

KNOWLEDGE, ATTITUDES, PERCEPTIONS AND ACCEPTABILITY OF ONCHOCERCIASIS CONTROL THROUGH COMMUNITY-DIRECTED TREATMENT WITH IVERMECTIN: IMPLICATIONS FOR PERSISTENT TRANSMISSION IN ULANGA DISTRICT, TANZANIA

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Background

Ulanga, an onchocerciasis-endemic district in Tanzania, has received preventive chemotherapy for onchocerciasis by community-directed treatment with ivermectin (CDTI). With CDTI, interruption of transmission could occur after 14-17 years, yet transmission persists even after 20 years. This may be due to high baseline endemicity and other factors that can lower coverage of CDTI, including poor knowledge of the disease and negative attitudes and perceptions towards CDTI. This study examined community knowledge, attitudes and perceptions towards onchocerciasis control and acceptability of the CDTI program in Ulanga.

Methods

A mixed methods cross-sectional study was carried out from June to July 2018. A quantitative questionnaire was administered to 422 household members in the community. This was complemented with qualitative in-depth interviews and focus group discussions.

Results

A majority (94.1%) of community members had heard of onchocerciasis. Only 15.4% had a high level of knowledge about onchocerciasis; about half (49.2%) had a low level of knowledge on the disease and CDTI. Negative attitudes and perceptions towards CDTI prevailed in nearly half of participants (46.2% and 44%, respectively). A majority (83.4%) of respondents agreed that they will take ivermectin, and 74.4% were willing to comply with treatment for 12 to 15 years to eliminate onchocerciasis. In focus group discussions, participants reported mistrust of the method of dose calculation, that affects the acceptability and use of ivermectin treatment.

Conclusion

Inadequate levels of knowledge, negative attitudes and perceptions have the potential to affect participation in CDTI. This may result in continual transmission of onchocerciasis.

Key words: CDTI, onchocerciasis knowledge, attitudes, perceptions, acceptability, Ulanga district.

INTRODUCTION

Onchocerciasis is a parasitic disease of the eye and skin caused by the filarial worm *Onchocerca volvulus*. The disease is transmitted to humans by repeated bites of an infected black fly that belongs to *Simulium spp* (Crump *et al.*, 2012). People who live near rapidly flowing rivers and streams are at high risk of acquiring onchocerciasis because black flies breed near fast flowing rivers. Infected people may have a skin disease in the form of nodules under the skin and debilitating itching; they may also have eye disease

resulting in visual impairment and blindness (WHO, 2017).

Onchocerciasis is endemic in Africa, the Americas and the Arabian Peninsula. Globally, in 2017, 198 million people in 36 countries lived in endemic areas that put them at risk of onchocerciasis, and over 40 million people were infected (WHO, 2017). Among the infected people, more than 6.5 million suffered from severe itching or dermatitis, 800,000 had visual impairment, and 300,000 people were blind due to infection (CDC, 2017; WHO, 2017). The African region is highly affected compared to other regions, as 99% of

infected people live in sub-Saharan Africa. The burden of onchocerciasis has led to the introduction of control interventions such as vector control (*simulium* control) and community-directed treatment with ivermectin (CDTI). This has relieved 40 million people from infection, prevented 600,000 people from going blind and ensured more than 18 million children were born free from the risk of acquiring the disease and becoming blind (WHO, 2017).

In Tanzania, 6 million people are at risk of onchocerciasis, mainly in Morogoro, Tanga, Iringa, Lindi, Mbeya and Ruvuma regions. The main vector for transmission of *Onchocerca volvulus* in Tanzania is *Simulium damnosum sensu lato* (Mweya *et al.*, 2007; Maegga *et al.*, 2011). Morogoro region, where Ulanga is located, was the first to be identified as hyperendemic, with microfilariae prevalence of around 60% and nodule prevalence of 95% (Mwaiko *et al.*, 1990). This led to the introduction of an onchocerciasis control program. Tanzania, in collaboration with the African Programme for Onchocerciasis Control, introduced CDTI in 1997 (NTDCP, 2016).

