DIAGNOSTIC PERFORMANCE OF SCREENING METHODS FOR URINARY SCHISTOSOMIASIS AMONG SCHOOL CHILDREN IN A SCHOOL- BASED ANTIHELMINTHIC PROGRAMME IN MBOZI DISTRICT

By

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A Dissertation Submitted in (partial) Fulfillment of the Requirements for the Degree of Master of Science in Tropical Diseases Control of the Muhimbili University of Health and Allied Sciences

Muhimbili University of Health and Allied Sciences

September, 2013

CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance of a dissertation entitled ***"Diagnostic Performance of Screening Methods for Urinary Schistosomiasis in a School- Based Antihelminthic Programme in Mbozi District"***, in fulfillment of the requirements for the degree of Master of Science in Tropical Diseases Control of Muhimbili University of Health and Allied Sciences.

_____

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Date: _____

DECLARATION AND COPY RIGHT

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ACKNOWLEDGEMENT

This dissertation would not have been possible without the help of my God Almighty and guidance of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

First and foremost, my utmost gratitude to my Supervisor, Dr. Billy Ngassala for his guidance and support throughout this dissertation preparation.

Also I am grateful to the academic and non academic staff of School of Public Health as this work could not be possible without their support, inputs and positive comments.

Sincere thanks also to Dr Lugano Daimon who was always willing to help and give his best suggestions and valuable contribution from the beginning of this dissertation, the data analysis to the completion.

My acknowledgement should also go to the Mbozi District officials, the DMO, DEO, NTD coordinator and Vwawa District Hospital staff, also the primary school teachers and pupils of the selected schools for their tireless support and cooperation during the entire period of data collection.

Lastly but not least, I would like extend my thanks to my family, my mom & dad, my lovely husband, my daughter , my son, brothers and sisters for their love, support encouragement and patience throughout my studies at MUHAS.

DEDICATION

This dissertation is dedicated to my Dad and Mom, Mr. and Mrs. Kabululu, my darling husband Dr. Lugano, my daughter Belinda and my son Christian.

ABSTRACT

Background: Accurate diagnosis for schistosomiasis is crucial for patient management, drug efficacy evaluations, and monitoring of large-scale control programs. However diagnostic performance of screening (indirect) methods vary in different endemic zones, age groups and sexes especially when there is low prevalence after large scale Praziquantel Mass Drug Administration (MDA) in a school based antihelminthic control programme.

Main Objective: To evaluate the diagnostic performance of screening (indirect diagnostic) methods for urinary schistosomiasis after wide scale use of praziquantel in a school based antihelminthic control programme in Mbozi District.

Materials and methods: A cross-sectional study was conducted in Mbozi District from March to June, 2013. Multistage cluster random sampling was applied to obtain the schools and participants of the study. Twelve schools out of 156 schools (7.7% of all schools) were randomly selected. A total of 429 participants from standard I – VII were chosen proportionally from each selected school. Interviewed questionnaire was used to collect information on demographic characteristics; self reported haematuria, and status of praziquantel administration. Each study participant was provided with 50mls clean, dry wide mouthed and well caped labeled plastic containers for collecting about 20ml of clean-catch, midstream urine sample between 10:00hr and 14:00hr. The diagnostic performance of screening tests were compared with microscopic examination of urine for *S. haematobium* egg (filtration method, which was regarded as the gold standard)

Results: The prevalence of urinary schistosomiasis in Mbozi district was 7.9%, whereby Chemical reagent strip was the most sensitive of all screening methods assessed with sensitivity of (78.8%) also with high NPV (97.8%), followed by self reported haematuria (51.9%), and visual examination of urine was least sensitive of all (42.4%). In terms of specificity, self reported haematuria was the most specific (91.7%) with positive predictive value (34.9%).

Conclusion: Despite low prevalence of schistosomiasis, chemical reagent strips and self reported haematuria are still useful diagnostic tools for targeting the effect of Praziquantel-MDA to school children in schistosomiasis endemic areas.

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LIST OF ABBREVIATIONS

CCA	Circulating Cathodic Antigen
CDC	Centre for Disease Control
DEO	District Education Officer
DMO	District Medical Officer
MDA	Mass Drug Administration
MoHSW	Ministry of Health and Social Welfare
MUHAS	Muhimbili University of Health and Allied Sciences
NPV	Negative Predictive Value
NTD	Neglected Tropical Diseases
PMDA	Praziquantel Mass Drug Administration
PPV	Positive Predictive Value
PZQ	Praziquantel
RDT	Rapid Diagnostic Test
SCI	Schistosomiasis Control Initiatives
SRS	Simple Random Sampling
WHO	World Health Organization

DEFINITIONS OF KEY TERMS

MDA:	Mass Drug Administration is the administration of drugs to whole population irrespectively of their disease status.
Diagnostic Performance:	The measures of sensitivity, specificity, positive and negative predictive values of a screening test against an agreed 'Gold Standard' test.
Haematuria:	Presence of blood in urine
Sensitivity:	Proportion of those with disease defined by gold standard testing who are labelled by the test in question as positive
Specificity:	Proportion of those without disease defined by gold standard testing who are labelled as negative by the test in question
Positive predictive value:	The proportion of patients testing positive who actually have the disease (by gold standard)
Negative predictive value:	The proportion of patients testing negative who are truly free of disease (by gold standard)
Prevalence:	Distribution or spread of a disease in a particular area at a particular time
Intensity:	Degree or extent to which someone is infected with the disease.

CHAPTER ONE: INTRODUCTION

1.1: BACKGROUND

Human schistosomiasis is second only to malaria in sub-Saharan Africa (SSA) for causing severe morbidities. Of the world's 207 million estimated cases of schistosomiasis, 93% occur in SSA and the United Republic of Tanzania is the second country that has the highest burden of schistosomiasis in the region, (Mazigo et al., 2012). The recent report of 2012 indicated that of the estimated population of 43.5 million people, about 23,189,294 million are infected with schistosomiasis and the country prevalence estimated to be 51.5% (Mazigo et al., 2012). It causes a disabling state of chronic ill-health that impairs human capital, while local poverty fosters schistosomiasis transmission by enforcing exposure to contaminated water, limiting access to health care resources, and reducing resources to decrease transmission (King, 2010).

Urinary schistosomiasis is a parasitic disease caused by infection with *Schistosoma haematobium* found in fresh water. Fresh water snails are also infected by these parasites during its life cycle, and humans when come into contact with fresh water that contains these snails during agricultural, domestic and recreational activities are at risk of acquiring infection (WHO, 2012).

The infection is prevalent in tropical and sub-tropical areas, in poor communities without portable water and adequate sanitation (CDC, 2010). Mostly infection occurs in children 5-15 years old (Koukounari et al., 2007). More than 200 million people are infected worldwide whereby in Sub-Saharan Africa, 112 million people are infected with Schistosoma haematobium (CDC, 2010). In Tanzania, both urinary and intestinal schistosomiasis are endemic in many parts and poses serious public health problems. According to MoHSW the prevalence of schistosomiasis in Tanzania varies from 13% to 88%, reaching 100% in some settings (Mazigo et al., 2010) and the prevalence of urinary schistosomiasis was 25% in Mbeya region and 36% in Mbozi district (SCI and MoHSW, 2010).

Urinary schistosomiasis can be diagnosed by rapid assessment questionnaire method, observable macrohaematuria, microhaematuria by reagent strips, microscopic examination of urine for detection of *S. haematobium* eggs (centrifugation or filtration), tests for circulating antigens, antibody tests, and ultrasound scans of the urinary system for detecting pathology caused by the disease. Filtration method is the gold standard diagnostic test (Koukounari et al., 2009).

Assessing the trends of infection through measuring prevalence and intensity is used to determine the effectiveness of PZQ MDA (Sousa-Figueiredo et al., 2009). Accurate diagnosis is important in determining the prevalence and intensity of the infection but substantial uncertainties surround the performances of diagnostic techniques for urinary schistosomiasis (Koukounari et al., 2009).

Several reasons explain the uncertainties of performances of diagnostic techniques for urinary schistosomiasis. For instance, self reported questionnaires have been showed to vary depending on age, sex and endemicity (Guyatt et al., 1999). For the case of haematuria, performance can be affected by factors such as menstruation and genitourinary infections. (Hassan et al. 2012). Also daily variation in egg excretion levels or duration of infection influence the accuracy of determining the correct current infection status when using the microscopic tests (Hatz et al., 1990). Also serodiagnosis of schistosomiasis suffers from a number of drawbacks common to antibody detection techniques for parasite infection. These include the difficulty distinguishing active from past infection, with parasite-specific antibodies remaining long time after cure, and inability to measure infection intensity (Johansen et al., 2000).

Diagnostic assays with low sensitivities are unsuitable for evaluation of schistosomiasis control programs, such as those aimed at morbidity reduction through mass human chemotherapy (Koukounari et al., 2009). Furthermore, we recommend that additional researches should be conducted in other countries where *S. haematobium* infection is endemic to further elucidate the relationship between this simple technique and other diagnostic methods (Akyala et al., 2009).

So, the drawbacks and the limitations of the diagnostics tests explained above, cause the diagnosis and control of schistosomiasis to be challenging. This study will provide the evidence for which the aforementioned diagnostic tests are suitable in monitoring the control programmes and in diagnosing the disease in areas with low prevalence.

1.2: LITERATURE REVIEW

One of the clearest signs of urinary schistosomiasis is bloody urine. The disease can be diagnosed using one of the following methods: detection of haematuria by using questionnaires, visual examination and dipsticks, microscopic examination of urine for detection of *S. haematobium* eggs, tests for circulating antigens, serological antibody tests and ultrasound scans of the urinary system (WHO, 2008; Koukounari et al., 2009).

The questionnaire method is cheap, simple and easiest method to use for the diagnosis of urinary schistosomiasis. It asks children whether they have seen blood in their urine over the past month. The child will answer "yes" or "no" of which will indicate whether the community is affected or not but it will not tell how many eggs are present, i.e. the intensity of infection and also it is less sensitive for girls than for boys. WHO estimates that if 30% of children are found to be positive using the questionnaire technique, approximately 50% of the community are infected (WHO, 2008).

