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Factors Characterising High Prevalence Rates of Urinary Schistosomiasis in Mufumbwe District, North Western Province of Zambia

Chansa Chomba^{1*} & Stephen Mutale²

¹School of Agriculture and Natural Resources, Disaster Management Training Centre, Mulungushi University, P.O. Box 80415, Kabwe, Zambia. ² District Health office, P.O. Box 130005 Mufumbwe, Zambia.

*Corresponding Author

Abstract

This study investigated prevalence of Urinary Schistosomiasis in Mufumbwe district of Zambia. It identified risk factors responsible and suggested possible ameliorating measures. Objectives were to; 1) determine prevalence rates, 2) identify and document risk factors responsible for the infection and spread of the disease, 3) determine affected gender and age groups among primary school children, and 4) identify indigenous control measures used and their efficacy. Questionnaires and field observations were used on pupils and teachers. Blood samples were collected from pupils and examined for *Schistosoma haematobium* ova. Results showed a high prevalence rate of urinary bilharzia (56.7%) in male age groups of 11-15 years with prevalence of 60.7%. Five water contact activities were responsible for transmission. Remedies used to treat bilharzia included; *Mitragyna stipulosa, Ricinus communis, Steganotaenia araliacea, Capsicum* roots and *Mangifera indica*, but these were not effective, and more research is required to determine their efficacy. *Keywords:* Prevalence, Schistosomiasis, Risk Factors, Gender, Age Group.

1. Introduction

Urinary bilharzia (urogenital Schistosomiasis) is caused by a digenetic trematode of the genus Schistosoma whose intermediate hosts (vector) are fresh water snails of the genus Bulinus (Augusto et al., 2009). Genus Bulinus in this case is a class of snails with limited morphological divergence. Transmission usually occurs when the larval form of blood flukes enter the bloodstream of people exposed to contaminated water (Eric, 1999). Symptoms include diarrhoea, inflammation and haemorrhage, which vary in humans depending on the species of fluke and part of the body infested and may be fatal if untreated. The Egyptian blood fluke, S. hematobium, which is one of the major causes, was first described by the German physician Theodor Bilharz in 1851 (Microsoft Encarta, 2010). The adult male is about 1.5 cm (about 0.6 in) long; the adult female is slightly longer and is much thinner than the male. The cercariae of the Egyptian blood fluke pierce the skin or mucous membranes when a human bathes in infested water. Eventually the flukes reach the venules and capillaries of the bladder. They mate and deposit eggs that, acting as foreign proteins, give rise to a severe inflammatory reaction in the walls of the bladder and find their way to the interior of the bladder; during their course, hemorrhages are produced, causing bloody urine and pain during urination. Eggs can be found in the urine on microscopic examination. These body flukes of the genus Schistosoma spend most of their life cycle in two hosts; eggs discharged from the host hatch into larval forms in fresh water miracidia; free swimming miracidia have to reach a snail host within 24 hours or die. The miracidia invade the snail and multiply into many tadpole-like larvae called cercariae and are the infective agents of Schistosomiasis. They are shed from the snail in 4-7 weeks and can only live up to 48 hours unless they infect a human who comes in contact with such water or drinking it. When cercariae leave the snail, they burrow through the skin of a human host swimming or wading in infested water from where they are carried to the liver or bladder where they develop into adult worms and settle in the veins of the gut (Eric, 1999). Here they lay eggs which are deposited in the lining of the human intestine and bladder. Haematuria is then experienced as the tissue reacts against the eggs of the schistosome worms which live in the venous plexus of the urinary bladder. Eggs eventually pass back into water via the sewage system, and the cycle begins again (Figure 1).



Figure 1 Transmission Cycle of Urogenital Bilharzia (Source: Microsoft ® Encarta ® 2009; WHO, 2002)

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Notes: Flukes of the genus Schistosoma parasitize two hosts. The young hatch from their eggs in rivers and lakes and enter a specific kind of aquatic snail, where they develop into tadpole-like larvae called cercariae. When the cercariae leave the snail, they burrow through the skin of a human host swimming or wading in infested water. Adult flukes mature in the host's bloodstream and settle in the veins of the gut. Their eggs, deposited in the lining of the human intestine and bladder, pass back into water, and the cycle begins again. More than 200 million people worldwide suffer from schistosomiasis, a disease characterized by the abscesses and bleeding caused by the flukes' infestation.

