

AFRICA UNIVERSITY

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UROGENITAL SCHISTOSOMIASIS IN PRE-SCHOOL CHILDREN IN
MUTOKO DISTRICT

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH IN THE
COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

2021

Abstract

Prevalence of schistosomiasis is high among children in Zimbabwe, but not so much defined among children under five years. Schistosomiasis control efforts over time have included periodic mass treatments in endemic areas for adults and school going children aged 6 years and above. This study explores risk factors associated with schistosomiasis infection among pre-school aged children aged 2 - 6 years. A matched case-control study design was employed. A mixed approach with both quantitative and qualitative approaches components was conducted using a structured questionnaire to conduct in-depth interviews with 62 caregivers of children aged 2 - 6 years who had been screened for schistosomiasis in a clinical trial between October and December 2020. Prevalence was calculated using secondary data from the screening registers which were used in the main clinical trial. The study was conducted in Mutoko District, Mashonaland Central in Zimbabwe. It is one of the areas known to have high prevalence of schistosomiasis. Data were anonymized, captured into Epi-info form and analyzed using Epi-info. Based on the urine filtration and microscopy technique, there was an overall schistosomiasis prevalence of 4.6%, [95% CI (4.22-4.98)], (4.96 % in males and 4.12% in females) among preschool children aged between 2 – 6 years for the period October to December 2020 in Mutoko District. There were equal number of male and female participants with median and modal age being 4 years. Caregiver lack of knowledge about schistosomiasis scientifically proved to be the major risk factor with an odds ratio of 10.9 (1.73-68.54) and p-value; 0.01, among those who showed to lack of any correct information about the disease. Some caregivers concurrently had mixed right and wrong information. The children in this study could have contracted schistosomiasis through the contact with infested water during activities such as gardening (OR: 1.8, p-value 0.5), bathing (OR: 3.2, p-value 0.21) and recreational activities (OR: 4, p-value 0.14). 88.7% of the children were reported to be frequently visiting the open water bodies accompanied by adults or elder siblings (80.6%) and sometimes alone (8.1%) especially the older pre-school aged children. The study revealed that staying near the dams/river was also a risk factor for schistosomiasis infection. There was an odds ratio of 1.4, among children who use dam or river water for bathing compared to 0.12 among those who used water from protected wells. No scientific evidence was observed to link type of sanitary facilities type of toilet and sharing of toilets with schistosomiasis infection. Based on the urine filtration and microscopy technique, there was a moderate prevalence of schistosomiasis infection among pre-school aged children. Pre-school children age 2 - 6 years were at a high risk of exposure to schistosomiasis although it might be lower than in other groups as the latest national survey results indicated prevalence of 22.7% among school going children and adults. There is need for prevention interventions to target children in their early stages of life to control schistosomiasis in this vulnerable population.

Keywords: Schistosomiasis; Bilharzia; Pre-school aged children; Neglected tropical diseases; Water, Sanitation.

Declaration

I declare that this dissertation is my original work except where sources have been cited and acknowledged. The work has never been submitted, nor will it be submitted to another university for the award of any degree.

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Acknowledgements

I would like to sincerely convey acknowledgements to all my colleagues and family members for their unwavering support during this program and action research study. I would also want to exceptionally thank my supervisor, Professor Mharakurwa, for his dedicated time and patience as he mentored me to come up with this piece of work, also not forgetting the Africa University community for its support. May God bless you abundantly.

List of acronyms and abbreviations

CDC	Centre for Disease Control
DALYS	Disability-Adjusted Life Years
MDA	Mass Drug Administration
NTDs	Neglected Tropical Diseases
WASH	Water Sanitation and Hygiene
WHO	World Health Organisation
PSAC	Pre-School Aged Children

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Chapter 1 Introduction

1.1. Introduction

Schistosomiasis is a water-based chronic parasitic disease caused by trematode worms of the genus *Schistosoma*. Considered as a neglected tropical disease by the World Health Organization (WHO), schistosomiasis affects more than 250 million people worldwide with an estimated global burden of 1.4 million disability-adjusted life years (DALYs) in 2017 (Angora et al., 2019). Schistosomiasis remains a public health problem in countries of the tropics and subtropics with approximately 90% of cases concentrated in Africa (Angora et al., 2019). Humans are the definitive host for adult parasites, while specific freshwater snails act as intermediate hosts. Hence, the transmission of schistosomiasis is governed by social-ecological systems, e.g. conditions of poverty and living near open freshwater bodies (Aagaard-Hansen, Mwanga, & Bruun, 2009).

People acquire infection during domestic, occupational, and recreational activities that expose them to water infested with cercariae from the intermediate host, snails (Adenewo, Oyinloye, Ogunyinka, & Kappo, 2015). Various factors such as climate change, proximity to water bodies, irrigation, and the construction of dams (World Health Organization [WHO], 2015), as well as sociodemographic factors, have been implicated in the spread of schistosomiasis in endemic areas (Adenewo et al., 2015). The lack of access to improved sanitation contributes to open urination and defecation, which results in environmental contamination that enhances the transmission of schistosomiasis.

While both *Schistosoma mansoni* (responsible for gastro-intestinal schistosomiasis) and *Schistosoma haematobium* (responsible for urogenital schistosomiasis) are endemic in Zimbabwe, the latter species (*S. haematobium*) is predominantly found in Mutoko District.

Most preventive and control programs such as WASH and chemotherapy are usually targeting school going age groups.

The purpose of this study was to determine the prevalence of schistosomiasis and associated risk factors among pre-school children in Mutoko District where the disease is most prevalent. The results help inform public health authorities of Zimbabwe and Mutoko District to refine control measures and complement preventive chemotherapy with specific information about infection prevalence and intensity, and to enhance education and communication approaches that are readily tailored to specific social-ecological contexts targeting this age group.

1.2. Background to the Study

Schistosomiasis, also called bilharzia, is one of the most important of the neglected tropical diseases caused by parasitic flatworms and remains one of the most prevalent parasitic diseases in Zimbabwe, affecting mainly children below 14 years. In 2014, a prevalence of 22.7% was reported after a national survey of which *Schistosoma haematobium* had alone had a prevalence of 18%, followed by *Schistosoma mansoni* which had 4.7%. The disease is second only to malaria as the most devastating parasitic disease, with significant economic and public health consequences (WHO, 2015).

The schistosomiasis transmission cycle starts when human urine and faeces containing parasite eggs are deposited in fresh water environments and hatched larvae infect the snail hosts. The parasites multiply in snails, releasing another larval stage into water that infects human. Infection is transmitted when people are exposed to infested water bodies

throughout routine agricultural, domestic, occupational, and recreational activities. The larvae evolve into male and female worms inside the human body and these coexist in the blood vessels for years. Female worms release thousands of eggs that are evacuated in human excreta. The cycle is perpetuated when infected people urinate or defecate in freshwater sources. The lack of proper sanitation and hygiene facilities increases the risk of contaminating the water bodies. School-going children and older preschool- age children are exposed to the parasites through swimming and bathing in infested water, and other water activities (Adenewo, Oyinloye, Ogunyinka, & Kappo, 2015). Studies have showed that infants and younger preschool-age children can be exposed by their mothers and caregivers who take them to water sources or use infested water to bathe them. Caregivers have admitted to these exposures in studies in Nigeria (Colley, Bustinduy, Secor, & King, 2014). The disease is estimated to affect more than 240 million individuals worldwide and millions of people including children live at risk.

Due to the overlap in their geographical distributions, schistosomiasis can occur independently or jointly with other helminths infections depending on the nature of risk factors and host related attributes. Risk factors such as access to safe water and sanitary related practices of caregivers and children have been reported to be associated with STH infection. Whilst school aged children (SAC) acquire schistosomiasis by participating in risky water practices, preschool aged children (PSAC) are passively exposed to infection when their parents perform daily water-related chores. PSAC may be exposed to infection within the first 5 years of life and thus contribute to the observed heavy burden of infection in the school-aged children.

In 2013, a roadmap for the elimination of Neglected Tropical Disease (NTDs) or reductions in their impact to low levels, with a global target to treat at least 75% of all school-age children at risk of morbidity from schistosomiasis was therefore instituted by the World Health Organization.

The WHO guided schistosomiasis control efforts are focused on reducing the disease through periodic largescale mass treatments with praziquantel (WHO, Neglected Tropical Diseases, 2020). However, by the year 2016, the WHO estimated that only 36% of the people requiring preventive treatment for schistosomiasis were reached. This leaves a big gap in the control efforts. Other strategies to sustain control and advance towards elimination include behavioural based interventions such health education for behavioural change to prevent water contamination and contact with infested water; interventions to provide safe water, sanitation and hygiene; environmental management and; snail control (WHO, Investing to Overcome the Global Impact of Neglected Tropical Diseases, Third WHO Report on Neglected Tropical Diseases, 2015).

However, pre-school age children, who may be also at high-risk for *Schistosoma* infections, are currently not included in the WHO schistosomiasis control programs.

While the World Health Organization acknowledged that most pre-school aged children (PSAC) are too young to engage in water contact activities, there is a plethora of evidence showing that young pre-scholars are regularly exposed to schistosome infection by their caregivers who take them to fresh water sources or use water from these sources for daily social activities, bathing and recreational activities (Mutsaka-Makuvaza et al., 2019).

In order to address this disparity in prevention and control of schistosomiasis, the researcher sought to find research-based evidence on the prevalence of the disease in pre-school aged children as well as related risk factors. This would assist policy makers, health care providers and program implementers in making informed decision in program planning and implementation.

1.3. Statement of the Problem

Schistosomiasis is one of the most important and prevalent neglected tropical diseases (NTDs) in developing countries, with significant economic and public health consequences. 90% of schistosomiasis infections are from Africa, particularly in rural agricultural and peri-urban areas like Mutoko. In many areas, schistosomiasis infects a large proportion of children under the age of 14 years.

According to the data from the 2012 national census, Mutoko district is mostly a rural community with only 8.4% living in urban setup. The district has a total population of 146 127 while children less than 9 years of age account for 29.9% of the total population which is the largest among all other age groups (Agency, 2012). It is thus within the largest and most significant age category where the pre-school children fall into.

A nationwide cross-sectional survey in Zimbabwe (N. Midzi et al., 2014) revealed that schistosomiasis is prevalent country-wide with prevalence of 22.7% of which *S. haematobium* had a prevalence of 18%. The same survey revealed that Mutoko District is one of the disease burdened areas with a prevalence of 43.5%, only second to Binga.

There is no data available citing the prevalence of schistosomiasis among pre-school children in Mutoko District although there is a plethora of evidence by other researchers that this age group is equally exposed to protozoa through a range of circumstances.

Hence, the study sought to provide scientific evidence to inform policy makers and relevant stakeholders on the possible need to include PSAC in the national schistosomiasis control programs.

