmission and infection risk in Kenya is determined largely by altitude, rainfall patterns and temperature, it has been found that deforestation also increases malaria risk^{13,14}. All four species of *Plasmodium* that infect humans occur in Kenya although *Plasmodium falciparum*, which causes the most severe form of the disease, is the most common and accounts for over 99% of all malaria infections in the country¹⁴. Recent studies have shown that changes in climatic conditions due to global warming and deforestation have caused changes in malaria infection rates, and pattern in the country¹³. Lake Victoria region falls under the endemic malaria zone where transmission is intense throughout the year¹⁵.

Schistosomiasis is another parasitic infection of public health importance in Kenya particularly in the Lake Victoria basin. Studies conducted along the lake shore have shown very high levels of *S. mansoni* among car washers working along the lake shores in Kisumu¹⁶. Likewise, other studies conducted with school children have shown higher prevalence along the lake shore and that prevalence of infection reduces with the distance to the lake¹⁷⁻²⁰.

The role of soil helminths in causing morbidity and mortality in developing countries has been well documented. Evidence has shown that helminths infestations share not only the areas in which they occur, but also the human hosts with other parasites²¹. STH have been widely documented to be associated with anaemia due to blood and adverse pregnancy outcomes^{18,22}. These parasites are mostly seen among the adults, younger women and children in the population^{23,24}. They have been found to cause an enormous burden on public health,

particularly affecting impoverished rural communities characterized by poor sanitation and hygiene practices²⁵. In Kenya, parasitic co-infections, consisting of malaria, schistosomiasis and/or STH have been found to be common among school going children and adults living in poor rural settings characterized by poor sanitation practices^{17,18,26}. Although many studies have been conducted²⁷⁻³⁰, few have evaluated communities' knowledge of the same.

Lack of knowledge about disease transmission and prevention can greatly contribute to low uptake of health care interventions³¹. Studies have shown that respondents who are knowledgeable about the risks to health and methods of preventing parasitic infections were more likely to comply with mass treatment³². The level of knowledge on the disease transmission and control measures can be increased through health education. However, for the health education to improve on the level of knowledge about a disease or preventive chemotherapy, it needs to be appropriate and focused on the needs of the community. This would encourage and modify beliefs of the target community towards the proposed control measures³³. This study therefore, aimed at understanding a community's knowledge on malaria, schistosomiasis and STH in Lake Victoria island where an integrated intervention was implemented. The intervention consisted of biannual malaria surveillance and control, community engagement and mass drug administration to control poly-parasitism.

Methods

Study setting

This study was conducted in Ngodhe Island in Lake Victoria in Homa-bay County, western Kenya region between April and May 2016. Ngodhe is one of the five islands found in Lake Victoria; others include Mfangano, Takawiri, Rusinga and Kibuogi. The average daily temperatures in Ngodhe Island lie between 16 and 34°C although temperatures always rise higher during the dry seasons of June to October and December to February. The island has a total household population of 418 in an area covering 7.9 km²³⁴. Ngodhe Island is situated to the north of Rusinga Island, which is connected to Mbita via a causeway. These islands have been extensively deforested and shrubs constitute the main vegetation today³⁵. The island is served by a health facility which is managed by the county government. Though there are many efforts geared towards development initiatives in this area especially with devolution of health services by the county government, poverty is still a major challenge. Farming and fishing are the major economic activities for the inhabitants of Ngodhe. Farming is mostly subsistence-based, with major crops including maize, millet and beans as well as small-scale animal husbandry involving keeping of cattle, goats and chicken³⁶. Fishing is done primarily by men and to some extent boys helping their fathers or for economic purposes using small, unpowered wooden boats. Other fishing related activities such as registration of fishermen and fishing vessels, sale and purchase of fish are coordinated by community-based beach management unit (BMU) situated within the island³⁵. Houses are typically made of mud walls with thatched or corrugated iron roofs.

Study design and data collection

Anyone who was above eighteen years of age and had been residing in the area for at least the last two years qualified to participate in the study. An additional inclusion criterion applied was language – participants who spoke in Dholuo, Kiswahili or English were eligible to take part in the study. A sequential mixed method approach was adopted to obtain data for the purposes of this study (Figure 1). Both qualitative and quantitative data collection started concurrently, however, qualitative data gathering was given more prominence over quantitative. Both data were then analyzed separately with quantitative data eliciting further inquiry through qualitative methods. Data was then interpreted and results obtained for the study.