1.1 History and Modern Understanding of Urinary Schistosomiasis

In Egyptian medical practice dating to c. 1550 BC, the disease was known as bloody urine which is a typical symptom of infection with *Schistosoma haematobium*. It was recorded in hieroglyphic as being a dripping penis disease but still remained idiopathic, thus the cause was not known. Elsewhere in the Middle East and ancient Assyrian, records show that it was referred to as the disease which gave rise to bloody urine. Despite not knowing the cause of the disease at the time, some basic knowledge was fairly widespread even during these ancient times (Ologunde et al., 2012). In modern medical practice however, it has now been fully established that the vector responsible for the infection of the disease belong to the snail of genus Bulinus particularly Bulinus globosus for Zambia, Malawi, Mozambique; and Republic of South Africa while Bulinus nasustus is the host in Tanzania (Beaver et al., 1984). The snail is easy to identify because it has a sinistral shell with a spire which is highly varied in shape and height relative to the aperture. It is inclined to the left with whorls coiling counter clockwise down the spire when viewed with the apex towards the observer and having the aperture situated on the left of the axis when held with the spire uppermost and with the aperture opening toward the observer as contrasted with dextral. The snail hosts prefer stagnant or slow moving water and show a high degree of tolerance to variation in temperature of their habitat. In general, the optimum temperature lies between 22°C and 26°C, but they can withstand extreme temperature for a considerable period of time (Chidi et al., 2006). This makes most water bodies in Zambia suitable habitat for Bulinus. They are generally found in shallow waters near the shore where they usually attach themselves to vegetation. It is rare to find them in depth exceeding 1.5 - 2.0 meters (Chidi et al., 2006). Choice of shallow water is correlated with the availability of food and shelter for the snails, which are available only near the surface. Water plants though necessary only form a desirable but not an essential feature of the habitat of the snails. When available, plants which are favourable to the snails include mainly hydrophytes, particularly members of the family Nymphaeceae, and genera Potamogeton, Pistia and Myriophyllum. Presence of such plants especially Potamogeton sp., is identified as a key factor determining snail occurrence in canals, impoundments and isolated small puddles and stream-lets (Edungbole et al., 1988). Species of plants not favoured by snails include Saponaria, Balanites, Eucalyptus, Tephrosia and Bobgunnia sp., and could be potential sources of snail control. In terms of morbidity and occurrence, the Centre for Disease Control and Prevention estimated that 150 to 200 million persons throughout the world were afflicted with Schistosomiasis (Microsoft Encarta, 2010) and before the advent of HIV/AIDS in the 1980's it ranked second to malaria in tropical and subtropical Africa in terms of social-economic importance, (WHO, 2002). In 2009, the annual report by the Ministry of Health showed that the prevalence of bilharzia in general was at a rate of 90% in some communities of Zambia and an estimated national prevalence of about 22% (Anon., 2013) with about 2 million children or more being infected countrywide, but particularly so in the high rainfall areas of Agro-Ecological Zone (III) in which Mufumbwe is located (Figure 2b), (Lungwangwa, 2009).

1.2Status and Distribution

The distribution of bilharzia is mainly restricted to the tropical areas; parts of Africa and its islands, Arabia the Middle East, and Khuzestan Province of Iran (Figure 2a). Though not as pronounced as malaria in news coverage and awareness campaigns, bilharzias is one of the most widespread parasitic diseases in Zambia (Figure 2 a & b) and tropical and subtropical countries (Mutengo *et al.*, 2009). In Zambia, it is distributed almost country wide but is more prevalent in Mufumbwe District and areas around Lake Kariba in Southern Province (Figure 2b). In 1985 for instance, Chimbari. *et al.* (2007) found that the number of children infected by bilharzia far outweighing the number of adults. Children were also more likely to pass on the disease than adults. He also found that over 17% of the dullest children in class were infected by bilharzia, mainly because they felt tired with headache and lower abdominal pain. The worm burden was also found to be high in infected persons reaching several hundreds and measuring up to 1.27 centimetres long in size and laying about 300 to 500 eggs per day each. Such egg burden if not passed out of the body was the main cause for concern to infected individuals. In Mufumbwe District of Zambia in particular, the prevalence rates of this disease particularly in school going children who were the most vulnerable groups was unknown. Some reports which were based on extrapolated data suggested prevalence of about 19 % as of 2010 (Anon. 2010), but this had not been verified by recent studies as the methods used and extent of area covered, and sample size were now well elaborated.



