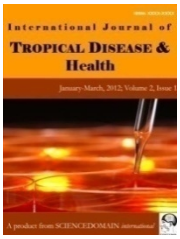

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Differences in Schistosomiasis Knowledge among Irrigation Rice Farming Communities in Different Irrigation Schemes in Tanzania

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Authors' contributions

This work was carried out in collaboration between all authors. Author FSS designed the study, collected data, performed the statistical analysis and wrote the first draft of the manuscript. Authors AZM, AKPRT, JHJE and MMAM gave comments. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aim: To assess differences in schistosomiasis knowledge in farmers working in traditional, improved traditional and modern irrigation schemes in Tanzania.
Study Design: A cross-sectional survey among farmers practicing irrigation rice farming, in 2 different regions and 6 different irrigation systems.
Place and Duration of Study: The study was carried out between November and

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December 2011 in the Morogoro and Kilimanjaro Regions, Tanzania.
Methodology: Equal number of irrigators in each scheme was employed. Irrigators were chosen randomly by the researcher from the list of all farmers actually engaged in rice irrigation farming provided by the village governments in the six schemes. Two hundred and fourty samples (240) were used, 120 from each region (40 farmers practicing irrigation rice farming in each scheme). Independent sample t-test was used for testing schistosomiasis knowledge differences among irrigators between schemes with the same design and construction of their infrastructures between the two regions.
Results: More than 88% of irrigators surveyed in Kilimanjaro schemes had better knowledge regarding to all schistosmiasis items asked compared to those in Morogoro, particularly Chabi scheme-traditional. There were significant difference on irrigators knowledge on schistosomiasis symptoms (P<0.001), and predisposing factors (P<0.001) between Morogoro and Kilimanjaro Modern schemes. Knowledge on predisposing factors differed significantly (P<0.001) between irrigators in Morogoro and Kilimanjaro improved traditional schemes. Moreover significant difference were noted on irrigators knowledge on schistosomiasis symptoms (P<0.001), predisposing factors (P<0.004) and schistosomiasis control measures (P=0.003) between irrigators in Morogoro and Kilimanjaro traditional schemes.
Conclusion: From the results it appears that the level of farmers' knowledge of schistosomiasis is related to: proximity to health facilities of the community, trainings that have been provided to farmers and farmer's literacy rate. However the government should be responsible to improve health facilities, construct roads and deliver schistosomiasis education to communities in irrigation areas even for schemes which have not been planned, designed and constructed by the government.

Keywords: Schistosomiasis; knowledge; different irrigation schemes; Morogoro; Kilimanjaro; Tanzania.

1. INTRODUCTION

It is estimated that 207 million people world-wide suffer from schistosomiasis, and the majority of these live in sub-Saharan Africa [1] Moreover, some estimates indicate that as many as 400 million people are affected [2]. Schistosomiasis is one of the major causes of morbidity in endemic areas of Asia, Africa and South America [3,4]. Users with a high water contact pattern like: housewives in charge of collecting drinking water, fishermen and farmers are at a high risk of contracting the infection [1]. In Tanzania the disease affects majority of the irrigated rice growing communities and causes a high disease burden in both health of the irrigation farming communities and socio-economy of the country [5].

Several factors influence schistosomiasis transmission levels in irrigation schemes, these include: the design of irrigation infrastructures and farming practices, like poor drainage and vegetation cover in canals. Changes in the management of irrigation systems can help control the intermediate host. Increases in the flow velocity in irrigation canals, through the construction of irrigation canals with an elevated proper slope, is a potential way to disperse snails, though this should be balanced with possible increased erosion of irrigation canals [6], and might not always be possible. The lining of irrigation canals, regular removal of weeds and improving drainage are however expensive.

Schistosomiasis is claimed to be primarily a disease that results from lack of education, public health facilities and poverty [7,2]. Although chemotherapy can reduce morbidity

caused by the infection, rapid re-infection usually occurs requiring repeated treatment [8]. Therefore, improvements in hygiene, water supply and sanitation combined with health promotion and sustainable behavior change will need to be put on the agenda in case long term control of schistosomiasis can be achieved in Tanzania [9,10]. Understanding the levels of knowledge regarding schistosomiasis transmission will enable policy makers to help design control programmes. Integrating health education and medical intervention remain a high priority for the World Health Organization's (WHO) schistosomiasis control programs. However, in many endemic areas, control programs often do not incorporate public health promotion of the target groups.