Qualitative data

Qualitative data involved focus group discussion (FGD), key informant interviews, in-depth interviews and observation. Because we were interested in exploring community’s knowledge on integrated malaria, schistosomiasis and STH polyparasitism following an intervention, we identified households within the island for the purposes of identifying potential focus group discussion (FGD) participants and conducting observation for the presence of latrine (as a proxy indicator of the sanitation situation in the island).

Four FGDs were conducted with male elders, women, youth and a mixed group respectively. Participants for each group were identified and referred by the community health volunteers and local village elders. Each of the FGD consisted of eight to twelve participants drawn randomly from the households. Each of the FGD discussions lasted about one to one and a half hour. An FGD guide (Supplementary File 1) was developed for soliciting information. For key informant interviews, a total of five interviews were conducted with various personalities whom were purposively selected. They included the local administrator or chief of the area, health facility in-charge of the (Ngodhe) dispensary, Sub County Public Health Officer, Public Health

Officer in-charge of the island, beach management unit leader. A key informant guide was developed and used to collect information from this group. For in-depth interviews, a total of three interviews were conducted comprising of participants who were purposively selected from the study site. They included the village elder, community health committee member and a community health volunteer who took part in the malaria mass drug administration. An in-depth interview guide (Supplementary File 1) was developed and used for this purpose. Whereas an observation check list was used in this study, it was limited to the observation of presence of latrines in the compounds of the sampled study participants (question 16 of Household interview guides, Supplementary File 1).

The qualitative data collection tools were translated into *dholuo*, a local language for ease of understanding and pre-tested for consistency. All the interviews were recorded verbatim using a tape recorder and notes taken to compliment the recordings. Full audio recordings of all the interviews were later translated back and transcribed verbatim into English before analysis was done. The recordings were stored using codes and only the researchers were able to access the database. The recordings will be destroyed six months after the publication of this work.

Quantitative data

A structured questionnaire which captured socio-demographic characteristics of the study participants as well as other variables on knowledge such as transmission mechanisms of malaria, schistosomiasis and STH, their causes, prevention and control, provision of sample such as blood or stool and their participation in a biomedical research or preventive chemotherapy was used to collect quantitative data (Supplementary File 1). However, there was no sample collection of either stool or blood for this particular study. This was due to the fact that our study was limited to understanding the community’s knowledge on co-infection with STH, malaria and schistosomiasis. The tool was pretested before administration and adjustments made where possible. The

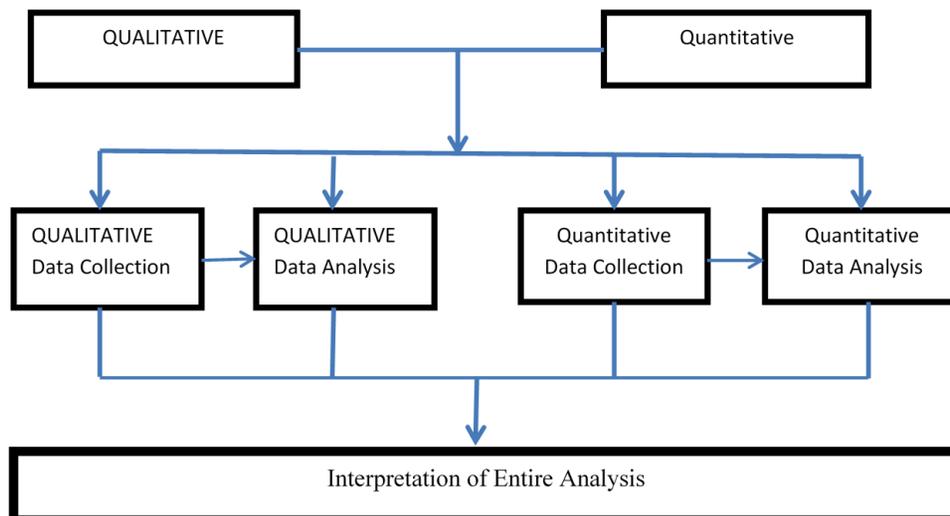


Figure 1. Mixed method sequential model.