Recent evidence from Egypt, Ghana, Nigeria, and the United Republic of Tanzania suggests that reported haematuria and self reported schistosomiasis are useful indicators for individual infection status and therefore helping to target individuals for chemotherapy (Lengeler et al., 2002).

The use of questionnaire in assessment of haematuria shows significant correlation with other tests. This was shown in a study done in Ghana where it was revealed that, self-reported haematuria had a sensitivity of 53% and a specificity of 85% when compared with centrifugation method (Bogoch et al., 2012).

Also in a study done in Kilombero, Tanzania, comparison between questionnaires and the parasitological findings was made, data showed strong correlation between the two diagnostic measures. The questionnaire showed a good diagnostic performance, with a moderate positive and a high negative predictive value. The questionnaire approach was also rapid and cost 20-fold less than standard parasitological examinations (Lengeler et al., 2002).

Questionnaires alone can miss a significant proportion of infected children, especially those with light infections, therefore causing difficulty towards morbidity control programmes (Lengeler et al., 2002).

Visual haematuria is another method for diagnosing urinary schistosomiasis, where by blood in urine is visualized through naked eyes and assigned a number. The urine colour chart ranges from 1 to 4 with 1 indicating urine free of any trace of microhaematuria or proteinuria (light - yellow) and 4 correspond to dark red urine (bloody urine). Whereas number 2 and 3 grouped as brown colour correspond to visually discernable microhaematuria and proteinuria present in the urine (Houmsou et al., 2009)

Visual haematuria been shown to correlate with infection intensity as measured by egg counts and can estimate the prevalence of infection. This was found in a study done in Benue state Nigeria where filtration technique considered as the gold standard test. It was recommended that urine colour observation, if used as rapid screening tool in an endemic area is capable of assessing the endemic community for urinary schistosomiasis prevalence. In addition to being a useful rapid field diagnostic for *Schistosoma haematobium* infection, urine colour as assessed by observation may also prove to be an indicator of morbidity through proteinuria and micro haematuria (Werf and Vlas, 2004; Houmsou et al., 2011).

To assess whether urine turbidity and microhaematuria can be used as rapid assessment indicators for *S. haematobium* infection, a cross-sectional study among school children was conducted in Nigeria. Urine samples were examined macroscopically for turbidity and screened for microhaematuria. The results revealed that their sensitivities were 54.8% and 59.3% and specificities 80.2% and 65.8% respectively and correlated significantly with the Intensity of infection, Hence they conclude that the possible use of urine turbidity as an indicator for rapid diagnosis of urinary schistosomiasis in low resource communities is implied (Hassan et al., 2012). A comparative study in Ghana and Zambia on indirect screening of S. *haematobium* infection also reveals that, visual inspection of the urine specimens (appearance and colour) was shown to be a specific and sensitive indicator of infection and inclusion of this screening procedure may be

recommended in order to identify heavily infected persons for treatment in endemic areas (Morr, et al., 1985).

Also a study done on Pemba Island to evaluate the validity and efficiency of indirect screening methods for detecting *S. haematobium* morbidity in children aged 5-19 years showed that visual haematuria had the highest specificity, highest overall diagnostic performance and highest positive predictive value compared to others. Although its sensitivity declined significantly between the evaluations, perhaps reflecting the decreasing prevalence of heavy infection arising from repeated treatment of all infected subjects. The specificity and efficiency of this screening method increased significantly. However, the positive predictive value declined with decreasing prevalence of heavy infection (Lwambo et al. 1997).

The dipstick technique specifies whether microscopic traces of blood that are invisible to the naked eye are present in a urine sample. It is simple to use where by even someone with minimal training can use it. It is based on the peroxidase-like activity of hemoglobin which catalyses the reaction of hydroperoxidase and O- tolidine. it is generally capable of 0.015 mg/100ml free hemoglobin or 5 to 15 intact blood cells per mL of urine (WHO, 2008).

The use of chemical reagent strips has been proven highly sensitive and specific in many endemic areas of the world (Hassan et al. 2012) . In a study done in Ethiopia, reagent strips showed high sensitivity, specificity, positive predictive value and negative predictive value of in low endemicity areas (Birrie et al., 1995). Moreover, in a study done in Ghana, it was revealed that, the presence of blood on a urine reagent strip was 100% sensitive and 93% specific for *S. haematobium* diagnosis (Bogoch et al., 2012).

Effectiveness of urinalysis reagent strips for haematuria and proteinuria in detecting *S. haematobium* egg-positive persons was assessed in a study done in Kenya, the degree of urinary blood or protein and prevalence of egg positives were closely associated. Haematuria and proteinuria were positively correlated with urinary egg counts. however, the diagnostic value of both haematuria and proteinuria varied according to the positivity

level adopted, intensity of infection and age, but was not affected by sex and village of residence (Kiliku et al., 1991).

A study done in Nigeria evaluated microhaematuria as indirect indicator for the presence of disease. The sensitivity of microhaematuria was relatively low, but in patients with a heavy infection the sensitivity of microhaematuria was high. Hence it was finally suggested that combining urine reagent strip tests and information on macrohaematuria increased the accuracy of the rapid diagnosis of urinary schistosomiasis (Ugbomoiko et al., 2009).

To determine whether microhaematuria and proteinuria as measured by reagent strips could estimate intensity of *S. haematobim* infection, a total of 1,124 urine samples were collected and screened for microhaematuria and using reagent strips and results were compared to filtration technique, the gold standard method. Findings suggested that use of urine reagent strips could potentially estimate intensity of *S. haematobium* infection and their performance to screen urinary schistosomiasis agreed with previous observations (Houmsou et al., 2011). This was also seen in Zimbabwe, where a significant correlation between dipstick haematuria and intensity of S. *haematobium* infection was found, hence concluded that haematuria was considered the overall better indicator due to its greater specificity before and after treatment (Murare and Taylor, 1987) .

One limitation of haematuria reagent strips is that they can be affected by factors such as menstruation and genitourinary infections (Poggensee and Feldmeier, 2001). A further shortcoming is that they are semi-quantitative and have a limited concentration detection range. Overall, it is suggested that a history of haematuria and/or visual haematuria are appropriate methods for preliminary screening of communities to identify those at risk of morbidity. Thereafter, microhaematuria (1 + positivity limit) may be the more appropriate method for targeting intervention at the individual level (Lwambo, et al., 1997).

Urine filtration technique is used for recovery of *S. haematobium* eggs. Using blunt ended (untoothed) forceps, carefully place a polycarbonate filter on the support of the

filter holder, reassemble the filter holder and attach it to the end of a10ml syringe. Remove the plunger from the syringe, fill the syringe to the 10ml mark with well mixed urine and replace the plunger. Holding the syringe over a Beaker or other suitable container slowly passes the urine through the filter .Remove the filter holder and un screw it. Using the blunt- ended forceps carefully remove the filter and transfer it upward to a slide, then, add a drop of saline and Lugol's iodine and cover with a cover glass then examine under the microscope. Using magnification of x10, count the number of eggs on entire filter membrane and report the number per 10ml of urine. It is considered as the 'gold standard' for diagnosis of urinary schistosomiasis due to its high sensitivity and specificity in urine although it requires trained laboratory technicians and proper equipment which are very expensive (WHO, 2008). All in all it has been found that haematuria and mean egg/10 mL urine to be reliable for the diagnosis of the disease and can be used to ascertain the prevalence of the disease in any community (Ogbonna, 2012).

Urinary schistosomiasis can also be diagnosed through immunological methods (antibody and antigen detection). The Bilharzia Urine CCA strip detects the schistosome Circulating Cathodic Antigen (CCA, present in all *Schistosoma* species, including animal species) in the urine of infected individuals though its use reveal some contradictions from different studies conducted. For *S. mansoni* and *S. japonicum* infections, CCA levels in urine are high and therefore the CCA strip is very sensitive for *S. mansoni* and *S. Japonicum* infections. However, for *S. haematobium* infections, CCA levels in urine are much lower. They usually are close to the cut-off point of the CCA strips (standard 100). Therefore, please note that the CCA strip is not very sensitive for *S. haematobium* infections in low transmission areas (Rapid Medical Diagnostics, 2008).

Also Stothard, in 2009 had similar observation on barriers in the use of schistosomiasis RDT (CCA strips) that they are not capable of detecting both disease forms simultaneously i.e. (*S. haematobium and S. Mansoni* infections), it incorrectly document the prevalence of schistosomiasis, especially co-infections, and also it is very expensive

retailing at between US$2.6 and US$4.6.27. So careful consideration is therefore needed to determine whether the performance, and more importantly cost-effective application, can be justified (Stothard, 2009).

In a study done in a rural area of Zimbabwe among 265 pre- and primary school children aged 2—19 years to compare the CCA strip with egg detection before and six weeks after treatment with praziquantel. The results show that there was a significant correlation between CCA and parasitological results. Both CCA and egg detection were formed as the gold standards and by using this standard, the sensitivities of the CCA test were 88.2% and 95.8%, respectively, for pre- and post-treatment results. So they conclude that CCA strips test was readily acceptable since can be performed and read in the field as it does not require sophisticated laboratory equipment, the sample (urine) collection is non-invasive, are less labour-intensive, a single urine sample is sufficient for a conclusive diagnosis (Midzi et al., 2009).