In Tanzania there have been several studies assessing community perceptions and knowledge about schistosomiasis, though most of these studies focused on school children [11,12,13,14,15,16], with the exception of one, which involved irrigated rice growers [17]. The level of knowledge demonstrated by school children does not necessarily represent the level of knowledge of their parents, or those of specific communities at risk like farmers and fishermen and neither is it necessarily comparable between traditional, improved traditional and modern irrigation schemes. In this case, there is no certainty on this subject matter. Therefore, this study sought to assess schistosomiasis knowledge differences among the farming communities in terms of the level of knowledge related to schistosomiasis cause, symptoms, transmission, control and health-effects that may occur due to schistosomiasis infection between schemes in Morogoro and Kilimanjaro regions. Results were envisioned to contribute to the identification of knowledge gaps on schistosomiasis among irrigation rice farming communities thus provide entry/departure points towards future schistosomiasis control efforts in Tanzania.

2. MATERIALS AND METHODS

2.1 Study Areas

Six irrigation schemes which differed in terms of design and construction of their irrigation infrastructures were purposively selected from two Regions, Morogoro and Kilimanjaro. Three irrigation schemes in each region were selected. Two irrigation systems: Lower Moshi and Mwega schemes were categorized as modern because their intakes, main canals, secondary and tertiary canals, division and drop structures are concrete lined. The schemes Kikafu Chini and Mkindo were categorised as improved traditional systems because only the intakes, and part of their main canals are concrete lined, while the rest of the infrastructure are earth lined. The final two: Njoro and Chabi were categorised as traditional schemes as from the intake, main, secondary canal and other infrastructures are earth lined and constructed using indigenous knowledge.

Njoro scheme is located in Kaloleni Ward, which is found in Moshi Municipal- Tanzania. It is the smallest ward in Moshi town. The major activity done in njoro is rice farming. There are about 232 rice farmers engaged in rice farming. Kaloleni ward has a population of about 6000 people with majority being subsistence farmers.

In 1999, Kikavu Chini had a population of nearly 3000, an average sized village in Tanzanian terms. The irrigation scheme is managed by about 760 farmers, including 430 land owners, 230 tenants, and 100 laborers. Kikavu is quite small, with 1600 acres. The irrigation scheme dominates the landscape taking up 1000 acres out of which only 300 acres are suitable for rice farming [18]. Lower Moshi scheme is located 15 kilometers in the southern part of Moshi

Town at the foot of the slopes of Mount Kilimanjaro (3º21'S, 37º21'E). The scheme lies at altitude ranging between 700 to 800 meters above sea level. The detailed description of Chabi, Mkindo and Mwega schemes are given in Salehe and Hassan [19].

The six schemes were selected due to the reason that they are among the main rice growing areas in Morogoro and Kilimanjaro. Additionally, nearly all the scheme inhabitants in the two regions use water from the canals for cooking, drinking, washing clothes and household utensils and for bathing.

2.2 Study Design and Sampling Procedure

A cross sectional research design was used and data collection was carried out in six irrigation schemes between November and December, 2011. Data were collected at a single point in time. Random sampling with equal number of irrigators in each scheme was employed. Irrigators were chosen by the researcher from the list provided by the village government in the six schemes of all farmers actually involved in irrigation rice farming. The researcher chose a total of 240 irrigation rice farmers for the study, 120 from each Region and 40 from each irrigation scheme. A structured questionnaire was used as a method of collecting data. Information on what causes schistosomiasis, how schistosomiasis can be transmitted, effects that can be caused by the disease, symptoms, schistosomiasis predisposing factors and schistosomiasis control measures was sought from each irrigator interviewed.

2.3 Determination of Schistosomiasis Knowledge Index

For better assessment of schistosomiasis knowledge status, a nine item index was used (Table 1). However, the items were divided into 6 Schistosomiasis knowledge domains: (i) causes of schistosomiasis, (ii) effects of schistomiasis, (iii) symptoms of schistomiasis, (iv) schistomiasis predisposing factors, (v) transmission of schistosomiasis and (vi) schistomiasis control measures. Where a domain had more than one item, the items were combined into one index for the domain. Respondents were asked to respond to whether they understood each item concerning schistosomiasis or not. The respondents scored 1 for a correct answer and 0 for incorrect answer. Respondents' responses were added to form a schistosomiasis knowledge index which ranged from 0 to 6.