study involved none probability sampling methodology combining random walk and quota sampling³⁷. The island is estimated to have a population of around 418 people of whom 239 were selected to take part in the study following sampling criteria as outlined below. Research assistants were instructed to begin the interview process at the health facility where they spun a pen and commenced a walk in the same direction. They were to take the direction pointed by head of the pen as a starting point and follow the same path to select households to be interviewed. They were instructed to use a skip pattern and select every third household to be included in the survey and interviewed. They were also instructed to only interview those households that took part in the initial preventive chemotherapy exercise. Identification of the households was made possible by the use of community health volunteers who had earlier participated in the preventive chemotherapy exercise. Each qualifying household were included and interviewed for the survey until a quota of 239 was reached (quota was based on the aim to survey 50% of the island). All the households interviewed had taken part in the preventive chemotherapy exercise.

This method was selected since it avoided the costly and time-consuming expense of listing all the households in the sample area as a prior stage before selecting the ones to be interviewed. The methodology was also preferred on the grounds that non-response is avoided by the fact that the interviewer continued beyond non-responding households until they obtained enough responding ones to fulfill the quota. Further, to ensure unbiased results or response, a starting point along the path of travel was determined randomly by calculating the number of households selected divided by the total number in the island.

Data entry and analysis

Qualitative data was analyzed manually through categorization and thematic ordering of emerging issues. This was later grouped and coded into knowledge on malaria, schistosomiasis and STH, their causes and prevention, water, sanitation and hygiene practices, knowledge on preventive chemotherapy and acceptance of sample provision. These thematic areas formed a 'tree like grouping of issues'. Quantitative data entry and analysis was performed using SPSS version 13.

Ethic approval

This study was approved by Mount Kenya University Ethical Review Board (P5/01/2015). The participants were asked for and gave their consent to participate and be recorded prior to gathering of information. Anonymity as well as confidentiality was highly maintained during the course of data collection.

Results

Socio demographic characteristics of the study population

A total of 239 people participated in this study out of which 113 were male and 126 were female, with married respondents constituting 75.7 %. Their ages varied from 18 years to 95 years, 37.7 % were aged between 18 – 26 years while 25.5 % were aged between 27 – 35 years, 4.2 % were aged 64 years and above. The majority of the respondents (61.5 %) had completed primary education, 10 % had no formal education while 3.7 % had either completed university or college education (Table 1).

Table 1. Socio-demographic characteristics of respondents.

	Frequency (n= 239)	Percentage (n= 239)
Sex		
Male	113	47.3
Female	126	52.7
Age		
18 – 26	90	37.7
27 – 35	61	25.5
36 – 45	36	15.1
46 – 54	21	8.8
55 – 63	21	8.8
≥ 64	10	4.2
Marital Status		
Married	181	75.7
Single	57	23.8
Not reported	1	0.5
Education		
None	24	10.0
Primary	147	61.5
Secondary	55	23.0
College	7	2.9
University/College	2	0.8
Unknown	4	1.7
Occupation		
Fishing	87	36.4
Fishing trade	78	31.8
Farming	28	11.7
None	27	11.3
Others e.g. teaching	21	8.8

Knowledge of malaria, schistosomiasis and STH

Respondents were asked if they have ever heard about Malaria, Schistosomiasis, and STH (Table 2). The survey showed that malaria was found to be the most prevalent compared to schistosomiasis and STH. All the 239 (100%) respondents reported that they had heard about malaria, 89.1% had heard about schistosomiasis while 87.4% had heard about soil transmitted helminthes (STH). These findings were supported by qualitative data as espoused by one of the in-depth interview participants;

Right now the people of Ngodhe Island know about malaria. They know of malaria and how it is prevented. They mostly knew it from Nagasaki people [Nagasaki University has an HDSS site in Mbita sub County where the island is part of] who have been close to them and continuously educating them on causes and prevention.... personally, I have been walking with

Table 2. Community’s knowledge on and causes of malaria, schistosomiasis and soil transmitted helminth (STH) infection.

		Frequency	Percentage
Response		(n=239)	(n=239)
Knowledge of malaria	Yes	239	100
	No	0	0
Knowledge of schistosomiasis	Yes	231	89.1
	No	8	10.9
Knowledge of STH	Yes	209	87.4
	No	30	12.6
Knowledge on causes of malaria	Yes	196	82.0
	No	43	18.0
Knowledge on causes of schistosomiasis	Yes	203	84.9
	No	36	15.0
Knowledge on causes of STH	Yes	236	98.7
	No	3	1.3

the Nagasaki health team as they educate and test people about these parasites. Many people have been tested willingly taking and this is due to the increased knowledge they have had.