The operational prediction is that interruption of transmission would be reached within 14-17 years with annual CDTI coverage of at least 80% (Colebunders *et al.*, 2018). Following two decades of annual CDTI, a transmission assessment survey carried out in 2017 in the Mahenge with a focus of Ulanga district found the prevalence of onchocerciasis to be 2.1%, indicating persistent transmission (NTDCP 2016; NTDCP 2017). This could plausibly be explained by several factors. CDTI coverage in Ulanga district was below the 80% optimal coverage (Colebunders *et al.*, 2018), at less than 65% between 1997 to 2002 and average of 76% between 2003 to 2017 (NTDCP, 2017). Higher baseline endemicity levels require higher coverage and longer treatment durations (Colebunders *et al.*, 2018). The contribution of community knowledge, attitudes and perceptions towards onchocerciasis and its influence on participation and acceptability of CDTI in Ulanga have not been fully investigated. This study examined the influence of knowledge, attitudes and perceptions on community participation and acceptability of the CDTI program in Ulanga district, Tanzania.

METHODS

Study design and setting

A mixed methods community-based study involving quantitative and qualitative approaches was conducted in Ulanga district from June to July 2018. The Ulanga district, one of the six districts in Morogoro region, has 40 rivers, of which 34 rivers flow throughout the year. Some of the perennial rivers such as Luli, Lukande, Mbalu, Mzelezi, Mzingizi and Ruaha constitute breeding sites for *S. damnosum* s.l. (vector) that transmits onchocerciasis.

Study participants

The study population consisted of community members above 15 years of age, who had been residents of their respective villages for more than 12 years and who voluntarily agreed to participate.

Sampling

For the quantitative component, a multistage sampling technique was used to obtain a representative sample. This was done in three stages using a cluster-sampling technique. The first stage involved simple random selection of one endemic ward from the list of all 29 onchocerciasis-endemic wards; Isongo ward was selected. The second stage was random selection of two representative villages from Isongo ward; Isongo and Uponera villages were selected from five villages. The third stage was simple random sampling of one representative village unit from the list of all village units in each of the two villages, which together had 422 households. One household member was randomly selected from each household, resulting in a total of 422 household members who met the inclusion criteria and were interviewed using questionnaires.

Participants for in-depth interviews (IDIs) and focus group discussions (FGDs) were sampled purposively. Five community drug distributors (CDDs) were recruited for IDIs and eight community members were recruited for each of the two FGDs. The inclusion criteria for purposive sampling were community members and community drug distributors older than 15 years and residents of their respective villages for more than 12 years.

Measurements

The main measurements were knowledge, attitudes, perceptions and acceptability of onchocerciasis control. A series of questions were asked to measure knowledge and acceptability. Questions of knowledge were measured as awareness and familiarity on cause, symptoms, mode of transmission and prevention strategies of onchocerciasis. Acceptability was measured as willingness to accept and comply with the duration of ivermectin treatment. A Likert scale was used to measure attitudes and perceptions. Attitude was measured by asking their opinions and feelings on onchocerciasis transmission, discrimination and distribution of ivermectin drugs by CDDs. Perception was measured by asking their experience and beliefs on the way ivermectin is distributed in the community, the benefits of ivermectin treatment, responsibility of women as community drug distributors, and role of government in running the onchocerciasis control program. The questionnaire was pre-tested among 42 community members (10% of the 422 calculated sample size) and the feedback obtained was used to improve the instrument.

For the qualitative component, focus group discussion and interview guides were used to explore participants' knowledge, attitudes and perceptions toward onchocerciasis and the CDTI program.

Data analysis

The quantitative data were entered, cleaned, coded and double-entered into a computer. Analysis was done using the statistical package for social sciences (SPSS) version 22 (IBM Corp., Armonk, NY, USA). Socio-demographic characteristics, knowledge, attitudes and perceptions were summarized in frequency tables with proportions and their 95% confidence intervals (CI).

To measure knowledge, a scale was developed from eight multiple-choice questions that carried a total of 12 correct responses. A correct response was scored 1 and an incorrect response was scored 0. Scores were added to make one scale that ranged from 0-12 points. Cut-off points were developed from the mean knowledge score and categorized as follows: 80 - 100% (10-12 points) indicated high knowledge level; 50% – 79% (6-9 points) indicated moderate knowledge; and less than 50% (0-5) indicated low knowledge.