1.3: CONCEPTUAL FRAMEWORK

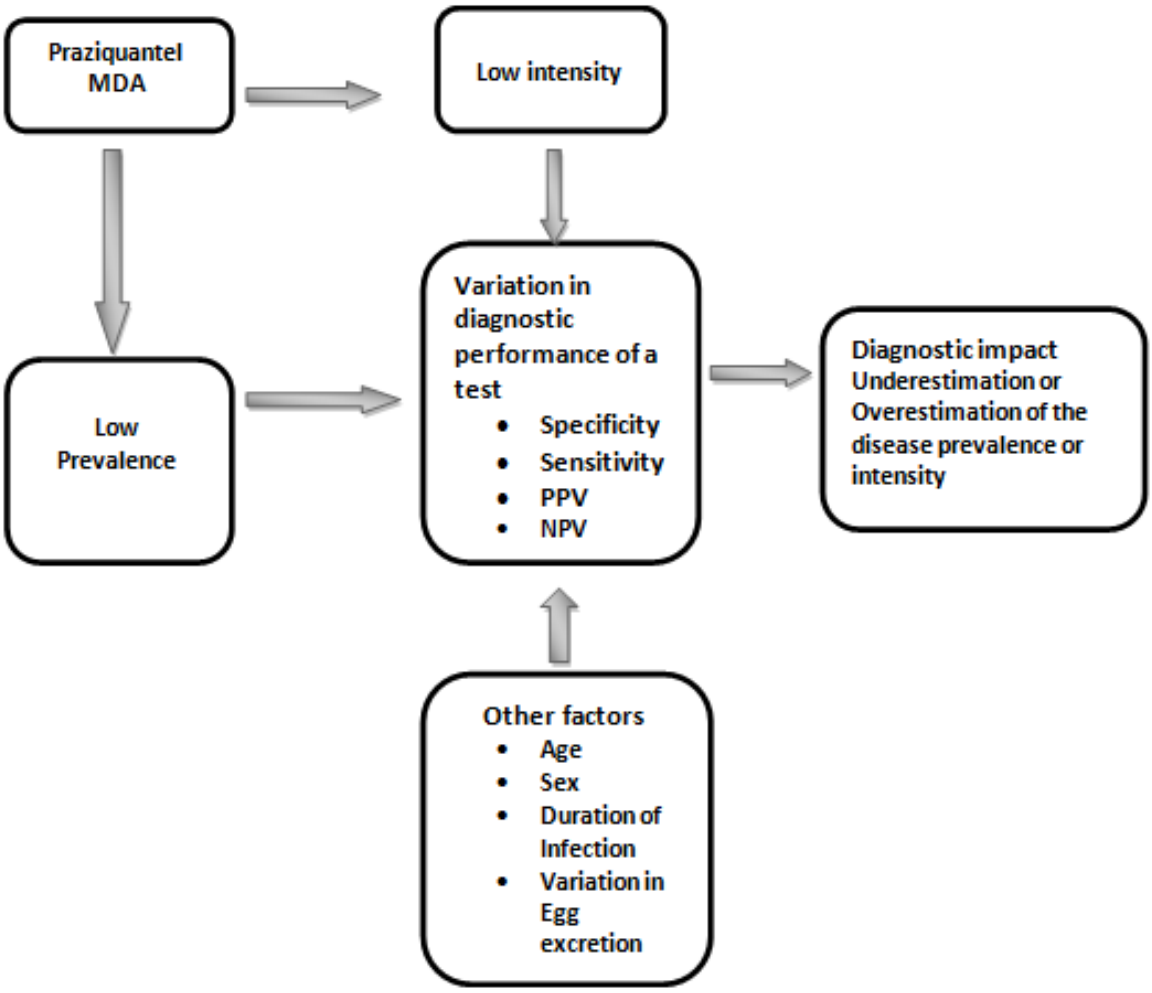


Figure 1: Conceptual Framework, Factors affecting diagnostic performance

1.4: PROBLEM STATEMENT

Sensitivity and specificity are two components that measure the inherent validity of a diagnostic test compared to the gold standard; a valid test would not only correctly detect the presence of disease but also correctly detect the absence of the disease in subjects with and without disease, respectively (Malhotra and Indrayan, 2010).

Accurate diagnosis for schistosomiasis is crucial for patient management, drug efficacy evaluations, and monitoring of large-scale control programs although it is a challenge, especially in areas with low infection intensities (Glinz et al., 2010). Indirect diagnostic methods in urinary schistosomiasis are widely used for screening high-risk populations in endemic areas. Their diagnostic performances, however, vary (Fatiregun et al., 2005). Large variations have been observed in specificities and sensitivities among different endemic zones, age groups and sex (Koukounari et al., 2009; Shiff, 2012). For example, the differences by age and sex have important implications for the use of questionnaires for the selection of schools and children for treatment (Guyatt et al., 1999). Moreover, daily variation in egg excretion levels and the passage of few eggs in chronically infected individual reduce the sensitivity of diagnosing procedures which might lead to prevalence underestimation, therefore causing difficulty in controlling this disease (Hatz, 1990; Wichmann et al., 2009; Zhong et al., 2010; Ibironke et al., 2011). Thus, methods that enable infections to be correctly diagnosed are a prerequisite for effective disease control (Koukounari et al., 2009).

In Mbozi district, four rounds of Praziquantel Mass Drug Administration (MDA) have been executed with a baseline prevalence of 36% in 2010 (SCI and MoHSW, 2010).

It is expected that after Praziquantel MDA the prevalence and intensity of infection might have gone down hence only few or no cases will have intensity high enough to cause morbidity (Toure, 2008; Hodges et al., 2012).) This study would bring about the scientifically sound suggestion regarding proper diagnostic test for urinary schistosomiasis that can be used after large scale control programs especially in areas with low prevalence of infection.

1.5: RATIONALE

Diagnosis of schistosomiasis in low endemic areas is still a challenge, hence, results obtained from this study provided the evidence of which among the aforementioned diagnostic techniques is sensitive, field-applicable, cheap and reliable for regular schistosomiasis screening in endemic communities where mass treatment interventions are being undertaken

Also this helps to show the prevalence of urinary schistosomiasis in Mbozi District after the four rounds of Praziquantel Mass Drug Administration.

1.6: RESEARCH QUESTIONS

1. What is the diagnostic performance of haematuria (self-reported, macro and micro haematuria) among school children in a school-based antihelminthic programme in Mbozi District.
2. What is the prevalence of urinary schistosomiasis among school children in a school-based antihelminthic programme in Mbozi District.
3. What is the intensity of urinary schistosomiasis among school children in a school-based antihelminthic programme in Mbozi District.

1.7: OBJECTIVES

1.7.1: General Objective

To assess the performance of screening (indirect diagnostic) methods for urinary schistosomiasis after wide scale use of praziquantel in a school based antihelminthic control programme in Mbozi District.

1.7.2: Specific Objectives

1. To determine the diagnostic performance of self reported haematuria for the diagnosis of urinary schistosomiasis among school children in a school-based antihelminthic programme in Mbozi District.

2. To determine the diagnostic performance of macro haematuria for the diagnosis of urinary schistosomiasis among school children in a school-based antihelminthic programme in Mbozi District.

3. To determine the diagnostic performance of micro haematuria for the diagnosis of urinary schistosomiasis among school children in a school-based antihelminthic programme in Mbozi District.

4. To determine the prevalence of urinary schistosomiasis among school children in a school-based antihelminthic programme in Mbozi District.

5. To determine the intensity of urinary schistosomiasis among school children in a school-based antihelminthic programme in Mbozi District.

CHAPTER TWO: MATERIALS AND METHODS

2.1: Study Area

Mbozi district is one of the eight districts of Mbeya Region, located in the South Western part of the region. It occupies a total area of about 967,900 ha, with the population of 446,339 according to the 2012 Tanzania National Census. To the East it is bordered by Mbeya Rural district at the mark of Songwe river, to the North, it extends to Lake Rukwa where it is bordered by Chunya district where rice cultivation and fishing are done.

It is administratively divided into 6 divisions, 26 wards and 175 villages (Mbozi District Council, 1997).

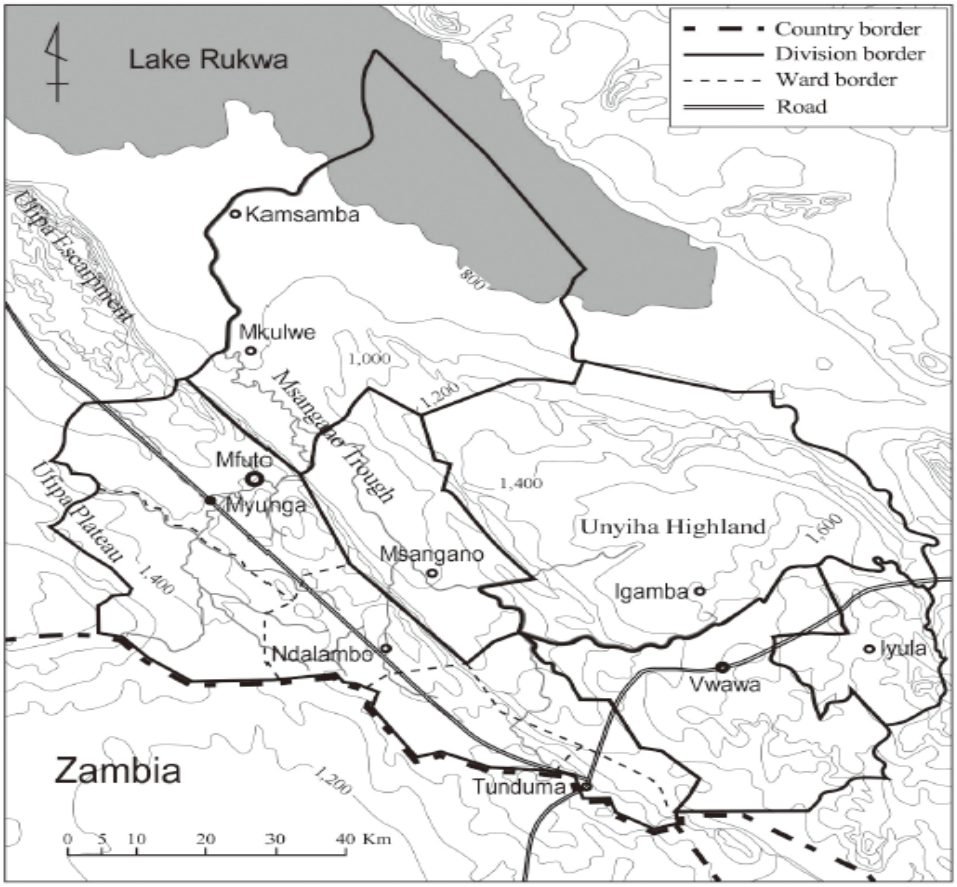


Figure 2: Mbozi Map (Mbozi District Council, 1997).