The key informants as well as focus group discussants attributed this high knowledge of malaria in the island to a joint initiative of ICIPE (International Center of Insect Physiology and Ecology), Nagasaki University and the community;

Schistosomiasis and SHT is very tricky because somehow people fear coming out to say that they have schistosomiasis. It is kind of they feel shy or they feel ashamed of having gotten schistosomiasis, they do not know that it comes as a result of interacting with snails in the water. Some of them think that if you have blood in your urine then you are having an STI (sexually transmitted infections) or other conditions.

Causes and prevalence of malaria, schistosomiasis and STH
 Most of the respondents reported that mosquito bites are the major cause of malaria at 70% while 12% said that having a bushy and unkempt areas surrounding the home as potential hiding points for mosquitoes. Other factors included being rained on, cold weather, drinking dirty water and walking barefoot from 18% of the respondents. Factors given as causes of Schistosomiasis and STH included contaminated water and urinating in water, snails or worms and walking barefoot or swimming in water were cited several times by the respondents. Other factors mentioned included poor human health and personal hygiene, untidy homestead, blood, coldness, houseflies and lack of latrines. A lady who took part in one of the in-depth interviews said that;

What I know that brings malaria is mosquitoes and stagnant waters that are next to the homes...which act as mosquitoes breeding sites and from where they bite us and malaria spreads.

However, some of the residents believed that malaria is caused by being rained on or by walking on water bare-footed. This was captured during a focus group discussion where it emerged that;

One can get malaria if they are rained on or when they walk barefoot in cold water after it has rained. Malaria can also be caused by eating cold foods and by chewing sugarcane that has not matured.

Although all agreed that malaria is a severe disease which can end one’s life if treatment is not sourced on time as stated during a focus group discussion;

Malaria is a serious disease since it can kill someone within a short time as compared to other diseases which people think can kill faster like HIV. We hear from radio that it is amongst the top killer diseases...but the good news is that the government has given out nets (treated mosquito nets) for free for people to use and as a result, it is being contained. Some people perceive it as simple... they say ‘malaria is just a disease that you only need to buy Panadol™ (analgesics) and you are well’. Yes, some people do not perceive it as serious

Poor hygiene and lack of latrines or bathrooms leading to practicing poor sanitation in the homestead was cited as a source of schistosomiasis and STH. This was captured in one of the focus group discussion where participant noted that;

Those people infected with bilharzia (schistosomiasis) acquire it through urinating in the lake water when they are bathing.

Knowledge on water, sanitation and hygiene practices

In order to understand the community’s knowledge on hygiene factors or practices which may promote infection by the parasites, respondents were asked about whether they had latrines in their compounds, their sources of drinking water and what they do to improve on its quality and whether they have a bathroom (Table 3). It was observed that only 41% of the respondents had a latrine next to where they were staying although it was also observed that the Beach Management Unit has built some shared latrines. Further, some participants reported that the latrines constructed at the beach management unit are not public because they are always locked and only a few individuals are in possession of the keys. One of the participant had this to say during an in-depth interview, “...not everyone within the beach knows the janitors with the keys and this makes latrine access a problem”. Other participants also noted that “some people do not know how to use the latrines” and they would rather relieve themselves on the door-steps of the latrine than enter inside. This makes the area filthy with faeces and poses a danger to health as well as making people not to use the shared latrines.

Table 3. Availability of a latrine in compound and bathing place.

Availability	Respondents (N= 239)	
	Yes	No
Has a bathroom at home	47 (19.7%)	192 (80.3%)
Bathes in the lake	192 (80.3%)	47 (19.7%)
Latrine	98 (41%)	141 (59%)

Some of the factors cited as a hindrance to latrine construction and access were topography due to the place being hilly and rocky. Other reasons included big stones making it hard to dig, most areas are also steep and sloppy meaning they cannot hold the latrines. The area chief (who was a key informant) was also in agreement that the sloppiness of most of the places makes it hard for people to construct latrines especially after struggling to make the land plain for house construction. According to the area Public Health Officer, the island has a low latrine coverage due to the attitudes of people. This makes them not construct latrines, not using them efficiently, and the type of soil in most of the sub-county makes it hard to support construction of pit latrines.