Attitudes and perceptions were measured with a five-point Likert scale. For attitudes, there were 7 items each scored from 1 to 5. These were subjected to reliability analysis and Cronbach's alpha value of 0.638 was obtained. This was followed by running a sum score, and the attitude scale was formed with a range from 7 to 35 points. The mean score was used to classify attitudes as negative or positive. Negative attitudes ranged from 8 to 23 points, while positive attitudes ranged from 24 to 35 points. For perceptions, there were 15 items each scored from 1 to 5. Reliability analysis for all 15 items resulted in Cronbach's alpha value of 0.714. Accordingly, all 15 items were added and a perception scale was formed, which ranged from 15 to 75. The mean score was calculated so as to classify perceptions as negative or positive. Negative perceptions ranged from 15 to 45 points, while positive perceptions ranged from 46 to 75 points.

The qualitative data from IDIs and FGDs were transcribed and then organized into segments of text; analysis and interpretations were done by clustering similar and related topics together to form major emerging themes.

Ethical considerations

Ethical clearance was obtained from the Muhimbili University of Health and Allied Sciences (MUHAS) Ethical Review Board, while permission to conduct the study was obtained from the administrative authorities of Morogoro region and Ulanga district. Informed verbal consent for participation in the study was obtained from each participant.

RESULTS

Socio-demographic characteristics of the study participants

A total of 422 respondents were interviewed in 422 households with a sex ratio of 1:1 with half (50.2%) being 30-49 years old (Table 1). More than two thirds (70.9%) of participants depended on small-scale agriculture and livestock keeping as sources of income while less than half (44%) were residents for 30-49 years.

Knowledge of onchocerciasis

Of 422 respondents interviewed, 397 (94.1%) had ever heard about onchocerciasis (Table 2). Only 78 (19.6%) correctly knew filarial worm as the causative agent; however, 247 (62.2%) thought the black fly to be the causative agent. Of respondents, 119 (28.2%) knew onchocerciasis is transmitted from one person to another, and 217 (51.4%) reported that onchocerciasis is not transmitted from one person to another. However, 301 (71.3%) correctly knew that the black fly bite was the mode of transmission; the rest (28.7%) reported mosquito bites, contact with infected persons, and aerosols.

Table 1: Demographic characteristics of study participants (N=422)

Variables	N (%)
Sex	
Males	211 (50.0)
Females	211 (50.0)
Age (years)	
≤29	100 (23.7)
30 - 49	212 (50.2)
50 - 69	83 (16.1)
Above > 69	27 (6.4)
Education level	
No formal education	54 (12.8)
Pre primary education	42 (10.0)
Primary education	239 (56.7)
Secondary education	70 (16.6)
Post-secondary education	17 (0.4)
Occupation	
Peasants and livestock keepers	299 (70.9)
Traders	74 (17.5)
Employed	33 (7.8)
Unemployed	16 (3.8)
Duration of residence (years)	
≤29	133 (31.5)
30 - 49	186 (44.0)
50 - 69	79 (18.8)
> 69	24 (5.7)

Respondents knew that the following were symptoms of onchocerciasis: skin itching (86.3%), followed by skin rashes (72.3%), blindness (71.8%), skin depigmentation (58.1%) and skin lesions (43.8%). A majority of participants (96.4%) were aware of modern treatment; however only 11.8% knew ivermectin as the drug of treatment and prevention. Respondents (44%) who had lived in Ulanga for 30-49 years were more likely to report the correct type of treatment compared to those (31.5%) who had lived in Ulanga for 29 or fewer years. From the total respondents, 207 (49.2%) had low level of knowledge; 150 (35.5%) had moderate level of knowledge; and 65 (15.4%) had high level of knowledge regarding onchocerciasis and ivermectin treatment.

Focus group discussions provided more depth about knowledge of the disease. Most participants were aware of the disease and knew its local name, sign and symptoms, but they did not clearly define the disease and cause of it. One of the participants said:

"...The local term for onchocerciasis is wankoseka, when

you say wankoseka even children can understand, the only thing I know about wankoseka is a disease of itching caused by vifuna, the moment vifuna bite you will suffer severe itching.” (Female, Uponera, 40-49 years)

Table 2: Knowledge of the disease among community members (N=422)