2.2: Study design

A cross-sectional study was conducted from March to June, 2013. The study was a multi-stage cluster random sampling, at first stage we randomly selected wards, at the second stage we randomly selected primary schools, lastly school age children were randomly selected.

2.3: Study Population

Primary school children attending school at the time of study, but also known to be at high risk (5–15 years) of acquiring *S.haematobium* infections.

2.4: Eligibility criteria

Inclusion criteria

- Children attending standard 1–7, who agreed to participate after being consented

Exclusion criteria

- Newly enrolled children.
- Female school children who were on menstruation

2.5: Variables

Independent variables

- Prevalence of infection
- Intensity of infection
- Screening methods
- Administration of Praziquantel
- Age
- Sex

Dependent variables

- Diagnostic performances of respective screening methods
- Presence of eggs in the urine samples
- Number of eggs per 10mls of urine
- Presence of haematuria
- History of haematuria

2.6: Sample size calculation

Sample size at the required absolute precision level for sensitivity and specificity can be calculated by Buderer's formula (Buderer, 1996).

$$n = \frac{Z^2_{1-\alpha/2} X S X (1-S)}{L^2 X Prevalence}$$

where

S = anticipated sensitivity or specificity

α = size of the critical region ($1 - \alpha$ is the confidence level),

$z_{1-\alpha/2}$ = standard normal deviate corresponding to the specified size of the critical region (α)

L = absolute precision desired on either side (half-width of the confidence interval) of sensitivity or specificity.

Taking Mbozi prevalence = 36% (SCI and MoHSW, 2010), S= 91% as specificity of reagent strips in a study done in Kilosa, Tanzania (Lengeler et al., 2002).

L = 0.05

$z_{1-\alpha/2}$ = 1.96

n = **260** x 1.5 (design effect) = **390**

Adding **10%** non response rate, drop out and missing data; total sample size was **429**

2.7: Sampling technique

Multistage Random Sampling was done in three stages, firstly, purposively selecting three (3) endemic wards to *S. haematobium* infection, these were; Chitete, Msangano and Kamsamba and randomly selecting 3 non endemic wards which were; Vwawa, Igamba and Mlowo. Secondly, from the available list of schools in these wards, Simple Random Sampling technique was used to select two schools from each ward and finally using the list of all standard I-VII school children in respective schools obtained from the attendance register, random sampling was then used to select the study participants whereby, pieces of paper written 'IN' and others blank were put in a box and all

students were allowed to pick one piece of paper and the remained pieces of paper were for those who were absent at the time of selection. The study took only those students who picked the "IN" papers in the list up to the size of sample required for the school, for those who were absent were followed next day. 429 participants were selected by using proportional allocation to the number of students in each school, whereby the number of participants to be enrolled in this study were as follows; From Kamsamba ward, **91** school children were included, 61 from Kamsamba and 30 from Usoche Primary School. From Msangano ward, **69** school children were included, 27 from Ntinga and 42 from Ipata Primary School. From Chitete ward, **53** school children were included, 17 from Chindi and 36 from Makamba Primary School. From Vwawa ward, **64** school children were included, 36 from Old Vwawa and 28 from Bondeni Primary School. From Igamba ward, **94** school children were included, 58 from Ifungo and 36 from Namigongo Primary School. From Mlowo ward, **58** school children were included, 28 from Mkonko and 30 from Mlowo Primary School. Simple random sampling was then used to select the study participants as explained above. Among 429 participants recruited, 10 of them did not bring back the urine sample despite being convinced by their teachers and the Principal investigator these were from, Kamsamba School, 5 participant; Ifungo School, 4 participants and Mlowo School 1 participant, so the total participants included in the analysis was 419.

2.8: Data collection procedure

2.8.1: Recruitment of research assistants

Two lab technicians (one male and one female) were recruited and oriented for data collection, logistic arrangements were also made. Information collected by the research assistants was validated by the researcher in the field by checking randomly sampled questionnaire.

2.8.2: Instruments of data collection

Selected participants from each school were assembled in a prepared classroom where interviewed structured questionnaire was used to for quantitative information collection. The questionnaire was composed of the socio demographic features in one part, then assessment of self reported haematuria, dysuria, frequency of micturition and status of Praziquantel administration on the other part.

Special forms (*Annex V*) were used to fill information obtained from macroscopic and microscopic urine assessment. 50mls clean, dry, wide mouthed and well caped labeled plastic containers with respective identification number from the questionnaire were used to collect urine samples.

2.8.3: Pretesting of research instruments

The study questionnaire was pre tested to 20 primary school children from Mlomba Primary school (randomly selected) to check for wording, flow and understandability; (to avoid bias this school was not included in the selected schools to participate in study). Pretesting helped to make amendments of some of the questions and also to re-state the instructions for urine collection and the refined questionnaires was used for final data collection. The questionnaire had 7 questions, developed in English and then translated to Swahili. Questions were of close ended questions (*Appendix III & IV*)

2.8.4: Data collection methods

Each school was visited first to explain the details of the study to the head teacher and teachers, and to seek consent. On a second visit to each of the twelve schools selected, all children present were interviewed individually by the researcher and the assistants.

Questionnaire

With the help of respective class teachers, recruited school children were assembled to a classroom where the interview was taking place so as to obtain social-demographic information which involve age and sex, and also assessment of participants' history regarding currently passing blood in urine, their history of painful micturition (dysuria),

their frequencies of micturition and also their status of Praziquantel administration by using interviewed questionnaires was done.

After the interview was completed, the urine collection containers were labeled by writing the numbers corresponding to the questionnaire numbers by using a permanent marker pen.

Urine samples collection and processing.

After having been carefully instructed on how to collect about 20ml of clean-catch, midstream urine samples, 50mls clean, dry wide mouthed and well caped labeled plastic containers were distributed to the participants for urine sample collection. Samples were collected between 10:00hrs and 14:00hrs the optimum time for optimum egg passage (WHO, 1993). Two milliliters of 10% formaldehyde was added to each sample to prevent bacteria growth and eggs hatching.

Visual examination of urine

Screening of the collected urine samples was done on the site, whereby specimens were first screened visually for visible blood (macro haematuria) and the results were recorded by using the colour code of which 1 stand for Light yellow colour, 2 - Light yellow but turbid, 3 – Brown colour and 4 –Bloody urine.

Examination of Urine for Microhaematuria

A chemical reagent strip (Urine 10 parameters, Neotest Multistix, United Kingdom) was carefully dipped into the container containing urine for 5 seconds so as to test for occult blood. The resulting change in colour of the strip was compared with the colour chart in a container of strips to estimate the amount of blood in the urine, and the results were recorded as negative, +, ++ or +++ as per manufacturer recommendations.

Examination for *Schistosoma haematobium* egg

After being screened, the collected urine samples were transferred to Mbozi District Hospital Laboratory, where urine samples were examined parasitologically by urine filtration technique as a reference test/gold standard test for *S. haematobium* egg presence and count.

The procedure for filtration technique was as follows, by using blunt ended (untoothed) forceps, a polycarbonate filter was placed on the support of the filter holder, and then the filter holder was reassembled and attached to the end of a10mls syringe. The plunger was removed from the syringe, which was then filled to the 10ml mark with well mixed urine specimen. If the collected urine specimen was less than 10ml then the syringe was filled to the 5ml mark. The plunger was replaced and pressed to push the urine through the filter into a beaker. The filter holder was opened and by using blunt forceps the filter was removed and transferred to a clean microscope glass slide. A drop of Lugol's iodine was added followed by microscopic cover glass. This was mounted under the microscope and examined at 40X objective to identify *S. haematobium* egg which is characterized with a terminal spine.

Intensity was established for all positive specimens, whereby egg count was done on entire filter membrane under ×40 magnification and we recorded the results as number of eggs per 10mls of urine.

2.9: Management of Cases

In collaboration with district health office and Neglected Tropical Diseases Coordinator of Mbozi District, all 33 children who were positive for *S. haematobium* infection after being confirmed microscopically were given PZQ.

2.10: Data Entry and Analysis

Collected data was edited during and after collection then entered using SPSS 16.0 software. Data cleaning was done manually for checking reasonableness before making computations. Univariate data analysis was used to describe frequencies and proportions of independent and dependent variables. Bivariate analysis using correlation

coefficients, chi square tests and T- tests were used to compare social demographics; age, sex, class level and status of praziquantel administration with history of haematuria, visual haematuria, prevalence of infection and egg count. Also bivariate analysis using chi square tests was used to check out if there was existing relationship among the diagnostic tests. Finally linear regression analysis was done to determine predictors for infection intensity, and binary logistic regression was done to reveal the predictors for prevalence of urinary schistosomiasis. For all tests, statistical significance was achieved at 95% confidence interval.

2.11: Ethical consideration

The study protocol was approved by the Research and Publication Committee of Muhimbili University of Health and Allied Science (MUHAS). The permission to conduct the study at the study area was obtained from the District Executive Director through District Education Officer and District Medical Officer of Mbozi District.

Through teachers, informed consent was obtained from school children prior to conducting the study, also confidentiality was assured through anonymity i.e. no names but only code numbers were used instead, answers to questionnaires including results for urine specimens were handled carefully to restrict unauthorized access.

Laboratory results were communicated between the infected pupil and his/her parent or guardian through their teachers. Those who were found infected (egg positive) were treated accordingly.

2.12: Study Limitation

- ✓ Many participants especially females in standard six and seven were feeling shy to give out urine samples in fear that they were being laughed by their fellows. Hence, they returned the container with no sample, extra effort from the researcher and their teachers was used to convince them to bring back the urine samples and majority of them submitted although some refused completely.
- ✓ Cooperation from school head teachers was not equally satisfying. Uncooperative response from some of the head teachers and teachers was faced as they asked for reimbursement for their time, which the researcher could not meet. Extra explanations were needed to win teachers' support.
- ✓ Use of a single urine specimen to assess infection status could have underestimated *S. haematobium* prevalence rate. This was because of financial and time constraints but more than one sample could be taken to confirm the results.