2.4 Data Analysis

The number of respondents to each knowledge item asked was expressed in percentage. It was not possible to examine the association between education level of respondents and knowledge of schistosomiasis due to incomparable size of samples (Table 2). Independent sample t-test was used to test for differences in schistosomiasis knowledge of irrigators between schemes with the same design and construction of their irrigation infrastructure. SPSS (statistical package) version 16.0 was used as a tool for analyzing data.

Table 1. Schistosomiasis knowledge index

Knowledge domains and items
Domain 1: Causes of schistomiasis
-Schistosomiasis is caused by snails
Domain 2: Effects of schistomiasis
- Schistosomiasis deteriorate people's health
- Schistosomiasis patient can die if not well treated
Domain 3: Symptoms of schistomiasis
The following are not schistosomiasis symptoms;
-Blood in urine, blood in stool, pains during urinating, pains during passing stool, pains below abdomen, abdominal pains
Domain 4: Schistomiasis predisposing factors
- One can acquire schistosomiasis through washing limbs, bathing and washing farming tools in irrigation infrastructures.
Domain 5: Schistosomiasis transmission
- Urinating and defecating in the scheme areas transmits schistosomiasis
Domain 6: Schistosomiasis control measures
- Construction of toilets in the scheme areas does not control schistosomiasis
- Proper canal cleaning to remove vegetation growth does not control schistosomiasis
- Draining excessive water in the plots and canals does not control schistosomiasis

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Education of respondent

Twenty one percent (21.0%) and 7.5% of respondents were illiterates in Morogoro and Kilimanjaro schemes respectively while 73.3 and 77.5 % in Morogoro and Kilimanjaro had primary level of education respectively. Moreover, 6 and 15% in Morogoro and Kilimanjaro had secondary level of education respectively (Table 2).

Table 2. Education of respondents

Education level	Morogoro schemes		Kilimanjaro schemes			
	Mkindo	Chabi	Mwega	Kikafu	Lower moshi	Njoro
Illiterate	9 (22.5)	11 (27.5)	5 (12.5)	5 (12.5)	4 (10.0)	0 (0)
Primary	29 (72.5)	26(65.0)	33 (82.5)	26 (65.0)	32(80.0)	35 (87.5)
Secondary	2 (5.0)	3(7.5)	2 (5.0)	9 (22.5)	4 (10.0)	5 (12.5)

Number in parenthesis refers to percentage of respondents interviewed

3.1.2 Respondents knowledge of schistosomiasis

3.1.2.1 Respondents' knowledge on schistosomiasis among irrigation rice growers in modern, improved traditional and traditional schemes in Morogoro region

Table 3 presents responses related to schistosomiasis knowledge among irrigators interviewed in Modern (Mwega), Improved traditional (Mkindo) and Traditional (Chabi) schemes in Morogoro. Eighty four percent (84.0%) of irrigators in all three schemes had enough knowledge about schistosomiasis as a disease caused by snails. In addition, ninety three percent (93.0%) of irrigators were knowledgeable on the effects that can be caused by schistosomiasis. Regarding irrigators' knowledge on schistosomiasis symptoms, only 58% in all three schemes had knowledge on that item. Moreover, less than half (44.2%) had knowledge on schistosomiasis predisposing factors. However, eighty one percent of irrigators interviewed in the three schemes were aware of schistosomiasis control measures and 92% had knowledge on how schistosomiasis can be transmitted. Generally, irrigators in Morogoro traditional scheme (Chabi) had poor knowledge on schistosomiasis symptoms and schistosomiasis predisposing factors while those in Morogoro improved traditional Scheme (Mkindo) had also poor knowledge on schistosomiasis predisposing factors (Table 3).

3.1.2.2 Respondents' knowledge on schistosomiasis among irrigation rice growers in modern, improved traditional and traditional schemes in Kilimanjaro region

Table 3 results reveal that more than 88% of irrigators interviewed in modern, improved traditional and traditional schemes in Kilimanjaro had better knowledge on what causes schistosomiasis, effects that can be caused by schistosomiasis, schistosomiasis predisposing factors, schistosomiasis symptoms, how the disease can be transmitted and controlled. Generally irrigators in Kilimanjaro traditional scheme (Njoro) had better schistosomiasis knowledge compared to their counterparts in Improved traditional and Modern.

3.1.2.3 Schistosomiasis knowledge differences among irrigators in modern irrigation schemes between Morogoro and Kilimanjaro regions.