1.4. Purpose of the Study

1.4.1. Broad objective

The purpose of this study is to determine the prevalence of schistosomiasis and associated risk factors among pre-school children aged between 2 to 6 years in Mutoko District, Mashonaland East Province.

1.4.2. Specific Objectives

1.4.2.1 To determine association between urinary Schistosomiasis in pre-school children and exposure to recreational activities within an age group of 2-6 years in Mutoko District.

1.4.2.2 To establish predisposing factors associated with schistosomiasis in pre-school children within an age group of 2-6 years in Mutoko District.

1.4.2.3 To determine association between urinary Schistosomiasis in pre-school children and exposure to risky social and occupational activities within an age group of 2-6 years in Mutoko District.

1.4.2.4 To assess the availability of recommended prevention and control interventions, including an effectiveness of schistosomiasis surveillance system.

1.5. Research Questions

- 1.5.1 What is the infection status of schistosomiasis haematobium (point prevalence) among pre-school aged children in Mutoko District?
- 1.5.2 What is the association between the conceptualized risk factors and schistosomiasis infection among pre-school children aged 2-6 years in Mutoko District?
- 1.5.3 What could be the other factors which are pre-disposing the pre-school children to schistosomiasis infection in Mutoko District?
- 1.5.4 Are there recommended prevention and control interventions available, including an effectiveness of schistosomiasis surveillance system?

1.6. Justification

Schistosomiasis affects mainly children below 14 years of age. Pre-school children, who are also at high-risk for schistosome infections, are currently not included in the WHO schistosomiasis control programs which are routinely implemented across the country although (WHO) formally recognizes that they are at risk and they qualify to be treated using standard treatment regimen of Praziquantel due to inadequate data to confirm the extent of their vulnerability.

Pre-school aged children are also not being targeted in the national schistosomiasis control events such as Mass Drug Administrations (MDAs) which are targeting school going

children. Hence the study sought to inform policy makers and stakeholders with scientific evidence on the need to start considering PSAC in national control programs as advised by research-based point prevalence and associated risk factors.

1.7. Delimitations of the study

Schistosomiasis infected children were selected from a list of participants enrolled in the main clinical trial research study which was aimed at investigating the efficacy, safety, and tolerability of the new Praziquantel formulation among children, hence the researcher had no control over representation of study participants in regard to person, place and geographic attributes.

1.8. Limitations

The study was limited to the small sample size due to limited funding and time; even though it would provide a preliminary data about the prevalence of schistosomiasis among school children in Mutoko District. The researcher had to consider all participants enrolled between October and November due to the small sampling frame.

1.9. Summary

The chapter was an introduction to the research process. It started with an overview of schistosomiasis as national and international neglected tropical disease, disease background in Zimbabwe and beyond and the supporting statistics. The problem statement was given, elaborating the how the problem at hand which prompted the researcher to

undertake this study. The two study objectives were enlisted as well as the related research questions. The chapter ended with justification of why the researcher thinks the study is of public health importance.

Chapter 2 Review of Literature

2.1. Introduction

Chapter two explores current literature on the burden and distribution of schistosomiasis around the globe and in Zimbabwe. The researcher will also present available literature on the possible risk factors of schistosomiasis infection specifically in children and the impact of the disease in affected areas as well as on risk groups will also be discussed. The chapter ends with a discussion on the approved methods of prevention and control of schistosomiasis.

2.2. Overview and Distribution of Schistosomiasis

Schistosomiasis is one of the most commonly neglected tropical diseases associated with significant morbidity and mortality in many developing countries in tropical and subtropical regions of Africa (WHO, 2015). Schistosomiasis remains a major health problem with significant socioeconomic impact.

The global prevalence of schistosomiasis is relatively high especially in developing countries. An estimated 779 million people are at risk of contracting the infection (WHO, 2015). The sub-Saharan region accounts for about 90% of the infection (WHO, 2015). *Schistosoma mansoni*, *Schistosoma mekongi*, *Schistosoma japonicum*, and *Schistosoma intercalatum* are responsible for intestinal infection, while *Schistosoma haematobium* causes urinary infection. *Schistosoma haematobium* (*S. haematobium*), which cause urinary schistosomiasis, and *Schistosoma mansoni* (*S. mansoni*), which is responsible for intestinal schistosomiasis are prevalent in Zimbabwe. Various epidemiological studies

showed that infections with *S. haematobium* and *S. mansoni* are widely distributed in different regions of Zimbabwe including Mutoko area.

According to research done in Sudan by (Khalid et al., 2018), Schistosomiasis infection among school children is often associated with many factors which correlate significantly with the spread of diseases in different regions of the country. These factors include low socioeconomic status, lack of clean water supply, lack of basic infrastructure, relatively low quality of housing and poor environmental sanitation.

It is most prevalent among children below fourteen years of age (Colley, Bustinduy, Secor, & King, 2014). School and preschool children represent the age group most vulnerable to infection due to their high contact with infested water, and the infection risk decreases progressively in adulthood.

A nationwide cross-sectional survey in Zimbabwe by (Nicholas Midzi et al., 2014) revealed that schistosomiasis was more prevalent country-wide with a prevalence of 22.7%. The prevalence of *S. haematobium* infections was 18.0%. The distribution of schistosomiasis varied significantly between provinces and districts (Midzi, et al., 2014).

A study done by (Mutsaka-Makuvaza et al., 2019), in the remote villages of Shamva, Mashonaland Central, Zimbabwe has shown that the general prevalence of schistosomiasis among the preschool aged children was 13.3%. The same study also revealed that *S. haematobium* infections and reinfections are seasonal and depend on micro-geographical settings while the risk of being infected with *schistosomes* in pre-school aged children increases with increasing age.

In Southern Africa, schistosomiasis and STH infection are more prevalent amongst disadvantaged children who live in poor rural communities (Sacalo-Gwebu, Chimbari, & Kalinda, 2019).

2.3. Transmission of Schistosomiasis in pre-school aged children

Schistosome eggs are excreted by humans with feces or urine. After hatching, *miracidia* infect specific snails to produce *cercariae* (Angora, 2019). Schistosome cercariae penetrate the unbroken skin of humans. People acquire infection during domestic, occupational, and recreational activities that expose them to water infested with cercariae from the intermediate host, snails (Adenewo et al., 2015)). Various factors such as climate change, proximity to water bodies, irrigation, and the construction of dams (WHO, 2015), as well as socio-demographic factors, have been implicated in the spread of schistosomiasis in endemic areas.

While it is acknowledged that most PSAC are too young to engage in water contact activities, there is a plethora of evidence showing that young pre-schoolers are regularly exposed to schistosome infection by their caregivers who take them to fresh water sources or use water from these sources for bathing. The older and more mobile group of PSAC visit water bodies for swimming, washing, bathing and other activities (Mutsaka-Makuvaza et al., 2019). However, there is a paucity of data on knowledge, perceptions, water contact and sanitary practices of women and the risk factors predisposing their PSAC and themselves to schistosomiasis infection in endemic areas.

Findings by (Mutsaka-Makuvaza, et al., 2019) showed that an overall disease prevalence was significantly different between caregivers and pre-school aged children, it was higher in caregivers (18.8%) compared to the pre-school children (13.3%), which could be translated to the fact that that schistosomiasis infection is a function of duration of exposure. Caregivers have had or have more water contact exposure, thus are likely to have a higher prevalence compared to pre-school aged children. These findings are similar to observations made in Sudan. Regarding pre-school aged children, the highest urogenital schistosomiasis prevalence was in the 5-year age group with no infections found in all the children less than one year old and only four (5.3%) children out of the 72 children aged one year were infected (Angora, et al., 2019). These results corroborated findings reported in Uganda, demonstrating an increase in prevalence of urogenital schistosomiasis infection with the age of the children (Makerere University School of Public Health, 2017).

The diagram below summarizes the life cycle of schistosomiasis.

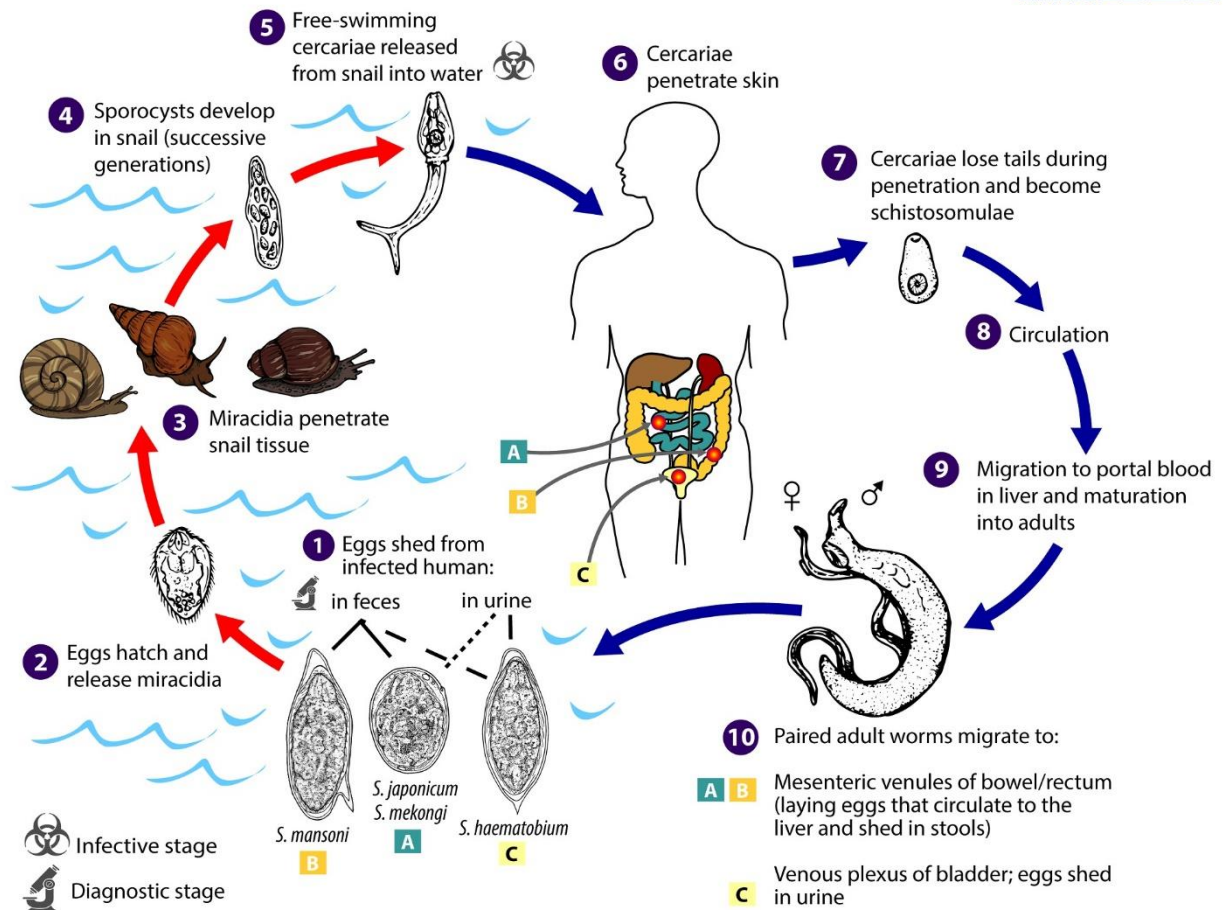


Diagram curtesy of CDC (CDC, 2019).