CHAPTER THREE: RESULTS

Introduction

A total of 429 pupils were initially enrolled, interviewed and then instructed to collect and submit urine samples using 50mls clean, dry wide mouthed and well caped labeled plastic containers. Out 429 pupils, 10 participants did not submit their urine samples despite being convinced by the researcher and their teachers, these were from Kamsamba School; 5 participants, Ifungo School; 4 participants and Mlowo School; 1 participant, therefore these were not involved in data analysis making a total of 419 pupils who were involved in data analysis

3.1: Social Demographic Characteristics

Of the 419 pupils who submitted their urine samples, majority were males 248 (59.2%). The sex ratio of males to female ranged from 1.1 to 2.2 with the mean age of 10.4 (SD ± 2.6) ranging from 5 – 16 years. Most of the participants 189 (45.1%) for both sexes were aged between 9-12 years. There was no significant difference between the average age of males (M= 10.6, SD = 2.5) and females (M = 10.2, SD = 2.6), t=1.399, P = 0.163. **(Table 1)** Six wards and twelve primary schools were selected to participate in data collection, and, it was observed that, most of the participants came from Igamba ward 90 (21.5%), and Chitete ward had the least number of participants 53 (12.6%), and from all schools many pupils were from standard five 64 (15.3%), **(Table 2).**

Table 1: Distribution of the study participants by age and sex (N = 419)

Age group (Years)	Males		Females		Total	
	Number	Percent (%)	Number	Percent (%)	Number	Percent (%)
5 - 8	64	15.3	52	12.4	116	27.7
9 - 12	113	27.0	76	18.1	189	**45.1**
13 - 16	71	16.9	43	10.3	114	27.2
Total	**248**	**59.2**	**171**	**40.8**	**419**	**100**

Table 2: Distribution of study participants by their wards and classes (N = 419)

Ward	No. participants involved	Percentages (%)
Kamsamba	86	(20.5%)
Msangano	69	(16.5%)
Chitete	53	(**12.6%)**
Vwawa	64	(15.3%)
Igamba	90	(**21.5%**)
Mlowo	57	(13.6)
Class	**No. participants involved**	**Percentages (%)**
I.	57	(13.6%)
II.	58	(13.8%)
III.	60	(14.3%)
IV.	62	(14.8%)
V.	64	(**15.3%)**
VI.	61	(14.6%)
VII.	57	(13.6%)

3.2: Praziquantel Mass Drug Administration

It is shown that out of 419 participants, 293 (69.9%) had taken PZQ once, twice or thrice and 126 (30.1%) had never taken. Among 293 participants who had taken PZQ, 192 (65.5%) had taken once, 85 (29.0%) twice, 16 (5.5%) had taken three rounds of PMDA. None of the participants had taken all four rounds of PMDA. Regarding PMDA within different wards, it has been shown that, the PMDA coverage was higher in Chitete ward (83.0%) but lower in Igamba ward (53.3%) and the difference of PMDA coverage between wards was statistically significant ($X^2 = 35.6$, $P = .001$) (Figure 3)

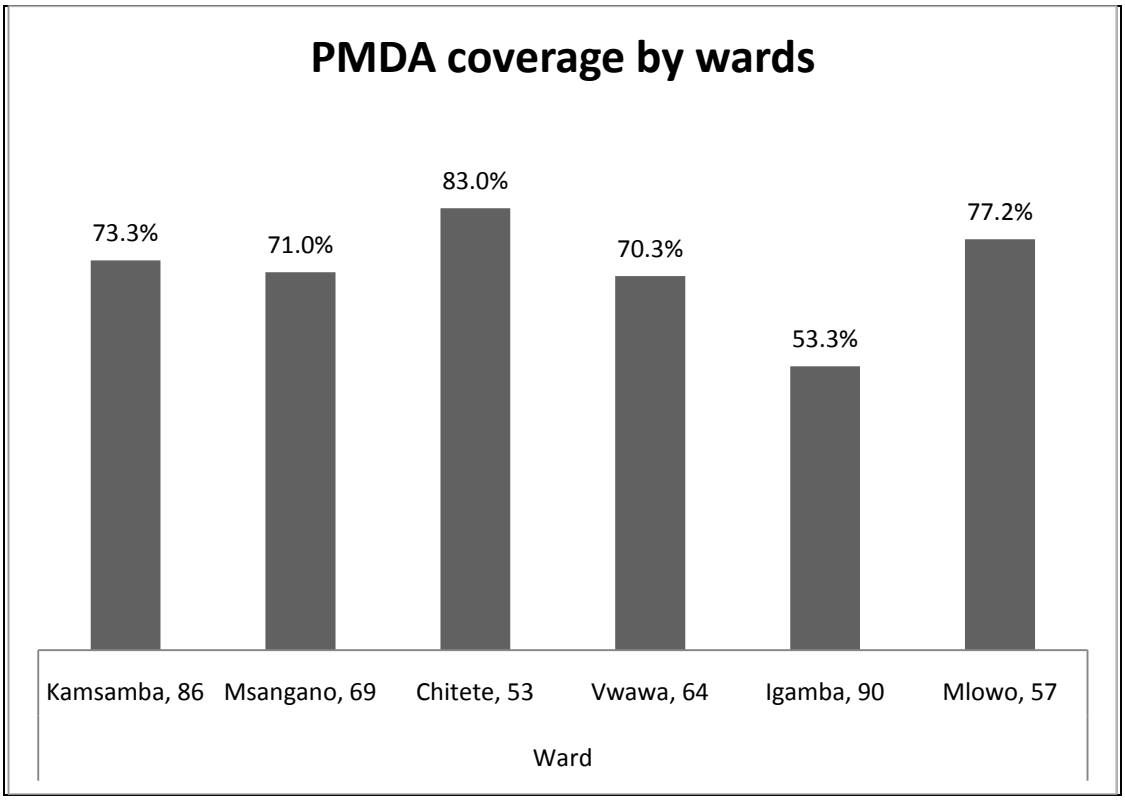


Figure 3: Praziquantel Mass Drug Administration coverage by Wards

3.3: Self reported haematuria

3.3.1 Diagnostic Performance of self reported haematuria

Using urine microscopic examination as a gold standard, the sensitivity and specificity of self reported haematuria was 51.5% and 91.7% respectively. The negative predictive value (NPV) was 95.7% while positive predictive (PPV) value was 34.7%. **(Table 3).**

Table 3: Diagnostic Performance of self reported haematuria

		Microscopy			Performance
		+ve	-ve	**Total**	Sensitivity = 17/33 = **51.5%**
Self reported Haematuria	+ve	17	32	49	Specificity = 354/386 = **91.7%**
	-ve	16	354	370	PPV = 17/49 = **34.7%**
Total		33	386	419	NPV = 354/370 = **95.7%**

3.3: Prevalence of self reported haematuria

Few pupils, 49 (11.7%) reported to have haematuria whereby majority of those who had reported to have haematuria, 31 (63.3%) experienced terminal haematuria while 18 (36.7%) experienced total haematuria. Among 248 male subjects interviewed 30 (12.1%) were positive for haematuria. Of 171 females, 19 (11.1%) were positive. In total 49 (11.7%) were positive for haematuria.

It was also observed that, males also reported more cases of blood in urine than females but the difference was not statistically significant (X^2 = 1.095, df = 3, P = 0.758), also, participants aged 9 – 12 years report blood in urine more frequently than other groups though the difference was not statistically significant (X^2= 1.478, df = 2, P = 0.478), likewise, those who had taken PZQ once, twice or thrice reported few cases of blood in urine compared to those who did not take PZQ at all, but the difference was not statistically significant (X^2 = 3.994, df = 1, P = 0.262) **(Table 4).**

Table 4: Prevalence of self reported haematuria among participants by sex and age

Age Groups	Number of Participants		Number of Positives		Prevalence (%)	
	Male	Female	Male	Female	Male	Female
5-8	64	52	6	5	9.4	9.6
9-12	113	76	18	8	15.9	10.5
13-16	71	43	6	6	8.5	14.0
Total	**248**	**171**	**30**	**19**	**12.1**	**11.1**
Cumulative total	**419**		**49**		**11.7**	

3.4: Visual examination of urine

3.4.1: Performance of Visual examination of urine

With microscopic examination of urine regarded as a gold standard, the sensitivity and specificity of visual examination was 42.4% and 89.6% respectively. The negative predictive value (NPV) was 94.8% while positive predictive (PPV) value was 25.0% **(Table 5)**

Table 5: Diagnostic Performance of Visual examination of urine

		Microscopy			Performance
		+ve	-ve	**Total**	Sensitivity = 14/33 = **42.4%**
Visual examination	+ve	14	40	54	Specificity = 346/386 = **89.6%**
	-ve	19	346	365	PPV = 14/54 = **25.0%**
Total		33	386	419	NPV = 346/365 = **94.8%**

3.4.2: Prevalence of visible haematuria

Visually, 54 (12.9%) participants had blood seen in their urine samples (bloody urine), others had light yellow clear urine 199 (47.5%), Light yellow but turbid urine 102 (24.3%) and Brown colored urine 64 (15.3%).

Dichotomization was done, those with bloody urine, 54 (12.9%) were regarded as positive for visual urine examination and the rest 365(87.1%) were regarded negative. When compared to self reported haematuria, a significant relationship was observed (X^2=50.6, N=419, P<.001) that those who reported more frequently blood seen in urine were positive for visual examination of urine **(Table 6).**

Table 6: Prevalence of visible haematuria among participants by sex and age

Age Groups	Number of Participants		Number of Positives		Prevalence (%)	
	Male	Female	Male	Female	Male	Female
5-8	64	52	1	2	1.6	3.8
9-12	113	76	18	9	15.9	11.8
13-16	71	43	17	7	23.9	16.3
Total	**248**	**171**	**36**	**18**	**14.5**	**10.5**
Cumulative total	**419**		**54**		**12.9**	

3.5: Chemical Reagent Strips for microhaematuria

3.5.1: Diagnostic Performance of Chemical Reagent Strips

The performance of chemical reagent strips when using urine microscopic examination as a gold standard was as follows, sensitivity and specificity of chemical reagent strips for haematuria was 78.8%and 80.1% respectively. The negative predictive value (NPV) was 97.8% while positive predictive (PPV) value was 25.2% (**Table 7)**.