When it comes to household drinking water sources, the majority of the respondents 93.3% were drawing their water directly from the lake while 6.7% said that they get their drinking water from rain water. The island has a central water tank located at the dispensary and school that is used as a reservoir to help people. It emerged from the discussions that most people acknowledge that lake and harvested rain water are not safe if consumed directly. Lake water was said to be contaminated by germs and worms since people urinate and defecate in it while fishing. It was also noted that when it rains, *'all the wastes are swept to the lake including human wastes.'* Rain water from the roofs was also seen to be contaminated from iron sheets' corrosions and general air pollution. Some of the water treatment methods used to make it safe include Waterguard™ (chlorine solution), P&G purifier of water, boiling, and leaving in the sun for at least 3 days before sieving and drinking. For those who boil the drinking water, all the participants unanimously agreed that it must be boiled until it achieves the required boiling point as noted by FGD discussants:

People treat water in different ways...after boiling water should be left to cool then sieved (filtered) before drinking. When you boil, you ensure that it is done until you see it evaporating/boiling like water for cooking ugali (flour paste).

Others had the opinion that it doesn't matter whether drinking water is treated or not, what matters is whether it is cold enough to quench thirst. A male in-depth interview participant had this to say:

On many occasions what people look at is cold water, the amount of water and how it cools the body. When I have

realized that the water is cold, even if it is rain or lake water and it is a bit cool, I will leave the boiled one in the bucket and drink the cold (untreated/un-boiled) water without looking at the impurities which may be in it.

Other hygiene practice such as bathing in the lake was also noted to be rampant. According to the findings, the majority of the population (80.3%) bath in the lake while only 19.7% have bathrooms within their homesteads and thus take a shower in the bathroom. This was also noted by focus group discussion and key informant interviews respectively:

The reason why almost everybody bathe in the lake is that it (lake) is close to us and you enjoy the water because it is abundant compared to that of a bathroom.

...personally if I use bathroom water, as soon as I step out I'm sweating, but in the lake I swim and feel the water in the whole of my body the way I want it.

This behavior is attributed to the fact that Ngodhe Island is surrounded by the lake and water is there in abundance. Key informant interview with the chief of the area also affirmed the same notion of using the lake as the point of bathing:

Most of the residents here bathe in the lake. It is just only a few people when they came back home late or when they are sick that they can bathe at home.

Knowledge of preventive chemotherapy

Survey respondents were asked about whether they have ever heard about integrated malaria, schistosomiasis and STH preventive chemotherapy taking place in the island. Out of 239 respondents, 96.2% had knowledge of the ongoing preventive chemotherapy while 2.9% had not. Some of the respondent (0.9%) refused to respond to the question. For triangulation purposes, the same question was posed to those who took part in the FGDs. All the participants who took part in the discussions confirmed that they have heard about preventive chemotherapy on the island. They were even specified that the exercise had been performed on the Island three times. They were also aware that preventive chemotherapy was for integrated malaria prevention and control. However, varied reactions were reported by the participants regarding their reaction when the first drug administration was conducted. Many shared the idea that despite initial education and awareness about the exercise, they were still afraid to whole-heartedly come out and take part in the exercise as noted by a woman during an in-depth interview, *"We were not comfortable to accept the drug at first and waited for a few people to try it."* In one of the focus group discussions, participants agreed that:

People were having diarrhea and others were getting tired. Others said it brings out some infection from the body; the drug was making people sick. An expectant mother had this to say during an in-depth interview:

"First, I was afraid to go because that time I was pregnant and I heard that the drug was making people to be sick and tired

and I was tired already. I argued with them and told them I could not take the drugs the way I was (pregnant). They told me that it would not hurt me. The first day I did not take it but they tried hard and came back again. Thereafter, I took the drug”

Respondents were further asked whether they or members of their households would participate in an integrated malaria, schistosomiasis and STH preventive chemotherapy exercise if it was to be conducted again. The majority of the respondents (94.1%) said they are willing to participate again, 5.5% said they are not willing, while 0.4% were not sure. Reasons for accepting future preventive chemotherapy included disease prevention (66.5%), general health benefits (17.9%), treatment of diseases (11.1%), and knowing (their) health status (4.5%). For those respondents who would not wish to take part in future preventive chemotherapy, negative side effects of the drug – dizziness, feeling more sick, other unforeseen effects, and lack of interest because of ‘no direct benefits’ were cited.