Indicative questions on knowledge	N (%)
Heard about onchocerciasis	
Yes	397(94.1)
No	25(5.9)
Causative agent of onchocerciasis	
Filarial worm	78(19.6)
Black fly	247(62.2)
Mosquito	37(9.3)
Witchcraft	2(0.5)
Don't know	33(8.3)
Transmission from person to person	
Yes	119(28.2)
No	217(51.4)
Don't know	86(20.4)
Mode of transmission of onchocerciasis	
Black fly bite	301(71.3)
Contact with infected person	10(2.4)
Mosquito bite	42(10)
Through breath	6(1.4)
Don't know	63(14.9)
Signs and symptoms of onchocerciasis	
Itching	
Yes	364(86.3)
No	14(3.3)
Don't know	44(10.4)
Lesion	
Yes	185(43.8)
No	114(27)
Don't know	123(29.1)
Skin depigmentation	
Yes	245(58.1)
No	63(14.9)
Don't know	114(27)
Blindness	

Yes	303(71.8)
No	47(11.1)
Don't know	72(17.1)
Skin rashes	
Yes	305(72.3)
No	42(10)
Don't know	75(17.8)
Type of treatment used	
Modern	407(96.4)
Traditional	15(3.6)
If Modern, which drug is used	
Ivermectin	86(20.4)
Albendazole	73(17.3)
Don't know	299(70.9)
Onchocerciasis can be prevented	
Yes	253(60)
No	83(19.7)
Don't know	86(20.4)

Acceptability of community-directed treatment with ivermectin

A majority of respondents (83.4%) agreed that they would take ivermectin, while 16.6% didn't agree (Table 3). Among those who would not agree to take ivermectin, the reasons were fear of side effects (52.9%), mistrust of the method of dose calculation (17.1%), and because they were not sick (30%). Most (74.4%) were willing to comply with CDTI for the duration of 12 to 15 years in order to eliminate onchocerciasis. Itching (49.1%) and body swelling (16.7%) were mentioned as side effects of taking ivermectin.

During focus groups, participants were concerned that there were misconceptions about the use of height measurements as a method of dose calculation; most participants did not trust this method.

“...Height measurement is used as method of dose calculation, but I do not trust this method, and I think it is the reason of the side effects people get; because how can a person with 60kg given the dose similar to that of a person with 80 kg with excuse that they have same height. I think other measurements should also be taken such as weight before giving the drugs.” (Female, Uponera, 30-39 years)

Attitudes towards onchocerciasis and ivermectin treatment

Among the 422 participants, 343 (79.1%) believed that onchocerciasis is a bad disease, and 338 (80.1%) believed that it's very sad when you see a person with onchocerciasis (Table 4). Similarly, 257 (60.9%) agreed that affected individuals worry about consequences of onchocerciasis. More than half of the respondents (53.3%) were against the idea of stigmatization of the affected people. Itching was

identified as the main side effect after taking ivermectin (71.1%). From the total respondents, 227 (53.8%) had a positive attitude towards onchocerciasis control and ivermectin treatment while the rest (46.2%) had a negative attitude towards onchocerciasis control and ivermectin treatment.

Table 3: Acceptability of Community Directed Treatment with Ivermectin Program among Community Members in Ulanga District (N=422)

Indicative statement on acceptability	N (%)
Would take ivermectin as distributed by CDDs	
Yes	352(83.4)
No	70(16.6)
Reasons for not taking (n=70)	
Fear of side effects	37(52.9)
Don't trust the dose	12(17.1)
Not sick	21(30)
Willingness to comply with 12 to 15 yearly rounds of CDTI	
Yes	314(74.4)
No	30(7.1)
Not sure	78(18.5)
Experiences with ivermectin side effects	
Yes	269(63.7)
No	96(22.7)
Don't remember	57(13.5)
Ivermectin side effects experienced	
Itching	132(49.1)
Dizziness	18(6.7)
Headache	22(8.2)
Vomiting	15(5.6)
Diarrhea	12(4.5)
Body swelling	45(16.7)
Body pain	25(9.3)

Perceptions towards onchocerciasis and ivermectin treatment

Out of 422 respondents, 321 (76.1%) agreed or strongly agreed that onchocerciasis is a common health problem in their community (Table 5). A majority [308 (73%) and 315 (74.1%) respectively] agreed that onchocerciasis is a dangerous disease and a curable disease. Approximately a quarter (24.2%) of respondents strongly disagreed that they

are at risk of contracting the disease; while 64 (15.2%) agreed or strongly agreed that onchocerciasis is caused by witchcraft. More than one third (39.1%) of the respondents agreed that ivermectin treatment will eliminate onchocerciasis; while 195 (46.1%) held the opinion that ivermectin has other health benefits [with 106 (25.1%) agreeing and 89 (21%) strongly agreeing].