Figure 1: Schistosomiasis life cycle.

Khalid et al, (2018) mentioned that “in developing countries, children aged 5–17 years possess the highest risk of infection and are the most infected group. Personal hygiene and high frequency of contact with water in an endemic area might significantly increase the risk of acquiring this infection.” In addition, poor sanitation, bathing and playing behavior

in dams and rivers or, type and consistent use of toilet, are the risks that significantly associated with higher rates of infection in children.

2.4.Effects of Schistosomiasis infection in Children

The adverse effects of schistosomiasis among this group are diverse and alarming, the infection can lead to urethral and bladder fibrosis and hydronephrosis, hepatosplenomegaly, moreover, bladder cancer and colorectal cancer is a possible late-stage complication (Adenewo et al., 2015).

Schistosomiasis prevalence and morbidity is highest among schoolchildren, adolescents, and young adults (Adenowo AF, 2015). Thus, the negative impacts on school performance and the debilitation caused by untreated infections demoralize both social and economic development in endemic areas. Urogenital schistosomiasis, caused by *S. haematobium*, is characterized by hematuria, dysuria, bladder wall pathology, hydronephrosis, and it can also lead to squamous cell carcinoma. The infection can cause genital ulcers and other lesions possibly resulting in poor reproductive health and infertility in the future (Colley, Bustinduy, Secor, & King, 2014).

Although not common in Mutoko District, intestinal schistosomiasis, caused by *S. mansoni*, presents with bloody diarrhoea and bowel ulceration, chronic infections progressing to hepatomegaly and/or associated with periportal liver fibrosis, portal hypertension, and hematemesis. Although *S. intercalatum* can cause another form of intestinal schistosomiasis, its distribution is limited to West and Central Africa (Angora, et al., 2019).

(Sacalo-Gwebu, Chimbari, & Kalinda, 2019) listed the impact of schistosomiasis to children as exhibiting notable commonalities;

- Schistosomiasis infections thrive in poverty-stricken areas with limited or no access to safe water supply and basic sanitation.
- Pathology is related to worm burden and may lead to death in heavily infected individuals,
- They retard the physical and cognitive development of children and hinder educational advancement.
- Schistosomes has immunosuppressive features which may predispose infected individuals to HIV/AIDS.
- Chronic infection may cause severe illness and irreversible disabilities, such as cancers of the bladder, prostate, kidney, liver or intestines.

2.5. Transmission, Prevention and Control of Schistosomiasis

Since the overall goal of this study is to inform the affected community, health care providers and relevant stakeholders to come up with sound and effective prevention and control strategies, is therefore vital to review some literature about schistosomiasis control and prevention.

The World Health Organisation set stepwise criteria for morbidity control, schistosomiasis elimination and interruption (Midzi N. , et al., 2014). According to these criteria, morbidity control can be achieved if the prevalence of heavy infection intensity with any schistosome species in an endemic country is reduced to <5%; elimination of

schistosomiasis will be achieved if the prevalence of heavy infection intensity with any schistosome species is reduced to <1% and interruption is achieved by reducing the incidence of infection to zero (WHO, Neglected Tropical Diseases, 2020).

Results from a survey by (Midzi N. , et al., 2014) show that Zimbabwe has an overall prevalence of heavy infection intensity with any schistosome species of 5.8%; 47.1% districts had the prevalence of heavy infection intensity with any schistosome species >5% and 75.0% of the 68 districts included in the survey had the prevalence of heavy infection intensity by any schistosome species >1%.

For preschool-aged children, there are no approved recommendations appropriate for the mass treatment, although there have been suggestions to use the single dose of praziquantel of 40 mg/kg, recommended by the WHO for *S. mansoni* infections in school-aged children (CDC, 2019). Paediatric formulations of praziquantel are still under clinical development to enable inclusion of preschool-aged children in preventive chemotherapy programmes. Several gaps and challenges in treatment have been documented, which include the absence of easy to use, child size, medicines (WHO, Neglected Tropical Diseases, 2020). In the current state, the WHO recommends that in schistosomiasis endemic areas, treatment for preschool-age children should be included in the regular health services, and ongoing public-health interventions such as child health days and expanded programme on immunization. There are challenges to this recommendation in Uganda; foremost is that Praziquantel is not readily available at health facilities to facilitate such efforts and, there are no diagnostic kits at health facilities. In the absence of an appropriate paediatric formulation, the WHO recommends that broken or crushed tablets can be used for administration of praziquantel (Makerere University School of

Public Health, 2017). However, these are not feasible in mass treatment campaigns given the complexities involved in the preparation.

The challenges above render efforts to treat children hardly possible and thus puts them at increased risk of developing serious consequences including death. Schistosomiasis eggs that are not passed out get trapped in body tissues resulting in immune reactions which lead to progressive damage to the body organs (Colley, Bustinduy, Secor, & King, 2014). Therefore, the delayed treatment of the under-five children will affect their wellbeing and growth at this vital stage of development. Yet, studies in Uganda and elsewhere showed that preschool-age children have higher infection levels than the adults. In Uganda, the first nationally representative population-based schistosomiasis sample survey conducted in 2016 showed a prevalence of 22%. The prevalence significantly varied by age, most common among 2 to 4 years old children (31%), followed by 13 to 19 years (28%) and lowest in the 20 and above years (19%). In Uganda mass preventive chemotherapy mainly focuses on primary school going age children, following available guidelines (Makerere University School of Public Health, 2017).

It is vital to have a better understanding of the exposure to schistosomiasis among under-five children to inform the design of effective context specific interventions for the prevention and treatment of this NTD. It is also crucial to have a clearer understanding of how early the infection occurs and the social-cultural factors, as well as the role of the caregivers in exposing children to Schistosomiasis. This study aimed to explore the behavioural practices related to water, sanitation, and hygiene among children under-five, who tested positive for schistosomiasis and their caregivers in the national prevalence

survey of 2017. The study team also observed activities around waterbodies in communities where these children had been surveyed.

Several programmatic steps are recognized for the control and elimination of schistosomiasis. These steps require specific interventions, including interventions for morbidity control and those for infection prevention. Currently, morbidity control is the main objective in Zimbabwe schistosomiasis control program using chemotherapy with praziquantel. However, it is known that treatment alone will not be sufficient to achieve the interruption of schistosomiasis transmission (WHO, 2015).

Combined approach is recommended in schistosomiasis endemic areas so to approaching elimination as a public-health problem. WHO recommends five public-health interventions to accelerate the prevention, control, elimination and eradication of Neglected Tropical Diseases. including schistosomiasis (WHO, 2020):

- Preventive chemotherapy – the large-scale delivery of free and safe, single-dose, quality-assured medicines, either alone or in combination, at regular intervals to treat selected diseases.
- Innovative and intensified disease management – the management of diseases that are difficult to diagnose and treat and which can, in most cases, trigger severe clinical manifestations and complications.
- Vector control and pesticide management – the safe and judicious management of public-health pesticides to achieve vector control through integrated vector management.
- Safe drinking-water, basic sanitation and hygiene services, and education – the prioritization of improved sanitation combined with delivering preventive

chemotherapy and health education to sustain reductions in prevalence of many of these diseases.

- Zoonotic disease management – the application of veterinary sciences and interventions to protect and improve human health (also referred to as veterinary public-health).

According to the recommendations by (Midzi N. , et al., 2014), in order for Zimbabwe to achieve the set WHO NTD global goals: to eliminate schistosomiasis by 2020 and interrupt it by 2025 respectively, the country should implement uninterrupted preventive chemotherapy and complementary strategies including health education, improved sanitation and safe water supply as recommended by this study. These should be guided by scientific evidence. The same authors also recommended that districts classified as high-risk areas based on prevalence of infection will therefore be recommended to require annual mass praziquantel treatment.

2.6. Literature on the factors contributing to Schistosomiasis infection among pre-school aged children and adults.

A study was done by (Mutsaka-Makuvaza, et al., 2019) to establish the factors associated with schistosomiasis infection among pre-school aged children and adults in Shamva District, Zimbabwe. The study overallly noted that caregivers had a low knowledge of schistosomiasis prevention and control, which will enable sustained infection and transmission in high-risk community groups such as pre-school aged children.

(Mutsaka-Makuvaza, et al., 2019) mentioned that women did not perceive themselves or their children to be high-risk groups. This results in exposing themselves as well as children, unknowingly, to infection through water contact activities such as allowing them to play or perform activities in the unprotected water while the caregiver is bathing or washing clothes.

Indiscriminate excreta disposal coupled with risky water contact activities reported here, such as bathing in the river or unprotected water sources, highly predispose individuals to schistosomiasis infection (Midzi N. , et al., 2014). Regardless that most of the caregivers reported the use of toilets for excreta disposal, the few individuals who are infected and are practicing indiscriminate disposal of excreta puts the communities at risk of infection (Mutsaka-Makuvaza, et al., 2019). A survey by (Midzi N. , et al., 2014), had earlier reported indiscriminate disposal of excreta and poor water contact practices of SAC from endemic communities in Zimbabwe.

A study almost similar to the author's was conducted in rural communities of South Africa by (Sacalo-Gwebu, Chimbari, & Kalinda, 2019) where they screened 1143 pre-school aged children in accessible early child development (ECD) centers and pre-schools in the area whose caregivers consented to the study. Results from the study showed that caregivers' habit of bathing children in river water and source of domestic water supply were significantly associated with schistosome infection. Schistosome infection was identified to be associated with water contact activities such as bathing children in the river. This is congruent with a study by (Khalid, et al., 2018) which have shown that *Schistosoma* infection is more prevalent among children whose parents/guardians have high contact with open water sources. In this study, predictors of schistosomiasis infection

were caregivers' level of education, caregiver's hand washing habit after toilet use and children's habit of washing hands with soap and water.

Another study in Uganda mentioned that; as the children grow, their independence also increases resulting in more repeated exposures to infections as they repeatedly play in pens and often infective water sources (Makerere University School of Public Health, 2017). Limited safe water sources and lack of knowledge on prevention and control of the disease result in a high reliance on unprotected water sources in the study area. Thus, the observed early infections among pre-school aged children less than three years of age were due to early exposure to contaminated water bodies when they accompany their mothers for different water contact activities, as reported in other settings. This kind of early exposure was regardless of gender as *S. haematobium* infection was not significantly different between male and female pre-school aged children.