When asked if an integrated approach to malaria, schistosomiasis and STH is effective in control and prevention of diseases in the island, the majority of the respondents (86.6%) reported that it is the most effective approach to control malaria, schistosomiasis and soil transmitted helminthes on the Island. According to one of the key informants, community members are ready to welcome the integrated approach. This was further reinforced during an FGD:

We are in the lake and most of us use water from the lake which carries many infections. Some of these infections such as bilharzia come because of that water, so we are trying to request, as those people who live on the shores of the lake ...if we could get drugs for bilharzia, malaria and others, it can help us.

However, a key informant had this to say on integrated approach:

I think if it is integrated then the drugs should not be given at one time and the service can be done at a particular interval to avoid mass side effects to the community, because when they get mass side effects, they may be discouraged and so another time when maybe we will be administering, they may not comply well.

Acceptance of provision of samples and sample collection

The study participants were asked if they have ever given stool or blood samples for testing before the preventive chemotherapy. Almost all the respondents (96.2%) have at one time or another given out specimen for test while only 3.8% had not given any specimen. Those who have never given any specimen cited fear of giving a blood sample, never been sick to warrant blood/stool specimen to be taken, and never been asked to provide any sample.

During the FGDs, many views were expressed regarding the blood samples taken from residents prior and after preventive chemotherapy. Some of the discussants were of the opinion that a lot of blood was being withdrawn leaving an individual ‘weak’. Most of the participants felt that the frequency of blood sample taking was too high, while some said that the blood samples

collected were not used to test malaria. Some felt that the blood samples were taken for secretly testing HIV while others felt that researchers had ‘their own reasons’ for it – that they were ‘forced to give blood’. According to others, if research had shown that the area residents are prone to malaria, they would have just been given (everybody) malaria drugs without taking blood samples. Equally, many participants still questioned why they never received back the test results immediately. According to some participants, this is what mostly contributed to the many perceptions about sample collection, especially blood. According to a key informant:

They (researchers) came here and took blood from people for about a week. So what was disturbing us was ...what kind of blood is it that is being withdrawn every day and there are no results?

Another youth reinforced this during an in-depth interview by saying that:

Producing blood is hard for us here at Ngodhe. People feel that when their blood is taken, it is not about testing malaria. They feel that these people want to secretly test HIV. That is what makes us not to give samples.

According to the area public health officer who was a key informant, “some people hold the perception that their blood is going to be sold”. He noted that the community is concerned about why the exercise was just being done only in Ngodhe Island and not their neighboring villages. According to him, these were some of the reasons that make people worried.

Discussion

This study aimed at evaluating community’s knowledge on integrated malaria, schistosomiasis and STH infections using both qualitative and quantitative methods. These diseases are widely distributed in the Islands of Lake Victoria. Schistosomiasis, for instance is estimated to be high, with a prevalence of above 30%³⁸ while malaria and STH co-infection is endemic. This study has found that knowledge of schistosomiasis as well as malaria and STH is very high. All the 239 (100%) respondents reported that they had heard about malaria, 89.1% had heard about schistosomiasis while 87.4% had heard about STH. This is in tandem with other studies which have been done in Africa and have shown that knowledge about schistosomiasis as well as malaria and STH is very high^{39,40}, but contradicts a study by Adoka and others along the shores of lake Victoria which found knowledge about schistosomiasis to be low⁴¹. This high knowledge is key to improvement of the health of the inhabitants of this island. Although knowledge was found to be high, there was an inconsistency between participants’ beliefs on the cause of the three diseases in spite of the high levels of awareness. Some of the respondents associated poor hygiene and lack of latrines as a source of Schistosomiasis and STH. Only 41% of the respondents had access to a latrine. This was also in agreement to an earlier study among school children in 2011, which had noted that latrine availability, sources of drinking water and hygiene among other factors contributed to the transmission of schistosomiasis⁴². In the study, the respondents

justified the lack of latrines by the presence of bushes. In one of the focus group discussions, the residents noted that due to the scarcity of latrines, they usually defecate in the bushes which are abundant. As for Schistosomiasis and STH, walking barefooted and urinating and swimming in the lake were cited.