Regarding the operations of the CDTI program, 107 (25.4 %) were not sure if CDDs are capable of handling side effects. However, 160 (37.9%) agreed CDTI is efficient in fighting and preventing onchocerciasis. Furthermore, a majority [308 (71.8%)] agreed that onchocerciasis control should be run by the government. From the total respondents, 236 (56%) of respondents had a positive perception towards onchocerciasis control and ivermectin treatment while the rest [186 (44%)] had a negative perception towards onchocerciasis control and ivermectin treatment.

Perceptions towards onchocerciasis were also supported with qualitative information from focus groups. Onchocerciasis-related discrimination and stigmas among infected people were not occurring in the community, according to participants, as they are treating each other equally. One of the participants said:

"...How can my fellows discriminate me because of wankoseka, I was infected with wankoseka but no one treated me badly, I continued to share alcohol with others" (Male, Uponera, 40-49 years)

Participants were also probed to see if there were local superstitions about the cause of onchocerciasis. All of them denied that this was the case. For example:

"...There is no relationship between superstition and onchocerciasis; it's a disease like other diseases that requires hospital treatment." (Male, Uponera, 20-29 years)

Knowledge, attitudes and perceptions of community drug distributors (CDDs)

During in-depth interviews, no CDDs knew the correct causative agent of onchocerciasis. Four of them responded that Vifuna (black flies) were the causative agent and one of them said that mosquitoes were the causative agent. Most CDDs were only aware of black fly bite as the mode of transmission and did not clearly know how transmission occurs. All CDDs were able to mention the symptoms of onchocerciasis, the most common symptoms being severe itching, skin depigmentation, skin lesions and blindness. Few CDDs were able to mention the correct drug for treatment for onchocerciasis. The following is one of the statements given by CDDs:

"...How can I memorize the name of the drug, I only know how they look like and how to distribute them." (Male, Isongo, 51 years)

CDDs believed that some of community members have positive attitudes and perceptions towards ivermectin as being very useful in treating those infected, and at the same

time preventing those uninfected from getting onchocerciasis, while others had negative attitudes and perception toward ivermectin due to side effects, mistrust of method of dose calculation, fear of becoming impotent or being uninfected.

“...Community members know the importance of using ivermectin, it has helped to treat a lot of infected people

in the community and transmission has decreased compared to before. Now when distribution of ivermectin is late people are coming to ask me what is happening. Or why are they not getting the medication?” (Female, Isongo, 49 years)

Table 4: Attitude towards Onchocerciasis and Ivermectin treatment (N=422)

Attitudes statements on disease and treatment	Strongly	Agree	Not	Disagree	Strongly
	agree		sure		disagree
	No (%)	No (%)	No (%)	No (%)	No (%)
Onchocerciasis is a bad disease	133(31.5)	201(47.6)	41(9.7)	26(6.2)	21(5)
It's very sad when you see a person with the diseases	120(28.4)	218(51.7)	52(12.3)	17(4)	15(3.6)
A person with the disease worries about its consequences	83(19.7)	174(41.2)	83(19.7)	30(7.1)	52(12.3)
A person with the disease avoids contacts with other community member	22(5.2)	66(15.6)	109(25.8)	86(20.4)	139(32.9)
Sometimes Ivermectin causes itching	102(24.2)	198(46.9)	35(8.3)	48(11.4)	39(9.2)
Ivermectin is preferably given by female CDDs	111(26.3)	126(29.9)	91(21.6)	50(11.8)	44(10.4)
CDDs are happy to help patients without payment	68(16.1)	83(19.7)	39(9.2)	74(17.5)	158(37.4)

Side effects were mentioned as a barrier of community participation in the CDTI program. All CDDs said ivermectin has several side effects, but that they differ from person to person. The following were side effects mentioned:

“...The main side effects are swelling of the body, skin

hardening, vomiting, dizziness and diarrhea especially when it's the first time to take ivermectin, but when ivermectin is taken for several years these side effects tends to subside.” (Female, Isongo, 49 years)