An independent sample t-test indicates that there were significant differences on schistosomiasis symptoms and schistosomiasis predisposing factors among irrigator's between Morogoro modern scheme (Mwega) and Kilimanjaro modern scheme (Lowermoshi). Furthermore, results show that irrigators in Lower Moshi had more knowledge on schistosomiasis symptoms compared to those in Mwega (Table 4). Moreover irrigators in Lower Moshi had better understanding on schistosomiasis predisposing factors compared to their counterparts in Mwega.

3.1.2.4 Schistosomiasis knowledge differences among irrigators in improved traditional irrigation schemes between Morogoro and Kilimanjaro Regions

Table 4 revealed significant difference on schistosomiasis predisposing factors among irrigators between Morogoro Improved traditional scheme (Mkindo) and Kilimanjaro Improved traditional scheme (Kikafu Chini). Irrigators in Kikafu Chini scheme had more schistosomiasis knowledge on the above mentioned schistosomiasis item compared to those in Mkindo scheme.

Table 3. Schistosomiasis knowledge among surveyed irrigation rice growers in modern, improved traditional and traditional schemes in the two Regions

Variables	Morogoro schemes			Kilimanjaro schemes		
	Traditional (Chabi)	Improved tradition (Mkindo)	Modern (Mwega)	Traditional (Njoro)	Improved traditional (Kikavu chini)	Modern (Lower moshi)
Schistomiasis cause						
Yes	38 (95.0)	28 (70.0)	35 (87.5)	37 (92.5)	33 (82.5)	37(92.5)
No	2 (5.0)	12 (30.0)	5 (12.5)	3 (7.5)	7 (17.5)	3 (7.5)
Effects of schistomiasis						
Yes	38 (95.0)	37 (92.5)	37 (92.5)	39 (97.5)	38 (95.0)	38 (95.0)
No	2 (5.0.)	3 (7.5)	3 (7.5)	1 (2.5)	2 (5.0)	2 (5.0)
Symptoms of schistomiasis						
Yes	13 (32.5)	33 (82.5)	24 (60.0)	40 (100.0)	36 (90.0)	40 (100.0)
No	27 (67.5)	7 (17.5)	16 (40.0)	0	4 (10.0)	0
Schist. predisposing factors						
Yes	14 (35.0)	18 (45.0)	21 (52.5)	40 (100.0)	38 (95.0)	39 (97.5)
No	26 (65.0)	22 (55.0)	19 (47.5)	0	2 (5.0)	1 (2.5)
Schistosomiasis transmission						
Yes	38 (95.0)	33 (82.5)	39 (97.5)	39 (97.5)	37 (92.5)	39 (97.5)
No	2 (5.0)	7 (17.5)	1 (2.5)	1 (2.5)	3 (7.5)	1 (2.5)
Schist. control measures						
Yes	32 (80.0)	28 (70.0)	37 (92.5)	40 (100.0)	34 (85.0)	36 (90.0)
No	8 (20.0)	12 (30.0)	3 (7.5)	0	6 (15.0)	4 (10.0)

**Numbers in parenthesis refer to percentage of respondents that responded to schistosomiasis items.*

Table 4. Schistosomiasis knowledge difference among irrigators in modern, improved traditional and traditional irrigation schemes between Morogoro and Kilimanjaro regions

Variables	Modern schemes			Improved traditional schemes			Traditional schemes		
	Mwega	Lower Moshi	P-Value	Mkindo	Kikafu Chini	P-Value	Chabi	Njoro	P-Value
Causes of schistomiasis	0.88	0.92	0.46	0.70	0.82	0.19	0.95	0.92	0.65
Effects of schistomiasis	0.92	0.95	0.65	0.92	0.95	0.65	0.95	0.98	0.56
Symptoms of schistomiasis	0.60	1.00	<0.001**	0.82	0.90	0.34	0.32	1.00	<0.001**
Schistosomiasis transmission	0.98	0.98	1.00	0.82	0.92	0.18	0.95	0.98	0.56
Schistosomiasis predisposing factors	0.52	0.98	< 0.001**	0.45	0.95	<0.001**	0.35	1.00	0.004*
Schistosomiasis control	0.92	0.90	0.69	0.70	0.85	0.11	0.80	1.00	0.003*

**Mean difference statistically significant at P<0.05 level*

*** Mean difference statistically significant at <0.001 level*

3.1.2.5 Schistosomiasis knowledge differences among irrigators in traditional irrigation schemes between Morogoro and Kilimanjaro regions

Table 4 results show significant differences on three schistosomiasis knowledge items between irrigators interviewed in Morogoro traditional scheme (Chabi) and those in the Kilimanjaro traditional scheme (Njoro). Irrigators' knowledge on schistosomiasis symptoms, schistosomiasis control measures and schistosomiasis predisposing factors differed significantly between the two schemes. Schistosomiasis knowledge on the mentioned items was widely understood by irrigators in Njoro than those in Chabi scheme (Table 4).