Table 7: Diagnostic Performance of Chemical Reagent Strips

		Microscopy			Performance
		+ve	-ve	**Total**	Sensitivity = 26/33 = **78.8%**
Chemical Reagent Strips	+ve	26	77	103	Specificity = 309/386 = **80.1%**
	-ve	7	309	316	PPV = 26/103 = **25.2%**
Total		33	386	419	NPV = 309/316 =**97.8 %**

3.5.2: Prevalence of microhaematuria

Categories were made with respect to colour change in the chemical reagent strips after being dipped in the urine samples. 316 (75.4%) were reagent strip negative and the rest with numbers and percentages had "+" haematuria- 72(17.2%), "++" haematuria- 24 (5.7%) and "+++" haematuria- 7(1.7%)

Dichotomization was done in such a way that all those with either, "+", or "++" or "+++" haematuria, 103 (24.6%) were regarded as positive for chemical reagent strips for haematuria and 316 (75.4%) were negative.

The prevalence of microhaematuria by age showed that a total of 103 (24.6%) children tested positive for microhaematuria in their urine of which those of age between 9 – 12 years old, 47 (45.6%) had the highest prevalence of infection. However, difference between microhaematuria and age was not statistically associated ($X^2 = 3.124$, df = 2, P =0.210). Boys 67 (25.8%) had more of microhaematuria than girls 36 (21.1%) but there was no significant difference in the occurrence of microhaematuria between the sexes ($X^2 = 1.942$, df = 1, P = 0.164).

A statistically significant association was observed when chemical reagent strip was compared with self reported haematuria (X^2 = 17.8, df = 1, P <.001) as well as with visual haematuria (X^2 = 44.6, df = 3, P < .001) **(Table 8)**.

Table 8: Prevalence of microhaematuria among participants by sex and age

Age Groups	Number of Participants		Number of Positives		Prevalence (%)	
	Male	Female	Male	Female	Male	Female
5-8	64	52	19	15	29.7	28.8
9-12	113	76	31	16	27.4	21.1
13-16	71	43	17	5	23.9	11.6
Total	**248**	**171**	**67**	**36**	**27.0**	**21.1**
Cumulative total	**419**		**103**		**24.6**	

3.6: Summary of diagnostic performances of all the screening methods

The table below shows the diagnostic performance of all the screening methods as compared to the microscopic examination (filtration technique) as the gold standard. Chemical reagent strips was the most sensitive (78.8%) with high NPV (97.8%) compared to all other screening tests but, it was less specific of all (80.1%). Visual examination of urine was less sensitive (42.4%) and had low PPV (25.0%) while, history of haematuria (self reported haematuria) was the most specific with the highest PPV (91.7%) and (34.7%) respectively. The prevalence of self reported haematuria, macrohaematuria and microhaematuria among participants was 11.7%, 12.9%, and 24.6% respectively and the prevalence of urinary schistosomiasis in Mbozi district was 7.9% (**Table 9).**

Table 9: Summary of diagnostic performances of all the screening methods

Diagnostic test	Sensitivity %	Specificity %	Positive predictive value %	Negative predictive value %
History of haematuria	51.9	91.7	34.7	95.7
Visual examination	42.4	89.6	25.0	94.8
Reagent strips for haematuria	78.8	80.1	25.5	97.8
Microscopic examination	100	100	100	100

3.7: Prevalence of Urinary Schistosomiasis

All urine samples were filtrated after being screened for self reported haematuria, visible haematuria and microhaematuria by chemical reagent strip, then microscopic examination under X 40 objective was done. Out of 419, a total of 33 (7.9%) participants tested positive for *S. haematobium* infection (**Table 10**).

Table 10: Prevalence of urinary schistosomiasis among participants by sex and age

	Number of Participants		Number of Positives		Prevalence (%)	
Age Groups	Male	Female	Male	Female	Male	Female
5-8	64	52	2	2	3.1	3.8
9-12	113	76	15	4	13.3	5.3
13-16	71	43	9	1	12.7	2.3
Total	**248**	**171**	**26**	**7**	**10.5**	**4.1**
Cumulative total	**419**		**33**		**7.9**	

The prevalence of urinary schistosomiasis increased with increase in age with the highest prevalence occur among participants aged between 9 – 12 years, but, the difference was not statistically significant (X^2 = 4.5, df = 2, P = 0.107). Males were more infected than the females in (10.5% vs 4.1%) and the difference was statistically significant (X^2 = 5.6, df = 1, P= 0.017). Using binary logistic regression, holding other factors fixed, males were 66.0% more likely to be infected when compared to females (P = 0.05).

Likewise there was a significant relationship between prevalence of infection and self reported haematuria (X^2 = 55, df = 1, P = <.001), also with visual examination of urine (X^2 = 27.8, df = 1, P = <.001), and with chemical reagent strips (X^2 = 56.7, df = 1, P = <.001) and lastly with the status of Praziquantel (X^2 = 14.7, df = 3, P = <.006)

The prevalence of *S. haematobium* infection was higher in Kamsamba ward (12.8%) and Vwawa had the lowest prevalence of infection (0.0%) compared to all other remained wards. However, there was no significant difference in prevalence of *S. haematobium* infection between the wards (X^2 = 9.375, df = 5, P = 0.095)

3.8: Intensity of Infection

Intensity of infection was measured by counting number of eggs/ 10ml of urine. Intensity ranged from 1 to 2500, with median egg count of 30 eggs. Categorizing infection intensity as; light infection 1 - 49eggs/ 10 ml urine, moderate infection 50 – 499eggs/ 10 ml urine, heavy infection ≥500 eggs/ 10 ml urine (Ugbomoiko et al., 2010).

Out of 33 participants who were diagnosed to have Urinary Schistosomiasis, majority 19 (57.6%) had light infection, where males were 16 (84.2%) and 3 females (15.8%), also 11 (33.3%) had moderate infection where males were 8 (72.7%) and 3 females (27.3%) lastly 3 (9.1%) had heavy infection where 2 of them were males (66.7%) and 1 female (33.3%).

The intensity of infection was four times higher among males (M= 8.0, SD = 24) than females (M = 2, SD = 12), and the difference was statistically significant. (t (331.4) = 3.12, P = .002). This is keeping with the fact that prevalence of heavy infection was higher among the males 66.7% than the females 33.3%.

A positive correlation was observed when comparison between intensity of infection with classes and ages of participants was done. It was shown that, the intensity of infection increase as the age of the participants increase (r = .198, P =. 134). Prevalence of heavy infection was particularly higher in the age between 13 – 16 years and light intensity was more in 9 – 12 years of age. This findings also keep with fact that, as the classes of the participants ascend also the infection intensity increase (r = 1, P =. 041), **(Table 11)**

Table 11: Intensity of S. haematobium infection by age and sex

Age groups	Male				Female			
	Infection Intensity				Infection Intensity			
	Light	Mild	Heavy	**Total**	Light	Mild	Heavy	**Total**
5 - 8 yrs	1(50.0%)	1(50.0%)	0(.0%)	**2**	1(50.0%)	1(50.0%)	0(.0%)	**2**
9 - 12 yrs	11(73.3%)	3(20.0%)	1(6.7%)	**15**	2(50.0%)	2(50.0%)	0(.0%)	**4**
13 - 16 yrs	4(44.4%)	4(44.4%)	1(11.1%)	**9**	0(.0%)	0(.0%)	1(100.0%)	**1**
Total	**16**(84.2%)	**8**(72.7%)	**2**(66.7%)	**26**	**3**(15.8%)	**3**(27.3%)	**1**(33.3%)	**7**

Also, intensity of infection negatively correlated with status of PZQ administration whereby, those who had taken PZQ once, twice or thrice had few number of eggs/ 10 ml

urine compared to those who did not take PZQ since it was revealed that the prevalence of heavy infection was higher among those who did not take praziquantel and the difference was statistically significant (r= - .089, P= .034). Linear regression showed that, an additional PMDA round could decrease intensity by 24eggs (P=0.01) holding other factors; sex, class and age fixed.

Among the six wards included in the study, Igamba ward had the highest prevalence of heavy infection (66.7%), Kamsamba and Msangano ward also had the highest prevalence of light infection (26.3 % each).

CHAPTER FOUR: DISCUSSION

Introduction

Current estimates of the prevalence of schistosomiasis depend on the use of well-established diagnostic tests. Appropriate diagnosis of schistosomiasis becomes increasingly important since mass treatment (PMDA) might only remain cost effective through the use of appropriate diagnostic tools to only target further drug treatment to those groups of people actually infected (Koukounari et al., 2009).

4:1 Diagnostic Performance of self reported haematuria

Blood in urine is a common symptom of urinary schistosomiasis (Aboagye and Edoh, 2009) and in highly endemic areas, blood in urine is therefore a good indicator of *S. haematobium* infection (Kapito-Tembo et al., 2009). (WHO, 2008) estimated that if 30% of children are found to be positive using the questionnaire technique, approximately 50% of the community are infected.