A descriptive cross-sectional survey to investigate schistosomiasis infection risk factors among school going children was done in Gwanda by (Nyathi-Jokomo & Chimbari, 2017). 120 children were enrolled into the study. Of these, non-use of toilets emerged to be the largest risk factor where 81.7% of the children indicated that they did not consistently use the toilet. The other risk factors for schistosomiasis were bathing and swimming in rivers and dams 66.7%, watering the vegetable gardens using unprotected water sources 64.7% and crossing rivers on their way to school barefooted 31.7%. The study results also indicated that there was poor knowledge of schistosomiasis among the children with 54% of the children indicating that they had never heard about the disease. Another evidence of poor knowledge level was the rife of misconceptions on the causes of schistosomiasis. Children mentioned that the disease could be caused by drinking dirty

water, mosquitoes and flies. Parents were cited as the least disseminators of information on schistosomiasis with only 4 out of the 120 children having received information from their parents.

A cross sectional in Ivory Coast by (Angora, et al., 2019) on school aged children gave some insightful leads which can be helpful in the investigation on pre-school aged children. The environmental factors were key characteristics associated with schistosomiasis infection in children. A significant difference was found in the infection of children living in households where tap water and well water were the sources of drinking water. The difference was also pronounced considering the mode of drainage of solid waste and the proximity of the house to a surface water point. Children living in households close to surface water points were 2.8 times more likely to be infected compared with those living far from water points.

2.7.Theoretical framework for distribution and risk factors for Schistosomiasis infection

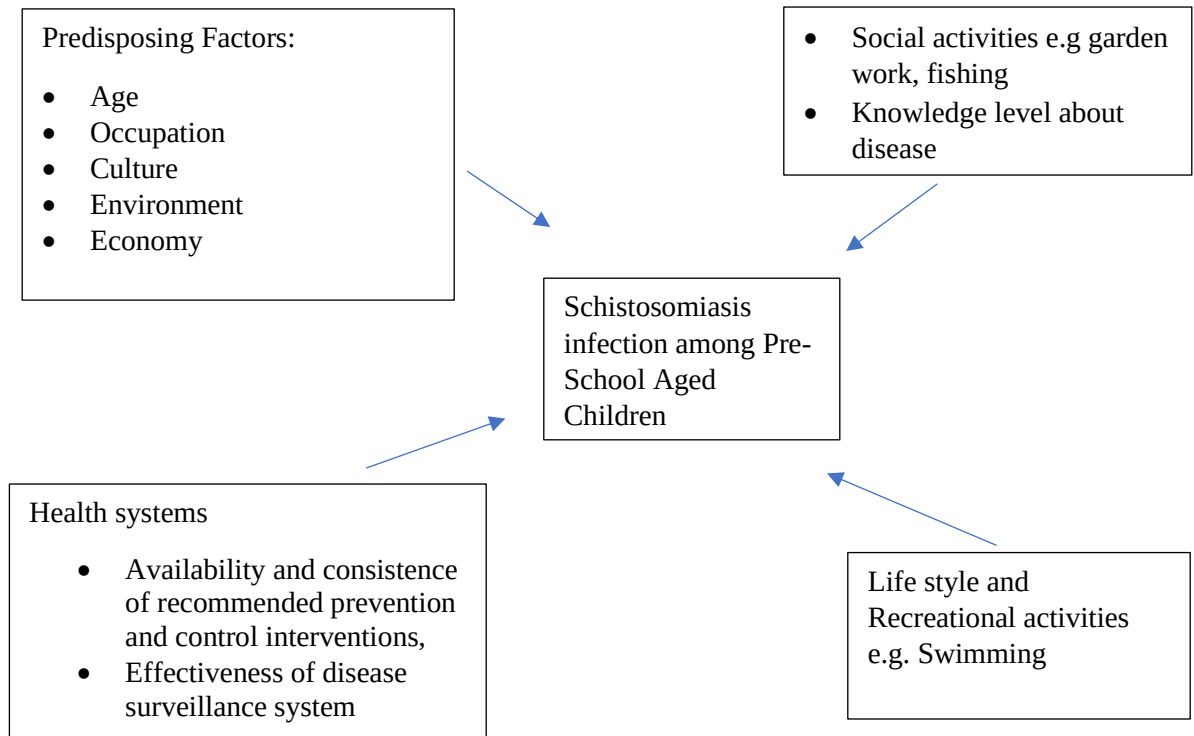


Figure 2: Theoretical framework

2.8.Summary

This chapter focused on review of literature related to the distribution of schistosomiasis globally and in Zimbabwe as illustrated in the 2014 national survey. Highlights from a related study done in Shamva District was given. Several literatures were reviewed which illustrated some work done by local and regional researchers on the effects of schistosomiasis. The chapter went on to discuss the transmission and risk factors of schistosomiasis in children and this was aided by an illustrative diagram of schistosomiasis life cycle. Effects of the diseases in children were discussed as well as the

preventive and control measures. The chapter ended with a theoretical framework for schistosomiasis infection among pre-school children.

Chapter 3 Methodology

3.1 Introduction

Chapter 3 will outline the concepts of research methodology. It will begin by describing the research design and how the sample was drawn. Data collection tools used during the study were explained as well as the outlining the data collection procedure. The researchers will also explain all the ethical issues which were considered as well as the research approval process all with the aim of protecting participants and research credibility and validity.

3.2 The Research Design and its appropriateness

The study employed a case-control design. The case group consisted of children found infected with *S. haematobium* while the control group consisted of children who are not infected with schistosomiasis. Parents or legal guardians of the children were interviewed to assess the exposure risks of their children as guided by the structured questionnaire. The prevalence aspect of the study was established based on the analysis of secondary data from the field schistosomiasis screening register of the main study described in section 3.7. between October and November 2020. The study included both qualitative and quantitative data collection and analysis.

3.3 Study setting and rationale for selection.

The study will be done in the rural villages of Mutoko District, located on the eastern part of Zimbabwe, Mashonaland East province. The district was conveniently selected as it is one of the schistosomiasis endemic areas in Zimbabwe.

3.4 Study Population

Children from Mutoko who are aged between 2 to 6 years, male and female, diagnosed to be infected with schistosomiasis constituted the *case group* and those screened and found to be schistosomiasis free represented the *control group*, in the study. The children had been participated in the main study and have completed all activities from the main study to be eligible for this study.

3.5 Sample Size

The sample size for participants enrolled in in this case-control study was calculated

using the formula:
$$n = \left[\left(\frac{r+1}{r} \right) \right] \left[\frac{[(\bar{p})(1-\bar{p})][Z_{\beta} + Z_{\alpha/2}]^2}{(p_1 - p_2)^2} \right]$$

Table 1: Sample size calculation

Indicators	Values	label
p1	0.57	Probability of exposure among control group
OR	3.00	Odds ratio of exposure in cases relative to controls
p2	1.00	Probability of exposure among case group
p^-	0.79	A measure of variability (similar to standard deviation)
r	1.00	ratio of controls to cases
α	0.05	Level of significance
β	0.20	Type II error
Power	0.80	Power
$Z_{\alpha/2}$	1.96	
Z_{β}	0.84	
n	31	Sample size in the case group
Total sample size	62.00	

It was calculated based on the findings of a study done by(Mutsaka-Makuvaza et al., 2019); at 95% confidence interval and 80% power, expected Odds Ratio of 3.0 and 56.9% expected proportion of exposed controls. A sample size of 62 was calculated with 31 cases and 31 controls.

3.6 Sampling procedure

This was a matched case-control study which enrolled preschool children who have participated in the main study between the period October to November 2020. There was an equal number of cases and controls which were enrolled to participate in this study. To reduce bias, for each enrolled case participant, the researcher selected a corresponding control participant from the same village and sharing similar or close to similar person attributes (age and sex) and demographic attributes (area of residence or village).

3.7 Data Collection Instruments

Data was collected guided by a structured questionnaire from the participants who were the primary data source. Secondary data sources for establishment of disease prevalence consisted of schistosomiasis screening results slips and registers which were available at the Mutoko Hospital main study site as mentioned before.

3.7.1 Validity and Reliability

Validity as relative to this study was the degree to which an instrument actually measures what it was intended to measure. Therefore, study instruments which in this case was the questionnaire and the researcher (interviewer) himself were tailored to achieve research objectives. The instruments to be used in this research were validated by ensuring that questions are structured in a manner that enabled the research to obtain data relevant to the study. The following were applied:

- Expert validity of the instrument through study supervision which gave opinions to guide the success of the study and data obtained from processes which is quality certified.
- Content validity of the research instrument and data sources so that it reflects the true picture under study.
- Construct validity, with emphasis that the theoretical concepts on this research are the foundation of the research questions.

On reliability, the researcher ensured that the instruments used were structured in simple way to avoid ambiguity and interpretations would have elicited erroneous responses. Furthermore, the researcher tried to field few but precise questions that would not derail the participants from the scope of the study so as to protect objectivity.

3.8 Pretesting of instruments

The questionnaire was pretested and reviewed by the researcher before a final version is issued and used. Because of time limitations, the researcher only tested the tool on peers then gave their views and suggestions to improve it.

3.9 Data Collection Procedure

The case-control study was carried out in a single setting. This study was a sub-study of a main clinical study which was between March and December 2020 with the title “*Open label, single-arm, Phase IIIb study to demonstrate the efficacy, safety and tolerability of a single dose of the new L-Praziquantel orally disintegrating tablets (L-PZQ ODTs) in*

children age 2 to 6 years infected with Schistosoma haematobium (urogenital schistosomiasis)” Protocol dated 22 July 2019/Version 1.0.

Since the targeted study group were minors, parents or caregivers of the selected children were identified, informed, and consented to provide information related to schistosomiasis risk exposure among their children. A structured questionnaire was administered to the parent or caregivers of participants in the case and control groups during face to face or telephone interviews for determining the association of conceptualized risk factors related to the schistosomiasis infection status of their child. Information collected was on socio-demographic characteristics, access to water and sanitation, sources of livelihood, recreational and occupational activities, and awareness of schistosomiasis. Data captured through questionnaires was entered into Epi-info forms on real time.

Screening registers and result slips from the screening activities in the main study were used to determine prevalence, aggregated by age and sex.

3.10 Analysis and Organization of Data

Data was analyzed using CDC Epi-Info version 7 as well as the MedCal statistical software (2021), which is an online statistical software found on www.scistat.com/statisticaltests/odds_ratio.php. Data for disease – risk factor association was presented using 2×2 tables. The Odds Ratios, confidence intervals and p-values were used to measure the causative relationship between the risk factors and the disease.

Totals of preschool children who tested positive for schistosomiasis between October and November 2020 were statistically calculated against the total screened over the same

period to estimate prevalence. Prevalence data was analyzed according to different presenting attributes and presented using tables and graphs.