Figure 2 a) Global Distribution of Urinary Bilharzia, b) Risk Areas in Zambia and Mufumbwe District in General (Source, WHO 2002).

This study therefore, investigated the prevalence of urinary Bilharzia in school going children and identified environmental and human risk factors responsible for the transmission of the disease. The objectives of the study were to; i) establish prevalence rates of the disease in school children, ii) identify the most affected gender and age groups among primary school children, iii) determine factors responsible for the spread of infection of the disease among primary school children in the district, and iv) identify and record indigenous measures used to control the disease and their efficacy.

2. Methods and Materials

2.1. Study Area

Mufumbwe district is located almost at the centre of North Western Province of Zambia (Figure 3), at coordinates; Universal Trans-Mercator (UTM), Latitudes 13.6833 and Longitudes 24.7999. It shares borders with Manyinga in the West, Mwinilunga in the North, Solwezi in the North East, Kasempa in the East, Mumbwa in the South and Kaoma and Lukulu districts in the South West respectively. The district headquarters is located approximately 244 km from Solwezi and 828 km from Lusaka. The district occupies an area of 20,856 square kilometres and lies at an altitude of about 1,200 meters above sea level.



Figure 3 Location map of Mufumbwe district, Zambia

2.1.1. Hydrogeology

The name Mufumbwe is derived from a river which is a tributary and part of the Kabompo River catchment. Other rivers in the watershed include Dongwe and Lunga Rivers. The area is generally flat with an almost uniform level gradient making most of the water bodies flow slowly (Anon., 2002).

2.1.2. Geographic Location of Schools Sampled

Details on the location of schools in Mufumbwe District are shown in Table 1 below.

Table 1 Details on the geographic location of selected schools in Mufumbwe District from which samples were taken.

Name of school	Number of water	· Geographic coordinates	5
	contact points	Latitudes South	Longitude East
Jivundu primary school	7	13.10569	24.68768
Kalengwa primary	5	13.46918	25.00319
Kamayembe primary	3	13.21579	24.6026
Kashima east primary	4	132159	24.60258
Kashima west primary	6	1323358	24.54872
Kifuwe primary school	3	1318475	24.88661
Matushi primary school	5	13.2014	24.77458
Munyambala primary	6	13.35999	24.86401
School			
Wishmanga primary school	3	13.22835	24.747559
Kamanzovu community primary school	6	13.209	24.64134
Kakundwe community	6	13.1406	24.4426
Kamisombo community	11	13.2101	24.8011
primary school			
Katoka community	6	13.30818	24.88928
Primary school			

2.2. Data Collection

Data collection was done over a period of 8 weeks in 2013. Primary school children of grades one (1) to seven (7) were the target population. This was because they had the highest recorded prevalence and transmission of Schistosomiasis, as could be deduced from records of treatment through clinics at community level. Qualitative and quantitative data collection methods were used. Structured questionnaires were administered to pupils and teachers in schools and descriptive data were captured on; age, gender, medical history and awareness about the disease. Information on the risk factors which included sources of drinking water, water contact activities and indigenous knowledge on basic prevention and control measures of the disease were also collected.

2.2.1 Sampling

Simple Random Sampling techniques were used. This was the simplest way of picking elements as it was free from bias. When selecting schools systematic random sampling was used as follows;

1. Numbers representing the schools were listed in a random order

N-31 schools

n=16 schools targeted

- 2. A sampling frame (f)=16/32=50%
- 3. The interval size (m) was determined = 100/50=2
- 4. A random integer 1 was selected between 1 and 2. Entry one was selected and every 2nd unit was selected to come up with 16 schools.

When selecting grades and pupils, simple lottery sampling and proportionate stratified random sampling methods were used respectively. Pupils were randomly arranged in five rows of even numbers depending on the number of pupils found on that day at a given school. Pupils were asked to pick from a bag containing options (Yes = 20) and (No = 20). Pupils that picked yes were selected for the study.