In this study self reported haematuria had low sensitivity of 51.5% , comparable to a study done in Ghana, 53% (Bogoch et al., 2012). But it is contrary to (Lengeler et al., 2002) findings in Kilosa, Kilombero and Magu where sensitivities of self reported haematuria were 90%, 100% and 89% respectively. Also lower compared to findings from Dar es salaam where sensitivity of self reported haematuria was 60.4% (Ndyomugyenyi and Minjas, 2001)

Specificity of self reported haematuria was 91.7%, comparable to findings from Kilosa 91% (Lengeler et al., 2002) but higher when compared with a study done in Ghana, 85% (Bogoch et al., 2012), Kilombero 82% and Magu 80% (Lengeler et al., 2002), Dar es salaam 72.7% (Ndyomugyenyi and Minjas, 2001)

The negative predictive value (NPV) was 95.7%, relatively comparable to Kilosa findings 93% (Lengeler et al., 2002) but lower when compared to Kilombero findings 100% (Lengeler et al., 2002) and higher than Magu findings 75% (Lengeler et al., 2002) and Dar es salaam 67% (Ndyomugyenyi and Minjas, 2001)

This study observed a low Positive predictive (PPV) value of 34.7% for self reported haematuria. This is relatively higher when compared to study done in Kilombero (31%) but absolutely lower when compared to Magu and Kilosa findings where PPVs were 92% and 88% respectively (Lengeler et al., 2002) and in Dar es salaam 67% (Ndyomugyenyi and Minjas, 2001)

In this study, it is shown that, males reported more cases of blood in urine than females but the difference was not statistically significant ($P > 0.05$). A similar trend was observed in Magu district, Tanzania by (Guyatt et al., 1999). Also, participants aged 9 – 12 years report blood in urine more frequently than other groups though the difference was not statistically significant.

A significant association between self reported haematuria with other tests like visual examination of urine, chemical reagent strips and microscopic examination of urine was observed in this study ($P < .05$). Similar findings was also obtained in a study done in Ghana (Bogoch et al., 2012) also in a study done in Kilombero, Tanzania, where comparison between questionnaires and the parasitological findings was made and data showed strong correlation between the two diagnostic measures (Lengeler et al., 2002).

It should be kept in mind that questionnaires alone can miss a significant proportion of infected children, especially those with light infections, therefore causing difficulty towards morbidity control programmes (Lengeler et al., 2002).

4.2: Diagnostic Performance of Visual examination of urine

Among the three screening methods used in this study, visual examination of urine was the least sensitive (42.4%) , similar to what was found in Nigeria where sensitivity of visual examination was 38% while for reagent strip test was 69.0% and self reported haematuria 44% respectively (Mafe, 1997). Contrary, a study done in Ghana and Zambia, visual inspection of the urine specimens (appearance and colour) was shown to be a highly specific and sensitive indicator of infection (Morr, et al., 1985).

The low value of sensitivity of visual examination of urine might have been due to faulty technique in the collection of urine by the students, they didn’t strictly follow

instructions with regards to collection of terminal stream of urine which is expected to contain blood. This may not support visual method to be operationally effective among the school children but also it can be due to the difficulty in interpreting colour of urine to determine if it contains blood or not which to a certain extent is subjective, hence many false positives.

Visual examination of urine had the lowest PPV of 25.0%. But it had high specificity of 89.6% and high NPV of 94.8%, similar to the findings from Pemba (Lwambo et al. 1997).

Positive correlation between visual haematuria with intensity of infection was shown in this study. Similar findings was also obtained to a study done by (Werf and Vlas, 2004; Houmsou et al., 2011 and Hassan et al., 2012)

Visual examination of urine is still an effective method for initial screening as it is easier to use and it is less prone to recall bias when compared with history of self reported haematuria

4.3: Diagnostic Performance of Chemical reagent strips.

Compared with other diagnostic tests, it has been shown in this study that chemical reagent strips had the highest sensitivity of 78.8%, similar to a studies done in Pemba Island 98% (Lwambo et al. 1997), Ghana 100% (Bogoch et al., 2012), Ethiopia 80% (Birrie et al., 1995), Nigeria 68.3% (Fatiregun et al., 2005), Zanzibar 86% (French et al., 2007) and Dar es Salaam, 84.3% (Ndyomugyenyi and Minjas, 2001). This is contrary to a study done in Nigeria where the sensitivity of microhaematuria was relatively low although in patients with a heavy infection the sensitivity of microhaematuria was high (Ugbomoiko et al., 2009).

This method had the lowest specificity (80.1%) and one of the lowest positive predictive values (25.2%) of all the screening tests keeping with findings from Pemba Islands (Lwambo et al. 1997). Different findings were observed in Ethiopia, 96% (Birrie et al., 1995) and Ghana, 93% (Bogoch et al., 2012), Zanzibar, 99% (French et al., 2007) and in

Dar es Salaam, 77% (Ndyomugyenyi and Minjas, 2001) where reagent strips showed high specificity.

In this study, the highest prevalence of microhaematuria was observed in the age group of 9 – 12 years also higher to males than females, however, the difference between microhaematuria with age and sex was not significantly associated ($P > 0.05$). Similar observation was reported in Nigeria, by Ekpo et al., (2010) whereby subjects with blood urine had high risk of infection of 4.55 (2.82, 7.36); $P < 0.001$ when compared with those without blood in urine.

Keeping with findings from this study, studies in Kenya and Zimbabwe showed that haematuria to be positively correlated with urinary egg counts (Kiliku et al., 1991, Murare and Taylor, 1987).

Preliminary studies on the use of reagent strips to screen and diagnose previously infected individuals after treatment has been proven to be highly sensitive and specific more appropriate to use in many endemic areas of the world (Stephenson et al., 1984; Ugbomoiko et al., 2009). Also reagent strip findings have been shown to correlate with infection intensities (Feldmeier et al., 1982; Jemaneh et al., 1994), and therefore useful at targeting relevant intervention at an individual level (Lwambo et al., 1997).

4.4: Prevalence of Urinary Schistosomiasis

The prevalence of urinary schistosomiasis in Mbozi District observed in this study was 7.9% which is low when compared to 36% which was reported in 2010 (SCI and MoHSW, 2010). This may be explained by the four PMDA rounds which have been executed in Mbozi district since 2009 to July, 2012. This is low prevalence according to the WHO classification whereby prevalence rates below 25% are seen to be low (WHO, 1993).

Reduction of prevalence of urinary schistosomiasis following PMDA had also been observed in Central Sudan by (Ahmed et al., 2012) where a single dose of PZQ significantly reduced the prevalence of *S. haematobium* infection by 83.3% (from 51.4% to 8.6%) and in Burkina Faso (Touré et al., 2008) where just a single round of PZQ

reduced prevalence of urinary schistosomiasis by 87% (from 59.6% to 7.7%). The same observation was also seen in Mali, where there was a significant reduction of *S. haematobium* infection by 30% (from 73.1% to 61.7%) (Landouré et al., 2012).

The prevalence of urinary schistosomiasis was higher in males 10.5% compared to females 4.1% and the difference was statistically significant ($P < 0.05$). This is comparable to a study done in Nigeria (Ogbonna et al., 2012) in Dar es Salaam, Tanzania (Ndyomugyenyi and Minjas, 2001), and in Cote d'Ivoire (Stete et al., 2012). Contrary (Ndamukong et al., 2001) in Cameroun found that prevalence rate did not vary significantly with sex.

This high prevalence of infection to males than females is presumably due to higher water contact activities by male participants particularly in the swamp-rice farming and fishing areas where they might be engaging themselves with the aforementioned economic activities. Also, age group most affected was from 9-12 years with the prevalence of 13.1%.

4.5: Intensity of infection

There was positive correlation between intensity of infection and age ($r = .198$) and class level ($r = 1$), and infection intensity varied significantly between male and female participants. Likewise, (Ndyomugyenyi and Minjas, 2001) in Dar es Salaam and (Chigozie et al., 2007) in Nigeria found that males participants had higher intensities of infection. But a study done in Cameroun and Nigeria found that intensity of infection did not vary significantly ($p > 0.05$) with sex, class or age of the participants (Ndamukong et al., 2001, Ekpo et al., 2010)

In this study, it was observed that the percentage of participants with heavy infection (≥ 500eggs/10ml of urine) was considerably lower 9.1% than those with light infection (1 – 49eggs/10ml of urine) 57.6%, this is comparable to a study done in Nigeria by (Chigozie et al., 2007). The prevalence of heavy infection was higher in the age between 13 – 16 years (66.7%) and light intensity was more in 9 – 12 years of age (68.4%), contrary to findings in Cameroun where the age group most heavily infested was that of 9-11 years (36.40%) and less affected than 6-8 years (14.70%) (Saotoing et al., 2011).

It was shown in this study that infection intensity to be negatively correlated with PMDA status, (r= - .089). Similar finding were observed among school children in Central Sudan (Ahmed et al., 2012b) as well as in south Côte d'Ivoire (Stete et al., 2012) where cure and egg reduction were associated with PMDA post treatment.

Among the six wards included in the study, Igamba ward had the highest prevalence of heavy infection (66.7%), Kamsamba and Msangano ward also had the highest prevalence of light infection (26.3 % each), the difference of infection intensity can presumably be due to the presence or absence of risk factors for acquisition of urinary schistosomiasis, these are behavioral activities like fishing, fetching of water, swimming, washing, also the coverage of the PZQ Mass Drug Administration may bring about the difference of infection intensity among the wards.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1: CONCLUSION

The performance of the screening methods assessed in this study agreed to a large extent with previous studies observations but their uses however depend on the level of endemicity of the disease in a given area.

Despite low prevalence of urinary schistosomiasis in Mbozi district, chemical reagent strips has been shown to be highly performing test for urinary schistosomiasis screening. Still visual haematuria and a history of haematuria can both be employed for preliminary screening.

Also, despite the observed low Praziquantel Mass Drug Administration coverage of 69.9%, Praziquantel Mass Drug Administration has been shown to have huge impact towards decreasing prevalence of Urinary Schistosomiasis but as well as reducing infection intensities in the infected school children.

5.2: RECOMMENDATION

- ✓ The study suggests that chemical reagent strips should be the recommended method for launching and monitoring mass treatment for *S. haematobium*.
- ✓ Praziquantel is the cornerstone of schistosomiasis control. Further effort should be undertaken to scale up the coverage of PMDA to other schistosomiasis endemic districts all over Tanzania and subsequently impact evaluations should be done in the respective areas.
- ✓ Education on health seeking behavior among school children should be executed through strengthening of school health programs related to schistosomiasis in particular. Otherwise outreach clinics should be implemented.