3.11 Ethical Considerations

Ethical approval was sought from the Africa University Research Ethics Committee before any data is collected. The study was also conducted under the already signed permission from the main study by the Mashonaland East Provincial Medical Director and Mutoko District Health Executive. Permission has also been sort from the local community leaderships (traditional and political leadership).

The researcher first obtained informed parental or caregiver consent before interviews were conducted. Only the researcher had access to the study data and all study documents. The documents and study related material were kept under lock. Three digit codes were used for participant identification and data collected could by no means linked to the actual identity of the participant.

3.12 Summary

Chapter three focused on the research methodology. It is when the research design was given including the precise location of the study and the targeted population including the rational for selecting targeting the location. The sampling procedure was elaborated instruments and procedures as well for data collection. The chapter ended by describing how study data was analysed using known electronic statistical packages and some ethical considerations during the study.

Chapter 4 Data Analysis and Presentation

4.1 Introduction

This chapter will present the finding of the research study in determining association between urinary schistosomiasis in pre-school children and exposure to recreational activities, establishing predisposing factors associated with schistosomiasis in pre-school children, determining association between urinary schistosomiasis in pre-school children and exposure to risky social and occupational activities within an age group of 2-6 years in Mutoko District. Data on the availability of recommended prevention and control interventions, including an effectiveness of schistosomiasis surveillance system will also be presented.

4.2 Data presentation and analysis

4.2.1 Demographic data for study participants

Participants' demographic information such as age, gender, location and relation of interview to the participant is presented in table 2 below. Measure of dispersion for age is also shown in the table. All the information is disaggregated into cases and control groups.

Table 2: Participants demographic information

Variable	Category	Cases (%)	Controls (%)
<i>n</i> =		31 (50)	31 (50)
Consent given		31 (50)	31 (50)
Gender	Males	20 (64.52)	20 (64.52)
	Females	11 (35.48)	11 (35.48)
Age	2 years	2 (6.45)	2 (6.45)
	3 years	8 (28.81)	7 (22.58)
	4 years	12 (38.71)	15 (48.39)
	5 years	7 (22.58)	7 (22.58)
	6 years	2 (6.45)	0 (0)
Median Age		4 years	4 years
Interview Relationship to participant	Biological parent	30 (96.77)	29 (93.55)
	Relative	1 (3.23)	2 (6.45)
	Legal guardian	0	1 (3.23)
Village/Location	Bwanya	1 (3.23%)	1 (3.23%)
	Chapfiko	1 (3.23%)	1 (3.23%)
	Chatiza	1 (3.23%)	1 (3.23%)
	Chibeta	3 (9.68%)	3 (9.68%)
	Chindenga	1 (3.23%)	1 (3.23%)
	Chitekwe	1 (3.23%)	1 (3.23%)
	Danda	1 (3.23%)	1 (3.23%)
	Dzanga	1 (3.23%)	1 (3.23%)
	Gumbure	1 (3.23%)	1 (3.23%)
	Gwarima	2 (6.45%)	2 (6.45%)
	Kawere	3 (9.68%)	3 (9.68%)
	Makochera	1 (3.23%)	1 (3.23%)
	Makora	5 (9.68%)	5 (9.68%)
	Masvaire	2 (6.45%)	2 (6.45%)
	Mudzonga	1 (3.23%)	1 (3.23%)
	Nyakabawu	1 (3.23%)	1 (3.23%)
	Nyamakosi	2 (6.45%)	2 (6.45%)
	Nyamuzuwe	2 (6.45%)	2 (6.45%)
	Tsiko	1 (3.23%)	1 (3.23%)

The study was a 1:1 matched case-control design, hence equally distributed number of participants in the cases and controls groups giving a total number of 62 participants interviewed. Males contributed larger proportion (64.5%) compared to females contributed (35.6%). Age range of participants was 2-6 years with the modal median age of 4 in both the cases and control groups. Consent was obtained from both all the parents/relatives/legal guardians of the participants before interviews. Majority of interviewees (95.2%) were biological parents of the enrolled participants, while 9.7% were participant relatives and 3.2 were legal guardians of the participants. Participants were from 17 rural villages of Mutoko district.

4.2.2 Prevalence

Figure 1 summarizes the schistosomiasis prevalence among Prevalence was calculated from the line listing of a 674 pre-school aged children who where screened for schistosomiasis between October and November 2020 through the L-Praziquantel clinical trial.

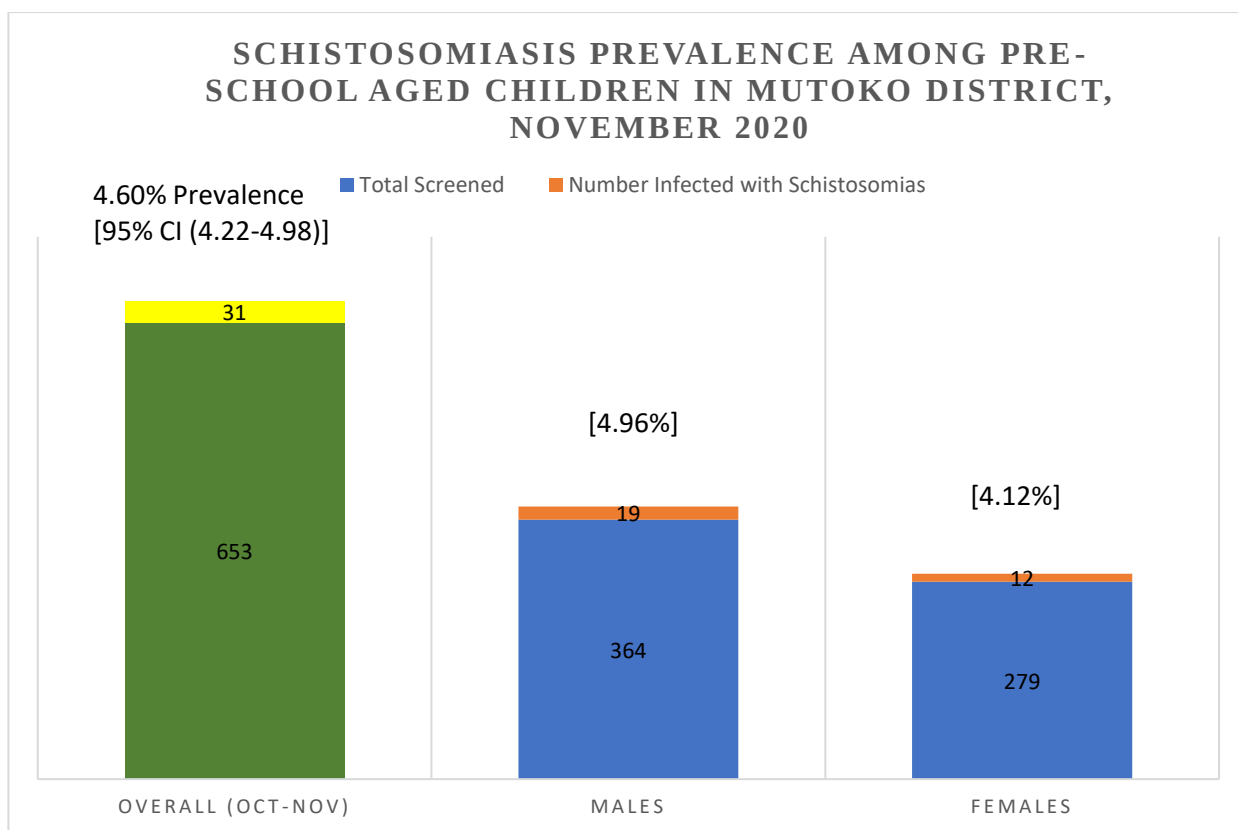


Figure 3: Prevalence of Schistosomiasis among pre-school aged children in Mutoko District, November 2020.

4.2.3 Descriptive analysis

This section will summarize responses from the care givers on the questions exploring exposure of study participants to schistosomiasis.

Knowledge of schistosomiasis among care givers

Frequencies for the care giver knowledge levels are summarized in the table below. These are responses from question 9 in the participant questionnaire. Participants were graded as not knowledgeable, partially knowledgeable, or knowledgeable.

Table 3: Caregiver knowledge about schistosomiasis

Care giver knowledge level	Frequency	
	Cases	Controls
No (if all information is incorrect/no information)	14 (45.2%)	3 (9.7)
Partially (if some of the information is incorrect)	14 (45.2%)	21 (67.7%)
Yes (if giving all correct information)	3 (9.7%)	7 (22.6%)

Figure 4 below is a graphical presentation of the caregiver knowledge levels in the case group as well as the control group for an eyecatch of the frequencies.

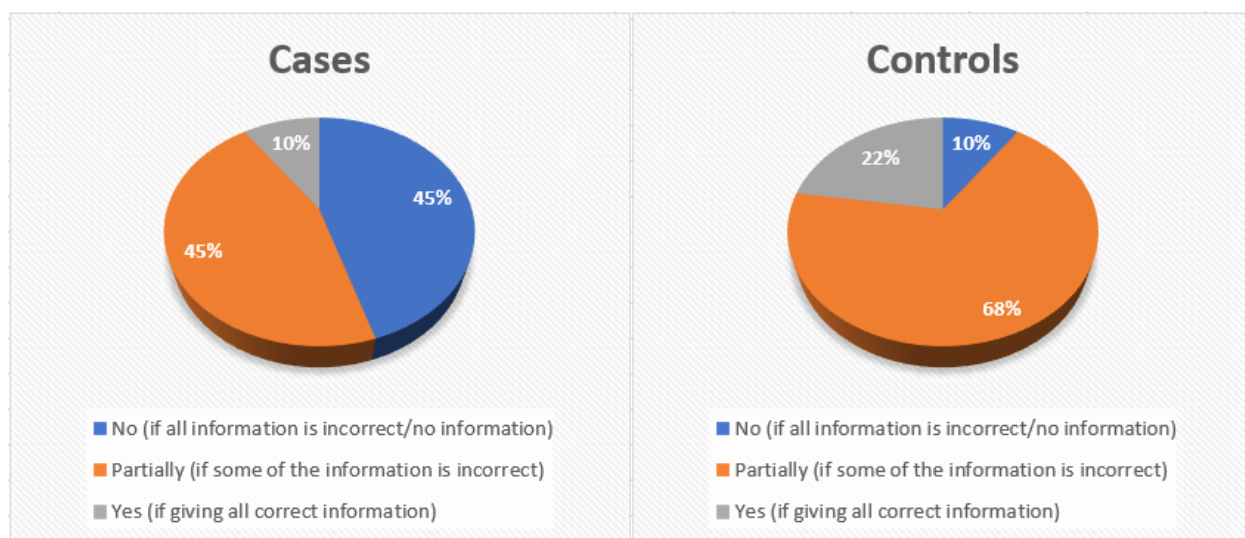


Figure 4: Presentation of care giver knowledge about schistosomiasis

All the 62 interviewees responded to the question 9 which asked about general knowledge about schistosomiasis. The lowest proportion of caregivers of participants from the case group had correct information about schistosomiasis and how schistosomiasis is transmitted from person to person while the proportion has more than doubled among

caregivers in the control group. The proportion of caregivers who showed to have no information at all was more than four times higher in the case group comparing with caregivers of participants from the control group. However, in both groups the larger proportion of interviewees had a mix of right and wrong information. This category had a total 56.5% (35) caregivers from both groups. Misconceptions were rife among these caregivers as illustrated by responses received from question 20 in the study questionnaire. Contact with infested water, dirty water, sharing toilets, drinking contaminated water, not wearing shoes, contaminated air and contaminated food were some of the reported avenues for infection.