2.2.2 Sample Size

Samples of n = 16 primary schools representing 50% of the total (N = 32) were selected at random. Out of which 44% (n = 14) were visited. In each selected school, 20 pupils were randomly selected as candidates for urine analysis giving a total 280 pupils. Furthermore, 140 pupils were randomly selected and considered as respondents to the administered questionnaires. A total of 30 teachers were also randomly selected from the 14 schools as respondents to the teacher's guided questionnaire.

2.3 Prevalence Levels

To determine prevalence rates, terminal urine of about 25 mls was collected from each of the randomly selected 280 pupils (140 boys and 140girls). Urine samples were collected using sterile plastic sample bottles obtained from the Mufumbwe district laboratory. Samples from girls were collected by a female teacher and a male teacher collected from boys. Each urine sample was labelled to prevent mixing specimens. On the label was gender and age group. Specimens were run through a centrifuge machine at 1,500 revolutions for 3 minutes. This is a standard method applied to concentrate urine sediments. The supernatant was discarded to leave sediment which was transferred to the centre of a clean grease-free glass slide to which was added a cover slip and the specimen viewed through a light microscope at magnification of x 10 and x 40 objective to see *Schistosoma haemat*obium ova which are easily identified by presence of a terminal spine. In order to get prevalence rate of bilharzia, the total number of observed positives (n) divided by the total sample population number (N = 280) was multiplied by hundred, as given by the formula:

Prevalence = <u>Sample of new and pre-existing cases in January to February, 2014</u> $_{\rm X}$ 10ⁿ

Total number of children in sample population during the same time period

= New + Old cases \div Total number of pupils $_X 10^n$

The quartile method was used to define prevalence levels as follows:

- i. 75% 100% Very high ii. 50% - 74% High iii. 25% - 49% Low
- iv. 0 25% Very low

2.4 Determining Most Affected Age Groups and Gender

Two age groups were used; these were 7-10 years and 11-15 years. These age groups were chosen because grades one (1) to seven (7) fall within this range. Equal numbers of boys and girls were selected and had their urine tested. Based on the data collected, the method used to determine age group range most affected by bilharzia was done by comparing proportions of positive cases among the two age groups; 7-10 years and 11-15 years in the sampled population as described below;

- 1. Defined x and y: x = age ranges,
 - y = total of confirmed positive cases in all age groups.
- 2. Identified x and y: x = number of positives,

y = total number of positives.

3. Set up the ratio x/y; n1/N₁ and n/N₁.

4. Proportions were expressed as percentages.

Value found multiplied by 100 = percentage (%).

2.5 Predisposing Factors

Structured questionnaires for both pupils and teachers were used to obtain information on the level of knowledge on causes, transmission and prevention of bilharzia. Views given by respondents were compared to existing basic knowledge on bilharzia from published literature. Further, pupils who had in the recent past suffered from bilharzia were asked to list in order of importance water contact activities in which they were involved. A field observation of risk factors among children was also carried out and photos were taken and used as documentary data.

2.6 Indigenous Measures Used to Control Bilharzia

Structured questionnaires were used in which respondents were required to state any effective and efficient control measures they knew to the best of their knowledge or had used before.

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2.7 Data Analysis

Data was analysed using a software package; Statistical Package for Social Sciences (SPSS version 16.0) which selected the total number of males and females pupils from the data sets and also number of the infected. Hence, the gender with the highest number of positives was the most infected and the age range which had the highest proportion in percentage was most affected.

3. Results

3.1. Prevalence Rates in School Children

There was a high prevalence rate of Schistosomiasis among school children. A total of 163 pupils, 58.2% (N = 280) tested positive for *S. haematobium* infection. The highest percentage being in the age range 11-15 years with 60.7% (n = 175) and lowest was 7-10 years age range with 39.2% (n = 105).

3.2 Affected Age Group and Gender

a) Age group

Age group 11-15 years had the highest infection rates 62.5% (n = 175) and age group 7-10 years the lowest 37.5% (n = 105) (Figure 5).