The inconsistency was also noted in responses on the causes of malaria. Though about 70% of the respondents were aware that a mosquito bite is the cause of malaria, a few attributed the disease to other factors such as being rained on, cold weather, walking barefoot and drinking dirty water. The respondents were aware that malaria is a potentially lethal disease. However, despite the knowledge, they still bought over the counter drugs rather than seeking help from qualified health care professionals. This may pose a danger to public health and control of such diseases considering that self-medication has been found to increase drug resistance especially against malaria^{43,44}.

Poor hygiene and sanitation practices such as not having a latrine and bathing in the lake shore was identified as the causes of schistosomiasis and STH by the respondents. Despite this awareness, it was found that majority of the households did not have latrines and bathrooms which encourages open defecation and bathing. Use of safe treated water was also found to be low among the residents of the island as they almost entirely rely on the lake water as the major source for household use including for drinking. The study found that knowledge on water quality improvement at the point of use was very high with the majority being able to mention several household water treatment methods. They were also aware of the Lake water contaminants which may necessitate treatment before use or consumption. These practices expose the inhabitants to the risks of acquiring schistosomiasis as well as STH yet the use of safe water and improved sanitation facilities has been found to decrease the severity of infections and reduce morbidity^{45,46}. Thus, there is need to help the community understand the importance of safe water, improved sanitation and hygiene practices in order to make them translate this high knowledge into practice.

Community participation in preventive chemotherapy and acceptance to provision of samples, is a key to control and elimination of malaria and NTDS⁴⁷. Furthermore, studies have shown that the integration of such programs targeting multiple neglected tropical diseases with similar strategic approaches offers opportunities for enhanced cost-effectiveness and improved health care and outcomes^{48,49}. The acceptance of sample provision and collection, coupled with willingness to take part in mass preventive chemotherapy in this community is a boost to public health provision. However, some concerns like negative side effects of the drugs used such as dizziness, feeling more sick, other unforeseen effects, and lack of interest because of 'no direct benefits' were raised by those who wished not be involved in such interventions. There is a need to address such concerns with more robust strategic approaches and information about the importance of such programs. The scientific community should also be willing to invest more in terms of research into drugs which have less side effects and offers more protection to the community.

Conclusion

The findings of this study show that there is very high knowledge about malaria, schistosomiasis and STH. However, there is still need to translate this knowledge into practice in order to ensure improvements in the health of the inhabitants of Ngodhe Island. This study also underscores the importance of preventive chemotherapy programs in Africa and contributes to the discourse on malaria co-infection preventive strategies.

Declarations

Ethics approval and consent to participate

This study was approved by Mount Kenya University Ethical Review Board (P5/01/2015). The participants were asked for consent prior to gathering of information and anonymity as well as confidentiality was highly maintained during the course of data collection.

Data availability

Underlying data

The data underlying this study is presented in the tables with additional data available from Figshare.

Dataset 1: Gitaka J *et al.* 2018. <http://dx.doi.org/10.6084/m9.figshare.7015436>⁵⁰

Dataset 2: KAPstudy18 with Keys-deidentified.xls <https://doi.org/10.6084/m9.figshare.7182194.v1>⁵¹

Dataset 3: Interviews <https://doi.org/10.6084/m9.figshare.7447004.v1>⁵²

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Interview transcript (Dataset 3⁵²) with key informants include the name of the individual interviewed along with their job title. These individuals provided consent to the authors to publish their names with the transcripts.

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Supplementary material

Supplementary File 1: Focus group interview guide

[Click here to access the data](#)

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1. Revise the title to read: “Evaluating community’s knowledge on integrated interventions for malaria, schistosomiasis and soil transmitted helminthiasis in a Lake Victoria island, Kenya: A mixed method approach”.
2. Write: “infections with *P. falciparum*, schistosomes and soil transmitted helminths (STH)” when referring to infection with the parasites, and “malaria, schistosomiasis, and soil transmitted helminthiasis (STH)” when referring to the diseases the infections cause.
3. Throughout the document, replace “soil transmitted helminths (STH)” with “soil transmitted”.
4. Adequately describe the integrated preventive chemotherapy approach on which this evaluation is based - present this clearly in the abstract, methodology.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Neglected tropical diseases

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