Risk factors: Water and hygiene

Frequencies for responses on water and hygiene questions (questions 10 to 13 of the participant questionnaire) are summarized in table 4 below.

Table 4: Frequencies for factors exposing to schistosomiasis

Risk factor	Description	Cases	Controls
Distance from the nearest open water source (dam/river)	≤ 500m	19	16
	>500m	12	15
*Does the child often visits the open water sources	Yes (Alone)	1	4
	Yes (Accompanied by adults)	29	26
	No	2	5
*What is the usual purpose of visit (if Yes to above)	Recreational,e.g swimming/fishing	20	10
	Gardening	12	13
	Bathing	24	15
Where do you often get water for bathing	Open water body (river/dam)	25	18
	Closed well	1	8
	Borehole	5	5

56.5% (35) of the participants reportedly stays within a range of less than 500m from open water bodies such as dams and river streams, while 43.5% (27) stays more than 500m away from the open water sources. Of the interviewed care givers, 11.4% (7) responded that participants do not visit water bodies while 88.6% (55) responded that the participants oftenly visits the dams or rivers alone or accompanied by adults or both. The most

common reason for the visits was for bathing (41.5%), followed by recreational purposes such as swimming and fishing (31.9%) and lastly gardening (15.96%). Additionally, the care giver were asked on where they get water for bathing their children. 69.4% (43) reported that they use water from the open sources such as dams and rivers, 16.1% (10) reported that they use water from the closed water sources and 14.5% (9) reported that they use borehole water.

NB: Risks factors marked with an asterik () were allowing multiple responses on each interviewee.*

Risk factors: Sanitation

Table 5 below is a summary of frequencies on the status of sanitary facilities in the targeted community as assessed by question 14 and 15 of the participant questionnaire. This asked about the availability and use of sanitary facilities at family level.

Table 5: Frequencies of responsees on sanitation related risk factors

Risk Factor	Description	Cases	Controls
Type of toilets used	Open bush	7	2
	Blair toilets	24	29
	Flush toilets	0	0
Do you share toilets	Yes	4	3
	No	27	28

Risk factors: Health care system

Table 6 below displays frequencies of question 17 to 19 in participant questionnaire on the availability of interventions for schistosomiasis prevention, care and support from the government and any supporting partners.

Table 6: Availability of schistosomiasis prevention, care and support interventions, Mutoko District, 2020.

Risk factor	Description	Cases	Controls
Distance to nearest health centre	≤ 10km	15	15
	>10km	16	16
Schistosomiasis care and prevention health education available?	Yes	0	0
	No	31	31
Do you routinely receive preventive medical care?	Yes	1	0
	No	30	31
Any stakeholder support against schistosomiasis?	Yes	5	4
	No	26	27

The number of participants in less than 10km and more than 10km radius from health care centres were equal in both the case and control groups. However, Majority caregivers indicated that there is no anykind of support available at community level specifically targeting prevention, care and support against schistosomiasis disease, whether in the form of health education or preventive therapy. Only 14.5% of caregivers acknowledged stakeholder support against schistosomiasis. This was qualitatively mentioned as Non-Governmental organizations such as World Vision, which educate communities on water, sanitation and hygiene to prevent various illnesses. The same organizations are said to technically and financially support communities in constructing safe water sources as well as construction of latrine toilets in schools and selected households.

4.2.4 Inferential analysis

The below bivariate analysis showed the odds of getting schistosomiasis among participants who stays less than 500m from the open water bodies such as rivers and dams was 1.48 compared to those who stays more than 500 metres from the water bodies.

Table 7: Bivariate analysis of risk factors associated with schistosomiasis among pre school aged children in Mutoko District, 2020.

Risk Factor	Ill (Schistosomiasis infection)			Odds Ratio	95% CI	Chi-Squared P-value
		Yes	No			
Distance for the water source	≤500m	19	16	1.4844	0.54 – 4.07	0.4422
	>500m	12	15			
Type of toilet	Bush	7	2	0.2365	0.04 – 1.25	0.0714
	Blair	24	29			
Sharing toilets	Yes	4	4	1.00	0.23 – 4.42	1.00
	No	27	27			
Distance from health centres	≤10km	15	15	1.00	0.37 – 2.71	1.00
	>10km	16	16			
Stakeholder support agaist schistosomiasis	Yes	5	4	1.2981	0.31 – 5.37	0.7184
	No	26	27			

On inference, the 95% CI was 0.54 - 4.07 and a P-value of 0.44, which means that the odds ratio is statistically significant. Stakeholder support also fell into the similar trend is it gave an odds ratio 1.30 (95% CI, 0.31 - 5.37, P-value of 0.72).

The analysis presented in the above 2x2 tables above showed that sharing of toilets as well as distance from the health centres had an odds ratio of 1.0, meaning that the two had no significant association with schistosomiasis infection among the participants. On Comparing those who used Blair toilets versus those who used bush toilet, those who used there was no significant association between type of toilet used and schistosomiasis infection (Table 7).

Table 8 below shows inferential analysis of the 4 multivariate risk factors which were under investigation during the study.

Table 8: Multi-variate analysis of risk factors associated with schistosomiasis among pre school aged children in Mutoko District, 2020.

Risk Factor		Ill (Schistosomiasis infection)		Odds ratio	95% CI	P-value
		Yes (Cases)	No (Controls)			
Care giver Knowledge about schistosomiasis	No knowledge	14	3	10.8889	1.73-68.54	0.0110
	Partial informed	14	21	1.556	0.34-7.06	0.5669
	Well informed	3	7	1.0 (Reference)		
Often Visits open water bodies	Yes (Alone)	1	4	0.6250	0.04-9.65	0.7364
	Yes (Accompanied)	29	26	2.7885	0.50-15.62	0.2434
	No	2	5	1.0 (Reference)		
Usual purpose of visit to open water bodies	Recreation	20	10	4.0000	0.62-25.68	0.1439
	Bathing	24	15	3.2000	0.52-19.67	0.2093
	Gardening	12	13	1.8462	0.28-11.98	0.5205

	None of above	2	4	1.0 (Reference)		
Source water used for bathing	Dam/river	25	18	1.3889	0.35-5.52	0.6407
	Open well	1	8	0.1250	0.01	0.0992
	Borehole	5	5	1.0 (Reference)		

Calculated by “MedCal software (2021) www.scistat.com/statisticaltests/odds_ratio.php

Caregiver knowledge about schistosomiasis had the greatest causal association as evidenced by the highest odds ratio of 10.89. It means that odds of being a child of a caregiver who had completely no knowledge about schistosomiasis were 10.89 times higher among cases than controls. A smaller p-value of 0.01 means that there is less than 1 chance in 100 that the odds ratio of 10.89 would result by chance alone. A 95% CI of 1.73 - 68.54 is not inclusive of 1. Hence the finding is considered statistically significant. Caregivers who were partially knowledgeable had a far lesser odds ratio of 1.56, 95% CI (0.34; 7.06) and 0.57 but still indicating that having no adequate knowledge about schistosomiasis had a disease association although to a lesser extent compared to having no knowledge at all.

Question 12 from the questionnaire asked the caregivers if their children would visit the dams and/or rivers either alone or accompanied. Only 5 responded that their children would go alone and these were only older pre-school children and this could not give numbers enough to analyse causal relationship. However, visiting the rivers and/or dams in company of older siblings or other adults showed to have a causal disease causal

relationship with an odds ratio of 2.79 (95% CI, 0.50; 15.62, p-value, 0.24). This meant that participants there was no significant association between visiting the dams/streams and chances of getting schistosomiasis.

A statical analysis was also presented on the effect of purpose of visit to the open water bodies on schistosomiasis infection among the pre-school aged participants. This was captured on question 13 and was a followup question to the previously analysed question 12. This factor had 4 response (variables) as individual purposes for visiting the open water bodies, namely recreational, gardening and bathing. Multiple responses were allowed for each caregiver on these variables. All the three variables had odds ratios above 1.0, indicating that they were shown to have disease causal effect. There odds of having been visiting the open water bodies for recreational purposes was 4 times higher (95% CI, 0.62 - 25.68 and p-value 0.14) among participants in the cases group than in the controls group but the finding was not statistically significant. Recreation activities included commonly included fishing and swimming, and had no significant relationship, nor did bathing. Bathing had an odds ratio of 3.2 (95% CI, 0.52 - 19.67 and p-value 0.2093). Gardening had the least causal effect with odds of 1.8 (95% CI, 0.28 - 11.98, p-value 0.52). Here, the p-value was high indicating that there was 50% probability that the findings may have been occurred by chance alone.

4.3 Summary

In the present study area, it appears that schistosomiasis infection start at an early age and there are various risk factors associated with the disease. This evidence adds weight to the already growing body of evidence that pre-school aged children can have

schistosomiasis as they are exposed to similar risk factors as other older children and adults. The study results managed to show that age may not be a contributing factor but infection varied with sex.

The main identified risk factor for schistosomiasis infection was caregiver knowledge level about schistosomiasis as welfare of children of this age mainly depends on their caregivers. Other factors which appeared to be of paramount importance are frequencying to the open water sources as well as distance of less than 500m from the open water bodiesa such as rivers and dams

Chapter 5 Discussion, Conclusion, and Recommendations

5.1 Introduction

This mixed approach study (quantitative and qualitative) study conducted among caregivers of children who were screen both, negative and positive for schistosomiasis in the Mutoko District of rural Zimbabwe, explains some conceptualized risk factors for schistosomiasis infection in this endemic. The exposures from caregivers' accounts suggest that a significant proportion of children under 6 years in endemic areas are frequently in contact with infested water through different ways. Yet, this age group is not a target for mass drug administration. This could explain why the children 2–6 years had the 4.6% prevalence of schistosomiasis. It also shows challenging gaps in knowledge about how schistosomiasis is transmitted with caregivers of children in this study concurrently having the right information, but also varied misconceptions.