3.2 Training on Schistosomiasis

About 80% of respondents in Kilimanjaro schemes declared to have received schistosomiasis education from different institutions for example the Kilimanjaro Agriculture Training Centre (KATC) and from health centers and dispensaries. Contrary, all respondents in Chabi scheme (in Morogoro) declared to have not received any schistosomiasis training/education neither from dispensary/hospital nor from village extension officer or any media outlet. But, those from Mkindo and Mwega (also in Morogoro) declared to have received schistosomiasis education from the Mkindo Farmers Center and experts from Japan International Cooperation Agency (JICA) respectively.

3.3 Discussion

Schistosomiasis is one of the most widespread parasitic infections that affect humans socio-economically and health wise in the developing world. Yet majority of the people in these countries do not have correct knowledge of schistosomiasis as highlighted in this study. Among farmers interviewed in the three schemes in Morogoro, those in traditional scheme (Chabi) had low knowledge on schistosomiasis symptoms and predisposing factors. Similarly, those in improved traditional scheme (Mkindo) had low knowledge on schistosomiasis predisposing factors despite existing evidence on provision of training on schistosomiasis and water management practices from Mkindo Farmer's Centre. Contrary, more than 50% of farmers interviewed in Mwega had the correct knowledge of schistosomiasis, this could be due to training farmers received from JICA, which funded the construction of the scheme. We think that Chabi farmers had low knowledge of schistosomiasis due to a number of possibilities: 1) that the farmers had not received any training regarding schistosomiasis as a disease since the village does not even have health facilities such as dispensary, 2) given that the scheme is constructed through farmers initiatives using indigenous knowledge, the government through Ministry of Agriculture has not conducted any training on schistosomiasis and water management practice, 3) remoteness of the area and difficulty accessibility limit exchange of information hence poor exposure of the local community on matters pertaining to irrigated agriculture and its drawbacks. Other possibility could also be the overall low literacy rate observed. Therefore, our results tally with the study in Nigeria [7], that schistosomiasis results from lack of education and public health facilities. The findings are also in line with the results in Nigeria [20] that, lack of knowledge is the main factor responsible for the high level of schistosomiasis.

Njoro farmers' schistosomiasis knowledge was higher because farmers in this scheme have higher possibilities of accessing information from different institutions (visits by agriculture officers and health personnel, source of medias etc) due to its proximity to Moshi town. Also

high literacy rate is another factor which makes farmers in Njoro to have good knowledge of schistosomiasis. However, more than 80 and 89% of farmers interviewed in Kikafu chini and Lower moshi respectively had good knowledge of schistosomiasis because the schemes have been constructed through government initiatives and therefore farmers in these schemes had access to trainings on: schistosomiasis, rice production and water management practices.

4. CONCLUSION AND RECOMMENDATION

The findings of this study indicate that the level of schistosomiasis knowledge is related to: 1) proximity to health facilities and extension services in the community 2) trainings that have been provided to irrigators from different sources, 3) high literacy rate and 4) reliable infrastructures such as roads. The study therefore recommends that the government should: 1) provide trainings to irrigators on schistosomiasis, and how it relates with water as this strategy has been successful in Niger and Senegal, 2) construct infrastructures such as roads so that farmers engaged in irrigation farming can be easily accessed in terms of information related to agriculture, diseases and other extension services, 3) provide health facilities even to farmer practicing irrigation farming in schemes which were not planned and constructed by the government.

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CONSENT

All authors declare that ‘written informed consent was obtained from farmers for publication of this manuscript.

ETHICAL APPROVAL

All authors hereby declare that clearance certificate for conducting medical research in the study areas in Tanzania have been approved by the Ministry of Health and Social Welfare through National Institute for Medical Research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Steinmann P, Keiser J, Bos R, Tanner M, Utzinger J. Schistosomiasis and water resources development: systematic review, meta-analysis, and estimates of people at risk. Lancet Infect Dis. 2006;6(7):411–425.