Table 5: Perceptions towards Onchocerciasis and Ivermectin treatment (N=422)

Perceptions statements on disease and treatment	Strongly	Agree	Not	Disagree	Strongly
	agree	No (%)	sure	No (%)	disagree
	No (%)		No (%)		No (%)
Disease is common	124(29.4)	197(46.7)	54(12.8)	26(6.2)	21(5)
Disease is dangerous	134(31.8)	174(41.2)	77(12.8)	29(6.9)	8(1.9)
Disease is curable	144(34.1)	171(40.5)	58(13.7)	27(6.4)	22(5.2)
Risk of contracting disease	97(23)	89(21.1)	97(23)	37(8.8)	102(24.2)
Disease associated with witchcraft	23(5.5)	41(9.7)	65(15.4)	76(18)	217(51.4)
CDTI will eliminate disease	71(16.8)	165(39.1)	101(23.9)	55(13)	30(7.1)
CDTI has other health benefits	89(21)	106(25.1)	144(34.1)	63(14.9)	20(4.7)
CDDs households visits increase ivermectin uptake	134(31.8)	146(34.6)	79(18.7)	40(9.5)	23(5.5)
CDDs can manage side effects	79(18.7)	122(28.9)	107(25.4)	63(14.9)	51(12.1)
CDDs should get incentives	107(25.4)	139(32.9)	83(19.7)	47(11.1)	46(10.9)
Female CDDs are more persuasive	78(18.5)	118(28)	120(28.4)	51(12.1)	55(13)
CDTI is the most effective disease control tool	81(19.2)	160(37.9)	112(26.5)	24(5.7)	45(10.7)
Persons with disease should be isolated	35(8.3)	41(9.7)	101(23.9)	77(18.2)	168(39.8)
Disease has socio-economic impact	119(28.2)	148(35.1)	90(21.3)	36(8.5)	29(6.9)
Disease control should best be run by government	160(37.9)	143(33.9)	47(11.1)	23(5.5)	49(11.6)

All community drug distributors interviewed agreed that they were given education on how to manage side effects.

One of the CDDs said:

"...If a person complains of itching or swelling of body after taking medication, I know these are side effects of medication hence I administer aspirin/panadol to subside the side effects." (Male, Uponera, 70 years)

DISCUSSION

Knowledge of community members on onchocerciasis and CDTI

Inadequate level of knowledge on onchocerciasis affects coverage and community participation in CDTI programs, conceivably leading to a high prevalence in those areas (Okwara *et al.*, 2017). Despite onchocerciasis being a major health problem in Ulanga, less than a fifth of the study participants correctly knew the causative agent; the remaining participants held the misconceptions that the disease is caused by black flies and mosquitoes as well as witchcraft. Similarly, more than a quarter of participants had misconceptions that transmission is by mosquitoes bites, contact with infected person, and aerosols. This observation is consistent with studies conducted in Nigeria and Northwestern Ethiopia (Adeoye, Ashaye and Onakpoya, 2010; Weldegebreal *et al.*, 2014; Afolabi *et al.*, 2016). In one study, respondents were knowledgeable on the manifestations of onchocerciasis, possibly reflecting their long experiences with these symptoms (Zouré *et al.*, 2014).

Acceptability of CDTI

Most (83%) respondents were willing to take ivermectin and about three quarters were willing to comply with treatment for 12 to 15 years in order to eliminate the disease. These findings have positive implications for the success of the CDTI program because acceptability and compliance to ivermectin treatment is crucial in controlling onchocerciasis in endemic areas, and it has proven to be successful in reducing transmission, morbidity and elimination of the disease (Kim *et al.*, 2015). Fear of side effects, mistrust of method of dose calculation and being uninfected were reasons given for non-compliance, and this can affect the participation of people in CDTI programs and hence slow interruption of onchocerciasis transmission in this area. Similar observations were made in Morogoro, Tanzania (York *et al.* 2015).

Knowledge of community drug distributors

CDDs play an important role in engaging the community to participate in the control program; they can either influence positively or negatively the success of such a program (Krentel *et al.*, 2017). In Ulanga, all of the CDDs interviewed were familiar with onchocerciasis, though the majority of them had inadequate knowledge. This is possibly due to inadequate training in the biology of the disease, as the training mostly covered drug distribution and management of side effects (York *et al.*, 2015). Poor knowledge of CDDs affects participation of community members in the control program, as community members may not trust them (York *et al.*, 2015).