5.2 Discussion

This study managed to concur with the upcoming evidence from other researchers that pre-school aged children are at risk of getting infected with schistosomiasis. However, the prevalence recorded in this study is lower than in Mudzi District of rural Zimbabwe by (Mutsaka-Makuvaza et al., 2019). The study findings also pointed that age did not have significant effect on schistosomiasis infection while sex did have some effect as more males were infected more than females. This result was also in contradiction with another study which was done in Tanzania by Ruganuza, Humphrey, Waihenya, Morona, & Mkoji,(2015), which showed that infection rates increased with age but sex had no effect.

This is likely due to a uniformity of PSAC's water contact behaviour and parents' or guardians' behaviour towards their children's water contact across age groups.

Caregivers in this study had mixed information about schistosomiasis and how it is spread. Almost half of the interviewed caregivers did not have any knowledge about schistosomiasis transmission. It is disheartening that such a proportion of caregivers had no knowledge about potential sources of infection. Such knowledge gaps need to be addressed, noting that a high odds ratio has supported that low knowledge levels could be associated with schistosomiasis infection.

In the midst of the right information were also misconceptions that need to be corrected. The existence of the correct information without confronting wrong beliefs may continue to facilitate schistosomiasis infection or pull back treatment efforts. Misconceptions about schistosomiasis transmission which were common include thoughts that it was being caused by witchcraft, and that one can not get infected when they do not directly bathe children from the river water. Some misconceptions and gaps in knowledge have been quantified in the previous chapter. This is enough evidence that the caregivers and probably many other people in the endemic communities are not comprehensively knowledgeable about the modes of transmission for the schistosomiasis. The public health programs are not reaching the communities with educational programs nor preventive programs. However, those who would have some knowledge mentioned that they got it from the conventional education system during their school days and a few would mention that they got the knowledge from the less reliable sources like community members.

The observed risk activities including visititng the open water bodies for recreational bathing and gardening purposes as well general use of dam/river water for bathing showed a glaring need for water, sanitation and hygiene (WASH) interventions to mitigate schistosomiasis and other related diseases. This will primarily avoid contact with schistosome infested water and secondly reduce contamination of the water bodies. This agrees with (National Research Council (US) and Institute of Medicine (US). Children's Health, 2004), which stated that environmental exposures such as contaminated water are not only a risk factor for schistosomiasis but also affect the health of children in many other ways. Improvements in water and sanitation will, therefore, impact on the overall health and welfare of children and contribute to the achievement of the Sustainable Development Goals (SDGs) especially goal 3.

Some of the activities that exposed children to the risk of infection, eg fishing and gardening; are vital to the survival of the children and their families. This means that messages that only aim at preventing contact with infested water may not have an effect in such cases. In other cases, younger children are reported to contribute to household water needs together with their siblings, which is vital to the survival of households. This further supports the evidence for the need for universal coverage of sanitation facilities to prevent communities from infecting water bodies. There is clear research based evidence of a lower prevalence of schistosomiasis in areas where sanitation facilities are most used (16%) versus those where open defecation and urination are rife (28%) (National Research Council (US) and Institute of Medicine (US). Children's Health, 2017).

5.3 Limitations

The study findings should be interpreted in the context of some limitations. The in-depth interviews are based on caregivers recall about activities that their children engaged in that could have exposed them to schistosomiasis. There is a possibility of recall bias. However, interviewing them after a positive test result was confirmed, could have improved their recall about activities that they would otherwise not have considered risky before. The study also used qualitative information to triangulate the quantitative evidence from the accounts of the caregivers. In this study, the sampling process was itself more guided by the identified cases which can more than statistical calculation. Another limitation is the timing of the study, which could have effect on the prevalence of schistosomiasis since scientific evidence suggested that the disease prevalence can be affected by seasons. Lastly, this research study only managed to get opinions from the community member and did not sought other opinions from stakeholders such as non-governmental organizations and government ministries which could have varying opinions.

5.4 Conclusions

This study shows that many pre-school children in schistosomiasis endemic areas such as Mutoko, are constantly exposed to *Schistosoma* infested water during activities that involve their adult caregivers, older siblings in the households and sometimes themselves alone especially the older pre-school aged children. It provides in-depth explanation about how children get infected at an early age and provides more evidence for the need to include pre-school children in prevention and treatment efforts. The prevalence of

schistosomiasis in this study was low, suggesting that it may be possible to eliminate it among pre-school aged children in the area provided vertical morbidity control interventions are integrated with community-wide health promotion strategies such as health education and the provision of clean water and basic sanitation. Our findings highlight the need for behavioural change interventions among caregivers of pre-school aged children for schistosomiasis and soil-transmitted helminthiasis control. The consideration of sociodemographic, water, sanitation and behavioural factors emerged as key in the success of soiltransmitted helminthiasis and schistosomiasis control and elimination programmes. This is probably because the control of helminths largely depends on the progress towards addressing the root cause of infection beyond treating symptoms. The study findings may add to the national health strategy for the inclusion of pre-school aged children in Neglected Tropical Diseases screening and treatment programmes.

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Appendix I: Care giver questionnaire

PARENT/GUARDIAN QUESTIONNAIRE FOR SCHISTOSOMIASIS RISK FACTORS

Demographic Information

1. Study Number

2. Date of interview

3. Village

4. Interviewee Relationship to child

- ☐ Biological Parent
☐ Relative
☐ Legal Guardian

5 Participant Study Group

- ☐ Case ☐ Control

8 Consent given?

6 Sex of Child

- ☐ Male ☐ Female

7 Age of child

- ☐ 2 years ☐ 5 years
☐ 3 years ☐ 6 years
☐ 4 years

9 Do you have knowledge about Bilharzia? (Interviewer to classify accordingly)

- ☐ Yes (if giving all correct information)
☐ Partially (if some of the information is incorrect)
☐ No (if all information is incorrect/no information)

10 How far are you from the nearest open water source e.g Dam/river?

- ☐ Less than 500m
☐ More than 500m

11 Where do you get water for bathing?

- ☐ Open water body e.g. Dam / River
☐ Closed wells
☐ Tape water
☐ Borehole water

12 Does your child often visits open water sources?

- ☐ Yes (Alone)
☐ Yes (Accompanied by adults)
☐ No

13 If Yes, what is the usual purpose of visit?

- ☐ Recreational e.g. swimming/fishing
☐ Gardening
☐ Bathing
☐ Other reason not listed above

14 What type of toilets do you use at home?

- ☐ Open/Bush
- ☐ Blair toilets
- ☐ Flush toilets

15 Do you share toilets with other families?

16 How far is the nearest health centre?

- ☐ Less than 10km
- ☐ More than 10km

17 Are there schistosomiasis preventive health education you routinely receive from the local health institution?

18 Are there preventive medical treatment you routinely receive from the local health institution?

19 Is there any kind of support you have been receiving from any stakeholders towards schistosomiasis prevention?

20 What do you think is the cause of schistosomiasis infection among the pre-school children?

Appendix II: English consent form

Study title: urogenital schistosomiasis in pre-school children in Mutoko District

Researcher: Edson Marambire
Phone numbers: 0772286311 / 0712337995
Designation: Final Year MPH Student (Africa University)
Address: 2604 Highwood. Concession.

What you should know about this research study:

- We give you this consent so that you may read about the purpose, risks, and benefits of this research study.
- The main goal of research studies is to gain knowledge that may help current and future generations.
- We cannot promise that this research will benefit you.
- You have the right to refuse to take part or agree to take part now and change during the process
- Participation is voluntary, whatever you decide, it will not affect you in any way
- Please review this consent form carefully. Ask any related questions before you make a decision.

Invitation

You are being asked to participate in a research study to investigate urogenital schistosomiasis (also called bilharzia) in pre-school aged children in Mutoko district. I need participants to be part of this study which is part of the fulfilment of a Master's degree in Public Health, so please read all the information and then...YOU DECIDE! It is important that you take your time and read all the information. If there is anything you do not understand, you are free to ask. There is no problem if you do not want to participate. Your participation will only involve answering questions as they are presented in the study questionnaire. The interview is expected not to exceed 30 minutes.

What you should know about the study?

Objectives

The study is aimed to determine the prevalence of schistosomiasis and associated risk factors among pre-school children aged between 2 to 6 years in Mutoko district, Mashonaland East Province

About Schistosomiasis

Schistosomiasis, also called bilharzia, is one of the most important of the neglected tropical diseases caused by parasitic flatworms and remains one of the most prevalent parasitic diseases in Zimbabwe, affecting mainly children below 14 years. The disease is second only to malaria as the most devastating parasitic disease, with significant economic and public health consequences (CDC, 2016). In 2014, a prevalence of 22.7% was reported after a national survey.

Schistosomiasis is endemic in Mutoko area with a prevalence of 43.5%, only second to Binga according to the last national cross-sectional survey conducted in 2014 (Midzi, et al., 2014).

There is therefore a strong need to concentrate on investigating associated risk factors for the purpose of discovery, prevention, and elimination of continuing transmission. The Ministry of Health and Child Care has developed a public strategic plan in response to schistosomiasis. The strategic plan is in line with the 2020 World Health Organization (WHO) Roadmap. The aim of current public health strategies for schistosomiasis is to decrease morbidity.

Your participation is voluntary.

Your being part of this research sub-study is completely up to you. You do not have to do it if you do not want to. If there is anything you do not understand, you are free to ask.

Procedures and duration

If you decide to participate you will be interviewed concerning your child's exposure risk to schistosomiasis (Bilharzia) infection. It is expected that this will take not more than 30 minutes.

Risks and discomforts

- There is no any harm anticipated during your participation in this study.
- Participation will require your time which can be an inconvenience to you, however it is expected not to exceed 30 minutes.

Benefits and/or compensation

You are not likely to benefit immediately by taking part in this study. You will not be paid to participate in this research study. As states earlier, results from the research study may benefit the general population in the prevention and control of schistosomiasis.

Confidentiality

Information that is obtained in the study that can be identified with the participant will not be disclosed without your permission. Names and any other identification will not be asked for and your contribution will only be identified using a unique 3-digit code.

Offer to answer questions

Thank you for taking the time to think about being part of the research study. Before you sign this form, please ask any questions and let me know if there are things that you do not understand or would like more information about. You may take as much time as necessary to think it over.

Consent form / authorisation

If you have decided to participate in this study please sign this form in the space provide below as an indication that you have read and understood the information provided above and have agreed to participate.

Name of Participant (print)

Name of Name of caregiver (print)

Date

Signature of caregiver or legally authorised representative

If you have any questions concerning this study or consent form beyond those answered by the researcher including questions about the research, your rights as a research participant, or if you feel that you have been treated unfairly and would like to talk to someone other than the researcher, please feel free to contact the Africa University Research Ethics Committee on telephone (020) 60075 or 60026 extension 1156; email: aurec@africau.edu

Name of Researcher -----

YOU WILL BE OFFERED A COPY OF THIS CONSENT FORM TO KEEP.