2. King CH. Parasites and poverty: the case of schistosomiasis. Acta Trop. 2010;113(2):95–104.
3. World Health Organisation. A picture of health? WHO, Geneva/UNICEF, New York; 1995.
4. Hotez PJ, Bethony JM, Oliveira SC, Brindley PJ, Loukas A. Perspective multivalent anthelminthic vaccine to prevent hookworm and schistosomiasis. Expert Review of Vaccines. 2008;7(6):745-752.
5. United Republic of Tanzania. Neglected tropical diseases Country Plan. Ministry of Health and Social Welfare (MoHSW), Dar es Salaam; 2009. (unpublished paper).
6. Oomen JMV, de Wolf J, Jobin WR. Health and Irrigation. 1st ed. ILRI Wageningen: The Netherlands; 1988.
7. Oniya MO. Socio-Cultural practices promoting the transmission of urinary schistosomiasis among School Aged Pupils in a South Western Village in Nigeria. Research Journal of Biological Sciences. 2007;2(1):1-4.
8. N'Goran EK, Utzinger J, N'Guessan AN, Müller I, Zamblé K, et al. Reinfection with *Schistosoma haematobium* following school-based chemotherapy with praziquantel in four highly endemic villages in Côte d'Ivoire. Trop Med Int Health. 2001;6:817–825. (PubMed).
9. Hamed MA. Strategic control of *schistosome* Intermediate Host. Asian Journal of Epidemiology. 2010;3(3):123-140.
10. World Health Organisation. Schistosomiasis Fact Sheet No.115. 2012. Available: http://www.who.int/mediacentre/factsheets/fs115/en/index.html.
11. Mazigo H, Waihenya R, Mkoji GM, Zinga M, Ambrose EE, Jahanpour OF, Bahemana E, Mnyone LL, Kweka EJ, Lwambo NJS. Intestinal Schistosomiasis: Prevalence, knowledge, attitude and practices among school children in an endemic area of Norther Western Tanzania. Journal of Rural and Tropical Public Health. 2010;9:53–60.
12. Clements ACA, Brooker S, Nyandindi U, Fenwick A, Blair L. Bayesian spatial analysis of a national urinary schistosomiasis questionnaire to assist geographic targeting of *schistosomiasis* control in Tanzania, East Africa. International Journal of Parasitology. 2008;38(3-4):401-415.
13. Freudenthal S, Ahlberg BM, Mtweve S, Nyindo P, Poggensee G, Krantz I. School-based prevention of schistosomiasis: Initiating a participatory action research project in northern Tanzania. Acta Tropica. 2006;100(1-2):79-87.
14. Lansdown R, Ledward A, Hall A, Issae W, Yona E, Matulu J, Mweta M, Kihamia C, Nyandindi U, Bundy D. Schistosomiasis, helminth infection and health education in Tanzania: achieving behavior change in primary schools. Health Education Research. 2001;17(4):425-433.
15. Lwambo NJS, Siza JE, Brooker S, Bundy DAP, Guyatt H. Patterns of concurrent infection with hookworm and *schistosomiasis* in school children in Tanzania. Transactions of the Royal Society of Tropical Medicine and Hygiene. 1999;93(5):497 502.
16. Guyatt H, Brooker S, Lwambo NJS, Siza JE, Bundy DAP. The performance of school-based questionnaires of reported blood in urine in diagnosing *schistosoma* haematobium infection; bpatterns by age and sex. Tropical medicine and International Health. 1999;4:751-757.
17. Poggensee G, Krantz I, Kiwelu I, Feldmeier H. Screening of Tanzanian women of childbearing age for urinary schistosomiasis: validity of urine reagent strip readings and self-reported symptoms. Bulletin of the World Health Organisation. 2000;78(4):542-548.

18. Koopman J, Kweka R, Mboya M, Wangwe S. Community participation in traditional irrigation scheme rehabilitation projects in Tanzania: Report of a Collaborative Research Project; 2001.
19. Salehe FS, Hassan SN. Socio-economic Effects of Schistosomiasis on Irrigation Rice Growers in Morogoro, Tanzania. American Journal of Experimental Agriculture. 2012;2(3):395-406.
20. Onyeneho NG, Yinkore P, Egwuage J, Emukah E. Perceptions, attitudes and practices on schistosomiasis in Delta State, Nigeria. Tanzania Journal of Health Research. 2010;12(4).

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