Figure 5 Age range and number of infected and uninfected children in 2013 Mufumbwe District, Zambia

b) Most Affected Gender

Occurrence of infection based on gender showed that males had the highest infection 60.7% (n = 99) and females had the lowest 39.2% (n = 64). Boys were also recorded to have the highest incidences of having suffered haematuria in the past 68.1% (n = 105) and girls had lower records 31.9% (n = 54), (Figure 6).



Figure 6 Gender and haematuria cases, 2013, Mufumbwe District, Zambia

3.3 Risk Factors Responsible for the Spread and Transmission

3.3.1. Water Contact Activities

Of the 140 pupils sampled 78% (n = 49) that frequented streams or dams had had bilharzia, than those that did not 22% (n = 14); 72.4% (n = 42) of those that fetched drinking water from the streams had bilharzia than those that did not 27.6% (n = 16); 67.9% (n = 53) that bathed from streams and dams had the disease, and 32.1% (n = 25) did not; for those who went fishing in the streams or dams, 58.8% (n = 50) had the highest number compared to 41.2% (n = 35) that did not. Other water contact activities were fetching ground orchids along water logged marshes near streams, washing

kitchen utensils in the ponds, fishing, crossing streams on the way to and back from school and playing in water (Figure 7a, b & c).





Figure 7a) A girl washing plates at a pond, b) Boys fishing and playing in water and c) Boy washing his face in a stream, 2013, Mufumbwe.

3.3.2 Water Contact Activities Compared with Past Bilharzia Cases

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Most pupils, mainly boys that tested positive for haematuria had bathed in open water, while those that used bath rooms, mainly girls had fewer incidences. Results also showed that more girls used bath rooms rather than open water than boys (Figure 8).



Figure 8 Previous cases of bilharzia compared to bathing points, Mufumbwe

3.3.3. Levels of Knowledge on Factors Causing the Spread of Bilharzia among Pupils, Teachers and Parents.

There were low levels of understanding regarding causes of bilharzia among school children and the community at large. Most respondents 42% (school children) and 48% (adult members of the community) did not know the main causes, and only 15% (school children) 30% (adult members of the community) indicated playing in open water (Figure 9a & b). The answers given were not significantly different ($\chi^2 = 117.8$, df = 4, $\alpha = 0.01$, P > 0.01 for school children; $\chi^2 = 68.8$, df = 3, $\alpha = 0.01$, P < 0.01 for members of the community) respectively, which signified low levels of knowledge.





b) Figure 9 a) Pupil's response on causes of bilharzias, b) communities' (parents and teachers) response on major predisposing factors for bilharziasis in Mufumbwe

3.4.5. Indigenous Sustainable Measures used to Control the Disease

There were low levels of understanding on measures needed to be taken by the community to minimize incidences of bilharziasis in school children. The majority 50% (n = 15) indicated sensitizing the public on bilharzia, 20% (n = 6) said that condoms should be provided in schools, and only 16.7% (n = 5) said that pupils should avoid contact with stagnant water and should not bath or play in it.

(a) Natural Remedies used to Treat Bilharzia in Mufumbwe District

Residents interviewed mentioned only four common remedies in almost equal proportions, signifying low levels of efficacy of the named indigenous treatments. The highest of the four was Steganotaenia araliacea 32 % (relative frequency) and the lowest was *Mitragyna stipulosa* with 20% (relative frequency), the difference was not significant (χ^2 = 3.04, df = 3, α = 0.01, P > 0.01) (Figure 10).



Figure 10 Common indigenous remedies for treatment of bilharzia in Mufumbwe.

4. Discussion

4.1. Prevalence of Bilharzia in School Children

The high occurrence of urinary *Schistosomiasis* in primary school children of Mufumbwe district could be attributed to many factors among them being the following: i) most basic schools in Mufumbwe district are located near streams which eliminated costs of water reticulation. Most of these streams are slow moving owing to the gentle terrain of the landscape; ii) the lack of safe potable water exposes pupils to draw water for domestic uses from natural sources and in the process expose themselves to cercariae; iii) pupils have the habit of bathing in natural water bodies which are potential breeding sites of the vector snail; iv)school children are also often assigned by their parents to wash their clothes, soak cassava tubers (*Manihot esculenta*), and to draw water for domestic use while adults are involved in more strenuous chores. Such activities expose children to cercariae. These potential predisposing factors for infection could be responsible for the high incidences of schistosomiasis recorded in school going children in Mufumbwe district. Since there is a link between urogenital bilhazia and sanitation, it is obvious that the lack of access to clean water in most schools in Mufumbwe District accentuates prevalence rates of bilharzia as earlier reported by Lungwangwa (2009).