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APPENDICES:

***Appendix I*: Consent form (English Version)**

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCIES (MUHAS)

DIRECTORATE OF RESEARCH AND PUBLICATIONS

INFORMED CONSENT FORM

ID NO

……

Introduction

Greetings! My name is Happiness Kabululu, a student from MUHAS doing a research with a title; **'Diagnostic performance of screening (indirect diagnostic) methods for urinary schistosomiasis after wide scale use of praziquantel in a school based antihelminthic control programme in Mbozi District'**.

Purpose of this study

This study is intended to assess the diagnostic performance of screening (indirect diagnostic) methods for urinary schistosomiasis after wide scale use of praziquantel in a school based antihelminthic control programme in Mbozi District'. Findings from this study will help me to write a dissertation which is a partial fulfillment of MSc TDC for academic year 2012/2013

Participation

If you agree to participate in this study, you will be required to answer questions and to provide urine

Benefits and Risks

The information you will provide will help us to recognize appropriate diagnostic tests for urinary schistosomiasis in your area, to know the magnitude of the urinary schistosomiasis after four rounds of praziquantel MDA. Those who will be found infected will be treated accordingly

There won't be any harm for those who will voluntarily participate in the study

Confidentiality

Confidentiality will be reassured through anonymity by the use of identification numbers; also only authorized person shall have access to the collected data

Address

If you have any enquire you may contact me by sending a letter with this address: **Happiness Kabululu, MUHAS, P.O BOX 65015 Dar es Salaam**. If you have any question about your rights as a participant please contact **Prof.Mainen J.Moshi,** Chairman of the Science and Publications Committee,P.O.BOX 65001.Dar es Salaam.Tel:2150302-6, 2152489

Agreement part

I therefore request you to participate in this study by feeling the questionnaire and thereafter collecting you urine sample

DO YOU AGREE YES:_____ NO:_____ (Put ✓ for appropriate response)

I _____ have read/listened the contents in this form. I agree to participate in this study

Participant Signature _____ Date

Research Assistant Signature _____ Date

Appendix II: **Informed Consent form, Swahili Version**

CHUO KIKUU CHA SAYANSI ZA TIBA NA AFYA MUHIMBILI

KURUGENZI YA UTAFITI NA MACHAPISHO

FOMU YA RIDHAA

Ridhaa ya kushiriki katika utafiti

Namba ya Fomu

……..

Utambulisho

Habari! Jina langu ni: **Happiness Kabululu**, ni mwanafunzi wa Chuo Kikuu MuhimbiliI nikisomea shahada ya uzamili katika fani ya magonjwa ya ukanda wa joto. Ninafanya utafiti kama sehemu ya masomo yangu kuhusu " **Tathmini ya vipimo vitumikavyo kwa ajili kupima kichocho cha mkojo kwa wanafunzi wa shule za msingi wilayani Mbozi baada ya kupatiwa dawa kwa vipindi vinne"**

Kusudi la utafiti

Utafiti huu unakusudia kufanya tathmini ya vipimo vitumikavyo kwa ajili ya kupima kichocho cha mkojo baada ya kupatiwa dawa kwa vipindi vinne.

Ushiriki

Ukikubali kushiriki katika utafiti huu kwa hiari, utapewa karatasi ya maswali utakayoyajibu pia utapewa kifaa/chombo kwa ajili ya kuweka sampuli ya mkojo.

Faida na hasara

Taarifa zitakazotokana na utafiti huu zitasaidia kunyambua kipimo sahihi kwa ajili ya kichocho cha mkojo, pia kugundua ukubwa wa tatizo hili la kichocho cha mkojo katika wilaya yenu baada ya kupatiwa dawa kwa vipindi vinne. Wote watakaokutwa na tatizo watatibiwa ipasavyo.

Zoezi hili halina tatizo kwa mshiriki.

Usiri

Usiri utazingatiwa kwa kutotumia majina , washiriki watapewa namba, na ni wahusika tu ndio wataweza kuwa na ukaribu na takwimu zitakazokusanywa

Mawasiliano

Endapo utakuwa na swali lolote kuhusu utafiti huu wasiliana nami kwa kutumia anwani ifuatayo ; **Happiness Kabululu, MUHAS, S.L.P 65015 Dar es Salaam**. **Endapo una swali lolote kuhusu haki zako kama mshiriki katika utafiti huu, wasiliana na Mwenyekiti wa Utafiti na Machapisho Prof.Mainen J.Moshi , P.O.BOX 65001.Dar es Salaam.Tel:2150302-6, 2152489**

Kipengele cha Makubaliano

Baada ya maelezo hapo juu, nakuomba sasa ukubali kushiriki katika utafiti wangu, kwa kujibu maswali na kunipatia sampuli ya mkojo.

Je unakubali kushiriki?

NDIYO:_____ HAPANA:_____ (Weka ✓ kwenye sehemu husika)

Mimi _____ nimesoma/nimesomewa na kuyaelewa maelezo yaliyomo katika fomu hii. Ninakubali kushiriki katika utafiti huu

Sahihi ya mshiriki _____ Tarehe

Sahihi ya mtafiti msaidizi _____ Tarehe

***Appendix III*: Structured Questionnaire (English Version)**

Serial No----------

Structured questionnaire for primary school children to evaluate the performance of different diagnostic techniques for urinary schistosomiasis

Part A: Demographic information

Date of Interview _____

Name of school _____

Grade _____

Age _____

Sex _____

Part B: To assess self reported urinary schistosomiasis symptoms

1. Do you currently pass blood in urine?
   i. Yes
   ii. No

2. When does the urine come with blood?
   i. With last few drops of urine?
   ii. From the first to the last drop of urine

3. Do you feel pain during micturition?
   i. Yes
   ii. No
4. How often do you go to urinate per day?
   i. Three times
   ii. Four times
   iii. Many times

5. Did you take PZQ in the last four annual mass drug distributions?
   i. Yes; but only one time

ii. Yes; but only two times

iii. Yes; but only three times

iv. Yes; all four times

v. No, I have never taken

Thank you

***Appendix IV*: Structured Questionnaire (Swahili Version)**

Namba ya dodoso…….

Dodoso kwa wanafunzi wa shule za msingi kutathmini njia za uchunguzi wa kichocho cha mkojo

Sehemu A: Taarifa binafsi

Tarehe ya leo _____

Jina la shule _____

Darasa _____

Umri _____

Jinsia _____

Part B: Kuchunguza taarifa zinazohusiana na dalili za kichocho cha mkojo

1. Je hivi sasa unaona damu wakati wa haja ndogo (mkojo)?
   i. Ndiyo
   ii. Hapana

2. Je wakati gani damu inatoka na mkojo?
   i. Na matone ya mwisho ya mkojo
   ii. Mkojo wote unakuwa na damu

3. Je huwa unasikia maumivu wakati wa kukojoa?
   i. Ndiyo
   ii. Hapana
4. Kwa siku unaweza kukojoa mara ngapi
   i. Mara tatu
   ii. Mara nne
   iii. Mara nyingi

5. Je ulipata dawa za kichocho katika vipindi vinne vilivyopita vya ugawaji wa dawa za kichocho?
   i. Ndiyo, mara moja tu
   ii. Ndiyo, mara mbili tu
   iii. Ndiyo, mara tatu tu
   iv. Ndiyo, mara nne zote
   v. Hapana sijawahi kutumia dawa za kichocho

Ahsante

Appendix V: Special forms for filling Socio demographic data, assessment of macrohaematuria, microhaematuria, and egg count

SCHOOL.....

WARD.....

No	SEX(F/M)	AGE	STD	H B LD IN URIN (Y/N)	TERMINAL/TOTAL (TE/TO)	PAINFULL (Y/N)	MIC TURITION FREQUENCY	PRAZ MDA	URINE ANALYSIS RESULTS				
									VH	MH			No OF EGGS
										BLOOD	PROT	LEUK	

Appendix VI: Introduction Letter

MBOZI DISTRICT COUNCIL.

(All letter should be addressed to the District Medical Officer)

Tel: No. 025 2580286
Fax. No. 025 2580286



District Medical Officer,
Mbozi District Council,
P.O. Box 70,
MBOZI.

Ref.No. DH/M.10/13/160

05/04/2013

District Education Officer,
S.L.P 3
MBOZI.

REF:INTRODUCTION LETTER OF HAPPINESS KABULULU.

The above named is the candidate at Muhimbili University of Health and Allied Sciences doing her Master's Degree on Tropical Diseases Control.

She is doing her Research as part of fulfilment of her dissertation on "***Diagnostic performance of screening methods on urinary schistosomiasis in a school – bases control programe"*** in our District.

Since she is going to do her study to primary school children, I kindly request you to provide her assistance so that she can fulfil her study.

Thank you in Advance

DISTRICT MEDICAL OFFICER
MBOZI.

Dr. Lusubilo Adam
For; District Medical Officer
MBOZI.

Appendix VII: Ethical Clearance

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

Directorate of Postgraduate Studies

P.O. BOX 65001
DAR ES SALAAM
TANZANIA.

Website: http://www.muhas.ac.tz

Tel: +255-(0)22-2150302 Ext 207.
Tel (Direct): +255-(0)22-2151378
Telefax:255-(0)22-2150465
E-mail: *dpgs@muhas.ac.tz*

Ref. No. MU/PGS/SAEC/Vol. VI/

22nd March, 2013

Ms. Happiness Kabululu
MSc. in Tropical Diseases Control
MUHAS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED "DIAGNOSTIC PERFORMANCE OF SCREENING METHODS FOR UIRINARY SCHISTOSOMIASIS IN A SCHOOL-BASED ANTIHELMITHIC PROGRAMME IN MBOZI DISTRICT"

Reference is made to the above heading.

I am pleased to inform you that, the Chairman has on behalf of the Senate approved ethical clearance for the above-mentioned study.

Thus ethical clearance is granted and you may proceed with the planned study.

Please liaise with bursar's office to get your research fund.

Prof. O. Ngassapa
DIRECTOR, POSTGRADUATE STUDIES

/emm

cc Vice Chancellor, MUHAS
cc Deputy Vice Chancellor – ARC, MUHAS
cc Dean, School of Public Health and Social Sciences