Attitudes and perception of community members towards onchocerciasis and CDTI

Attitudes and perceptions towards onchocerciasis and the CDTI intervention have major implications for the uptake and therefore coverage of an intervention, which also affects the success of the control of the disease (Colebunders *et al.*, 2018). The present findings show that almost half of study participants had negative attitudes, which implies that coverage may not be optimal because those with negative attitudes may be non-compliant to the intervention. The findings are consistent with the studies done in DRC, Nigeria and Cameroon (Makenga *et al.*, 2017; Brieger *et al.*, 2012; Okeibunor *et al.*, 2011).

Attitudes and perception of community drug distributors

In Ulanga, CDDs held positive attitudes and perceptions towards use of ivermectin for onchocerciasis control. It was observed that CDDs and community members believed that ivermectin is the best drug for treatment and preventing onchocerciasis because of the obvious benefits. However, there were some negative attitudes and perceptions due to side effects and doubt of the method of dose calculation and fear of impotency or being uninfected.

LIMITATIONS

The major limitations of this study were accuracy of recall and personal bias from the respondents. Participants were asked questions that required them to recall information such as side effects experienced as a result of using ivermectin medication; this might have led to under- or over-reporting of the information. Furthermore, this cross-sectional design cannot determine if the measured outcomes had an impact on continued transmission of onchocerciasis.

Public health implications

In Ulanga district, a majority of community members were aware of the presence of onchocerciasis in the community. However, there was a borderline level of knowledge on the causative agent, transmission, treatment and prevention. Furthermore, nearly half of the population held negative attitudes and perceptions towards the CDTI program. Inadequate level of knowledge coupled with negative attitudes and perceptions in the community mean that coverage may not be optimal. Those with negative perceptions may be non-compliant to ivermectin treatment and therefore affect total coverage of the CDTI program, leading to persistent transmission.

In order to address this problem, public health education should be reinforced in the community so as to improve the level of knowledge regarding onchocerciasis and ivermectin treatment as well as changing the negative perceptions and attitudes towards CDTI. Health education should focus on the causative agent, transmission, signs and symptoms, ivermectin treatment and prevention in order to ensure better understanding about onchocerciasis control.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

AUTHORS' CONTRIBUTIONS

VM designed the study, did data collection, analysis and interpretation and drafted the manuscript. DT and DK participated in study design and critically revised the manuscript.