4.2 Gender and Age Groups Most Infected

Primary School children of the age group 11-15 years were the most exposed to risk factors. This is because this age group is slightly older than the 7-10 age group and hence more active and in greater demand for outdoor recreation activities. In the absence of facilities such as swimming pools and play parks which are available to urban populations, these children are compelled to seek alternatives and one of them is to use objectives in their natural environment, which consequently exposes them to cercariae in infested water bodies.

4.1.3. Factors Responsible for Spread of Infection

Pupils of school going age group 6-15 had the highest water contact frequency than adults or children below six years. Firstly, because this is the primary school going age that are required to go to school five days in a week, each day wading through water as they go to school. While at school, they get involved in a number of outdoor activities and would often want to bath or cool their bodies on their way home. On weekends, they are expected to help their parents in a number of activities. Major activities include; herding cattle, fishing and digging ground orchid tubers which are used to prepare a type of non meat based polony called *Chikanda* mainly of the genus *Habenaria*, *Satyrium* and *Disa* sp near streams and dambos. For girls, the main water contact activity was soaking or collecting soaked cassava tubers in infected water and washing kitchen utensils which are considered to be female based chores and partly digging for ground orchids. The girls' activities however, are not as frequent as those performed by boys which explains why there were fewer cases of bilharzia in females than boys.

4.1.4. Indigenous Control Measures

Indigenous control measures were not popular. This is probably because most of them targeted elimination of the vector (snail) rather curing the disease. For instance, using pounded concoctions of *Bobgunnia madagascariensis* pods and seeds which are crushed to make a potent poison that kills bilharzia snails has been used to localized extents. This concoction cannot be used on a large scale as the plant is not abundant, it does not produce enough fruit and the poison is nonspecific. If used in large quantities it kills fish as well as other aquatic fauna thereby destabilizing food chains and the aquatic ecosystem in general. The other example is use of *Ricinus communis* which contains ricin, a highly toxic protein with no known antidote. It is derived from the bean of castor plant and can be very poisonous to humans where it causes

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gastroenteritis, bloody diarrhea, and vomiting; once circulating in the blood, major organ systems fail and death may occur within 36 to 72 hours. This could be reason for its limited use by localsin treating bilharzias. In Zimbabwe, the plant's roots have also been used for the same purpose (Ndamba, 2013). The efficacy of herbal medicine *Mitragyna stipulosa* (Muwilankwazhi-Kaonde) was equally unknown and its use was low. The use of *Steganotaenia araliacea* and the actual plant parts used were not clear and so was the use boiled *Mangifera indica* roots (Ndamba *et al.*, 2013). Generally the indigenous methods that were mentioned were not effective because efficacies of the herbal medicines were not clear, and their use mostly impracticable.

4.2 Conclusion and Recommendations

This study confirms high prevalence rates of urinary bilharzia in school children of primary school going age in Mufumbwe District. The high prevalence rates are attributed to the wide range of predisposing factors to the disease and low levels of knowledge about the cause of bilharzias and lack of affordable remedies.

4.2.1 Recommendations

It is fact that untreated schistosomiasis often results in death. The first line of attack therefore, is supposed to be preventive, including proper sanitation and extermination of snails. Until 1982, none of the various drugs used to treat persons with the disease was completely effective and all had severe side effects. Then an unusual new drug, praziquantel (sold commercially as *Boltricide* in the United States of America), became widely available. Praziquantel taken orally, in a single dose or in several doses on the same day, is highly effective against *S. mansoni, S. japonicum*, and *S. hematobium*, without causing any serious side effects. Praziquantel increases the permeability of the worm's cell membranes to calcium ions, causing massive contraction and paralysis of its musculature, and then disintegration. For that reason, the WHO recommends the use of praziquantel to control Schistosomiasis. This practice though effective in the short term, is unsustainable in the long-term due to the high cost of the drug and the possibility of bilharzia parasites developing resistance to praziquantel. If that happened, an outbreak of praziquantel resistant parasites may be difficult to control. In view of the limitations of approaches based on chemotherapy techniques, it would be advisable, that sustainable and cost effective measures be considered in the long-term. Research in environmental control measures which are likely to be more sustainable than the use of chemotherapy should be encouraged. We therefore recommend the following as potential ameliorating measures:

- i. To conduct research on the efficacy and safety of local herbal medication used in treating bilharzia and controlling the vector, so that the burden of relying on conventional, intermittent and expensive praziquantel drug is reduced.
- ii. To institute a comprehensive awareness campaign on bilharzia.
- iii. To provide non water based recreation facilities so that children attention is diverted from swimming in open infested water.
- iv. Advise children to avoid water contact activities likely to expose them to cercariae.
- v. To conduct scientific research on biological control of bilharzias, for instance the use of fish *Sargochromis codringtonii* which preys on the vector snail thereby reducing their population and subsequently the disease itself.

References

Adewumi, C. O., Fury, P., Christensen, N.O. & Olorunmola, F. (1991). Endemicity Seasonality and Locality of Transmission of human *Schistosomiasis* in 3 communities in South-Western Nigeria. *Africa Journal of Tropical Medicine and Parasitology*, Vol. 42 No. 2, pp. 32 - 44.

Augusto, G., Nalá R., Casmo, V., Sabonete, A., Mapaco, L & Monteiro, J. (2009). Geographic Distribution and Prevalence of *Schistosomiasis* and Soil-Transmitted Helminthes among School children in Mozambique. *American Journal of Tropical Medicine* and Hygiene, Vol. 81 No.5, pp. 799 - 803.

Chidi, G., Okoli, J. C., Anosike, M. O. E. & Iwuala, E. (2006). Prevalence and Distribution of Urinary Schistosomiasis in Ohaji Local Government Area of Imo State, Nigeria. *American Journal of Disease Sciences*, Vol. 2 No. 4, pp. 45 - 48.

Chimbari, M.J., Makonic, P. & Madsen, H. (2007). Impact of *Sargochromis codrington* on Pulmonate Snails in Irrigation ponds in Zimbabwe. *Africa Journal of Aquatic Science*, Vol. 32 No. 2, pp. 197-233.

Edungbole, L.D., Ashaolu, S.O., Omonisi. M.K & Ayedun, B.A. (1988). Schistosoma haematobium infection among school children in the Babana District, Kwara State, Nigeria. *African Journal of Medicine and Medical Sciences*, Vol. 17 No.1, pp. 187-193.

Eric, N. (1999). Communicable Diseases. 3rd ed. Nairobi, Kenya. African Medical and Research foundation (AMREF).

Eline, B. & Hammou, L. (2004). Environmental control of *Schistosomiasis* through Community Participation in Moroccan. International. *Journal of Tropical Medicine and International Health*, Vol 9 No. 9, pp 997–1004.

Mutengo, M.M., Mudenda, V., Mwansa, C.J., Kaonga, K., Sianonga, S., Wamulume, H. & Shinondo, J.C. (2009). Presence of Schistosomiasis in Genital Biopsies from patients at the University Teaching Hospital in Lusaka Zambia. *Medical journal of Zambia*, Vol. 36 No. 36, pp. 1-5.

Ndamba, J., Nyamezi, N., Makanza, N., Anderson, C. & Kaondera, K. (1994). Traditional herbal medicine used for the treatment of urinary Schistosomiasis in Zimbabwe. *Africa Journal of Biomedical Research*, Vol. 12 No. 42, pp. 125-132.

Microsoft Encarta, (2010). Schistosomiais. Microsoft Coporation.

Ologunde, C. A., Olaoye, A.B, Olaifa, O. A. & Olowu, O. Y. (2012). Schistosomiasis in Ogbese, Re-Infection after Successful Treatment with Praziquantel in Nigeria. *Global Journal of Medical Research*, Vol. 12 No.1, pp. 19-34.

WHO (2002). *Schistosomiasis in Rural communities* [WWW] Community Health in tropical Africa. Available from: http://www.whobilharziarpt.com/tropicalmed.htm [Accessed 10/12/2013].