Appendix III: SHONA CONSENT FORM

Musoro wetsvakurudzo: *Urogenital schistosomiasis in pre-school children in Mutoko District*

Mutsvakurudzi: Edson Marambire
Nhamba dzenhare: 0772286311 / 0712337995
Chinzvimbo: Final Year MPH Student (Africa University)
Kero: 2604 Highwood. Concession.

Zvamungada kuziva pamusoro petsvakurudzo

- Tinokupai gwaro iri retaendarano kuti muverenge nezvechinangwa, njodzi uye zvakanakira tsvakurudzo ino.
- Chinangwa chetsvakurudzo ndechekutsvaga ruzivo runogona kuzobatsira veruzhinji munguva inotevera.
- Hatikupii chivimbiso chekuti tsvakurudzo iyi ichakubatsirai.
- Makasununguka kuramba kana kubvuma kupinda mutsvakurudzo izvozvi uye kuzoshandura mafungiro enyu kumberi
- Kupinda mutsvakurudzo isarudzo yakasununguka, hamumanikidzwi.
- Verengai gwaro retenderano iri zvakanaka. Mubvunze kana pane zvimwe zvamungada kuziva zvinechekuita netsvakurudzo ino musati maita sarudzo.

Kukokwa

Munokokwa kuti mupinde mutsvakurudzo yekuongorora zvinechekuita nechirwere BARAZIYA (*urogenital schistosomiasis*) kuvana vasati vavakuenda kuchikoro mudhunhu rekwa Mutoko. Ndinoda vanhu vanopinda mutsvakurudzo iyi, saka ndokumbirwa kuti muverenge ruzivo rwose mobva MASARUDZA ZVAMUNODA KUITA. Munokurudzirwa kuti muverenge ruzivo urwu rwose, muwane nguva yose yamungada yekuti muverenge mugobvunza chero mibvunzo ipi zvayo yamunayo. Kana pane chero chipi zvacho chamusinganzwisisi, makasununguka kubvunza. Hazvina dambudziko kana musingadi kupinda mutsvakurudzo iyi. Kana mukaszrudza kupinda mutsvakurudzo, munenge muchizokumbirwa kupindura mibvunzo sekupiwa kwayakaitwa mugwaro remibvunzo yetsvakurudzo. Hurukuro iyi inotarisirwa kusapfuura maminiti makuni matatu (30 minutes).

Zvamungada kuziva mausoro petsvakurudzo

Chinangwa

Chinangwa chetsvakurudzo ndechekuongorora kuwanda kwechirwere che Baraziya uye zvingava zvichiisa vana vasati voenda kuchikoro varipakati pemakore maviri nemakore matanhatu panjodzi yekubatwa nechirwere ichi mudunhu rekwaMutoko, ku *Mashonaland East Province*.

Baraziya (*Schistosomiasis*)

Baraziya (*schistosomiasis*) ndechimwe chezvirwere zvakasiririra zvinowanikwa mumatunhu anopisa chichikonzerwa nerukonye (*parasitic flatworm*) uye ndechimwe chezvirwere zvinokonzerwa ne *maparasites* chakatekeshera muZimbabwe chiripakinhanho chechipiri chichitevera *malaria*. Chirwere ichi chinokanganisa upfumi

uye utano hweveruzhinji. Ongororo yakaitwa nyika yose mugore ra 2014 yakaratidza kuti chine huwandu wezvikamu makumi maviri nechidimbu kubva muzana (22.7%).

Tsvakurudzo huru yakaitwa mugore ra 2014 yakataridza kuti chirwere che Baraziya (*schistosomiasis*) chakawanda nezvikamu zvinosvika makumi mana nechidimbu kubva muzana (43.5%) mudunhu rekwaMutoko chichitevera dunhu reku Binga.

Nekudaro pane panechikonzero chakasimba chekuita tsvakurudzo yezvingava zvichiisa vana vadiki ava panjodzi yekubatwa nechirwere ichi nechinangwa chekutsvaka ruzivo, kudzivirira uye kupedza kupararira kwechirwere che Baraziya. Bazi rezveutano mu Zimbabwe rine zvirongwa zvakasiyana siyan zvakatarwa zvakanangana nechirwere che Baraziya. Urongwa hwunoenderana nezvisungo zvebazi rehutano pasirose (*World Health organization*). Chinagwa chezvirongwa izvi ndechekuderedza uwandu hwevanhu vanobatwa nechirwere ichi.

Munopinda mutsvakurudzo nekuzvidira

Murikupinda mutsvakurudzo nekuzvidira. Hamufanirwi kupinda kana musingadi. Kana pane zvimwe zvamungada kunzwisisa makasununguka kubvunza.

Chii chichaitwa uye zvichatora nguva yakareba zvakadii?

Kana muchinge masarudza kupinda mutsvakurudzo, muchabvunzwa mibvunzo inechekuita nezvingangova zvichiisa mwana wenyu panjodzi yekubatwa ne Baraziya (*schistosomiasis*). Ndinotarisa kuti izvi hazvitori nguva inodarika maminiti makumi matatu (30 minutes).

Njodzi nekusagadzikana

- Hapana njodzi inotarisirwa kuti mungasangana nayo mutsvakurudzo ino
- Kupinda kwenyu mutsvakurudzo kunozitora chikamu chenguva yenyu zvinova zvinogona kukanganisa hurongwa hwenyu asi handitarisiri kuti zvinopfuura maminiti makumi matatu (*30 minutes*).

Zvamungawana kana muripo wamungawana

Hapana chamunotarisirwa kuwana nekuda kwekuti mapinda mutsvakurudzo. Hapana muripo wamuchapiwa kana mapinda mutsvakurudzo. Sezvambotaurwa, zvichabuda mutsvakurudzo zvinogona kuzobatsira veruzhinji maringe nekudzivirirwa uye kurapwa kechirwere che Baraziya.

Kuchengetedzeka

Ruzivo ruchawanika mutsvakurudzo zvinonongedzera kunemi semunhu haruzobudiswi pasina mvumo yenyu. Tsvakurudzo ino haizotori zita renyu kana zvimwe zvinokunongedzai semunhu asi kuti tichakuzivai kuburikidza nerupawo rwema namba matatu.

Mukana wekupindura mibvunzo

Ndinokutendai nenguva yenyu yamatora muchitora muchisarudza kupinda mutsvakurudzo. Musati maisa runyoro rwenyu pa rugwaro runo, ndapota bvunzai

mibvunzo yamungava munayo uye zvamungada kunzwisisa. Munokwanisa kutora nguva yose yamunoda kuti mupe sarudzo.

Gwaro rekupa mvumo

Kana masarudza kupinda mutsvakurudzo, munokumbirwa kuti muise runyoro rwenyu pazasi pakatarwa sechiratidzo chekuti maverenga gwaro ramapiwa mukabvuma kupinda mutsvakurudzo.

Zita rearikupinda mutsvakurudzo

Zita remuchengeti wearikupinda mutsvakurudzo

Zuva

Sainecha yemuchengeti kana mubereki weari kupinda mutsvakurudzo

Kana mune mibvunzo inechekuita netsvakurudzo ino kana gwaro retsvakurudzo isiri yamapindurwa nemutsvakurudzi, kusanganisira mibvunzo inechekuita nekodzero dzenyu semunhu apinda mutsvakurudzo, uye kana mufinga kuti hamuna kubatwa zvakana uye munoda kutaura nemumwe asiri mutsvakurudzi, sunungukai kubata ve Africa University research Ethics Committee panhare dznodi (020) 60075 kanakuti 60026 *extension* 1156; *email*: aurec@africau.edu

Zita remutsvakurudzi _____

MUCHAPIWA RIMWE GWARO KUTI MURICHENGETE

Appendix IV: Mutoko District hospital site approval

Telephone (263) 072 2411/5

Telegraphic ADDRESS

FAX (263) 072 2416

EMAIL: mutokohospital@gmail.com



ZIMBABWE

Ref:

MINISTRY OF HEALTH AND CHILD
WELFARE
MUTOKO DISTRICT HOSPITAL
P. O. BOX 59
MUTOKO
ZIMBABWE

10 JANUARY 2020

**The Province Medical Director
Mash East Province
P.O.Box 10
MARONDERA**

RE: AUTHORIZATION LETTER TO CONDUCT A RESEARCH STUDY AND REFURBISH PEADS WARD

The above matter refers.

This letter serves to confirm that Mutoko District Hospital Executive resolved to allow University of Zimbabwe to conduct a reasearch study at Mutoko District Hospital and to undertake the neccessary refurbishments at the hospital to enable the research to be successful.

Please be advised that Public Works Department Mutoko authorized structural refurbishments and all the marks to be done under the supervision of Public Works Department

Thank you.



DR P MANGWIRO 
A/DISTRICT MEDICAL OFFICER-MUTOKO

Appendix V: AUREC ethics approval



AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax (+263 20) 61785 website: www.africau.edu

Ref: AU1624//20

18 November, 2020

Edson Marambire
C/O CHANS
Africa University
Box 1320
Mutare

RE: UROGENITAL SCHISTOSOMIASIS IN PRE-SCHOOL CHILDREN IN MUTOKO DISTRICT

Thank you for the above titled proposal that you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following.

- a) Research proposal
- b) Data collection instruments
- c) Informed consent guide
- **APPROVAL NUMBER** AU1624/20/20
This number should be used on all correspondences, consent forms, and appropriate documents.
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** November 18, 2020
- **EXPIRATION DATE** November 18, 2021
- **TYPE OF MEETING** Expedited
After the expiration date this research may only continue upon renewal. For purposes of renewal, a progress report on a standard AUREC form should be submitted a month before expiration date.
- **SERIOUS ADVERSE EVENTS** All serious problems having to do with subject safety must be reported to AUREC within 3 working days on standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.



Yours Faithfully

MARY CHINZOU – A/AUREC ADMINISTRATOR FOR CHAIRPERSON, AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE

Appendix VI: Plagiarism report



Document Information

Analyzed document	EDSON MARAMBIRE DISSERTATION_Final_ (1).docx (D100160634)
Submitted	3/30/2021 10:39:00 AM
Submitted by	Dr Eltony Mugomeri
Submitter email	mugomerie@africa.ug.edu
Similarity	10%
Analysis address	mugomerie.africa@analysis.arkund.com

Sources included in the report

The researcher acknowledges similarity of content that came out of the plagiarism report. Use of own words, paraphrasing, were necessary and use of synonyms for key words were used to address the plagiarism problem as noted in the report. Proper acknowledgement of sources was also used to address the problem. It should however be noted that, there are some sections that were left unchanged such as the format of the report, abstract, declaration, chapter headings and subheadings as these were part of the research format. Some references were also not changed as similar sources could have been used in other research work by other scholars.