REFERENCES

- Adeoye, A.O., Ashaye, A.O., Onakpoya, O.H. (2010). Perception and attitude of people toward onchocerciasis (river blindness) in South Western Nigeria. *Middle East African Journal of Ophthalmology*, 17(4), 310–314.
- Afolabi, O., Okaka, C., Oke, I., and Oniya, M. (2016). Knowledge, Attitude and Perception of Onchocerciasis and Ivermectin Treatment in Idogun Community, Ondo State, Nigeria. *British Journal of Medicine & Medical Research*, 13(4), 1-7.
- Brieger, W.R., Okeibunor, J.C., Abiose, A.O., Ndyomugenyi, R., Wanji, S., Elhassan, E. and Amazigo, U. V. (2012). Characteristics of persons who complied with and failed to comply with annual ivermectin treatment. *Tropical Medicine & International Health*, 17(7), pp.920–930.
- CDC, (2017) CDC-Neglected Tropical Diseases -The Burden of Onchocerciasis. Available at: https://www.cdc.gov/globalhealth/ntd/diseases/oncho_burden.html [Accessed March 12, 2018].
- Colebunders, R., Basáñez, M.-G., Siling, K., Post, R. J., Rotsaert, A., Mmbando, B., Hopkins, A. (2018). From river blindness control to elimination: bridge over troubled water. *Infectious Diseases of Poverty*, 7(1), 21.
- Crump, A., Morel, C.M. and Omura, S. (2012). The onchocerciasis chronicle: From the beginning to the end? *Trends in Parasitology*, 28(7), pp.280–288.
- Endale, A., Erko, B., Weldegebreal, F. and Legesse, M. (2015). Predictors of compliance with community-directed treatment with ivermectin for onchocerciasis control in Kobo area, southwestern Ethiopia. *Parasites & Vectors*, 8(1), p.99.
- Fleming, F.M., Matovu, F., Hansen, K.S. and Webster, J.P. (2016). A mixed methods approach to evaluating community drug distributors performance in the control of neglected tropical diseases. *Parasites & Vectors*, 9(1), p.345.
- Kim, Y.E., Remme, J.H.F., Steinmann, P., Stolk, W.A., Rongou, J.B. and Tediosi, F. (2015) Control, elimination, and eradication of river blindness: scenarios, timelines, and ivermectin treatment needs in Africa. *PLoS neglected tropical diseases*, 9(4), p.e0003664.
- Krentel, A., Gyapong, M., Mallya, S., Boadu, N.Y.A., Nyamongo, M., Stephens, M. and McFarland, D.A. (2017). Review of the factors influencing the motivation of community drug distributors towards the control and elimination of neglected tropical diseases (NTDs) J. F. Friedman, ed. *PLOS Neglected Tropical Diseases*, 11(12), p.e0006065.
- Maegga, B.T.A., Kalinga, A.K., Kabula, B., Post, R.J. and Krueger, A. (2011). Investigations into the isolation of the Tukuyu focus of onchocerciasis (Tanzania) from *S. damnosum s.l.* vector re-invasion. *Acta Tropica*, 117(2), pp.86–96.
- Makenga Bof, J.-C., Mpunga, D., Soa, E. N., Ntumba, F., Bakajika, D., Murdoch, M. E., & Coppieters, Y. (2017). Onchocerciasis in the Democratic Republic of Congo: Survey of knowledge, attitude and perception in Bandundu province. *Journal of Infection and Public Health*, 10(5), 600–607. <https://doi.org/10.1016/j.jiph.2017.01.017>
- Mwaiko, G. L., Mtoi, R. S. and Mkufya, A.R. (1990). Onchocerciasis prevalence in Tanzania. *Cent Afr J Med*, 36(4), pp.94–6.
- Mweya, C.N. (2007). Onchocerciasis situation in the Tukuyu focus of southwest tanzania after ten years of ivermectin mass treatment. *Volume 9, Issue 3*, p.Pages 174-179.
- Neglected Tropical Diseases Control Program, (2016). *Neglected Tropical Disease Control Program*. 5th Annual Joint Planning Meeting. Ministry of Health, Community, Development, Gender, Elderly and Children.
- Neglected Tropical Diseases Control Program, (2017). *NTDSCP, 2016/2017 Annual Program Report*. Ministry of Health, Community, Development, Gender, Elderly and Children.
- Okeibunor, J. C., Amuyunzu-Nyamongo, M., Onyeneho, N. G., Tchounkeu, Y. F. L., Manianga, C., Kabali, A. T., and Leak, S. (2011). Where would I be without ivermectin? Capturing the benefits of community-directed treatment with ivermectin in Africa.
- Okwara, K., Iwunze J.I., Njoku F.U., Nwachukwu, M. and Heanacho J.N. (2017) Knowledge and perception on onchocerciasis and benefits of ivermectin in parts of imo river basin following long term treatment *Amaechi A. *Global Research Journal of Science*, 5(1), pp.21–31.
- Weldegebreal, F., Medhin, G., Weldegebriel, Z. and Legesse, M. (2016) Knowledge, attitude and practice of community drug distributors' about onchocerciasis and community directed treatment with ivermectin in Quara district, North Western Ethiopia. *BMC research notes*, 9, p.206.
- World Health Organization, (2017). Onchocerciasis fact sheet. Geneva:WHO. Available at: <http://www.who.int/mediacentre/factsheet/fs374/en>. [Accessed March 13, 2018].
- York, K.J., Kabole, I., Mrisho, M., Berry, D.M. and Schmidt, E. (2015) Factors Affecting Community Participation in the CDTI Program in Morogoro, Tanzania. *Journal of Nursing Scholarship*, 47(1), pp.96–104.
- Zouré, H.G.M., Noma, M., Tekle, A.H, Amazigo, U.V., Diggle, P.J., Giorgi, E. and Remme, J.H.F. (2014). The geographic distribution of onchocerciasis in the 20 participating countries of the African Programme for Onchocerciasis Control: (2) pre-control endemicity levels and estimated number infected. *Parasites & vectors*, 7, p.326.