

**PREVALENCE OF SCHISTOSOMIASIS AMONG PRIMARY SCHOOL CHILDREN IN
DAKACE DISTRICT, ZARIA LOCAL GOVERNMENT AREA, KADUNA STATE,
NIGERIA**

BY

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NIGERIA

BY

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JANUARY, 2017

DECLARATION

I declare that the work in this dissertation entitled “PREVALENCE OF SCHISTOSOMIASIS AMONG PRIMARY SCHOOL CHILDREN IN DAKACE DISTRICT, ZARIA LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA” has been carried out by me in the Department of Biology, Ahmadu Bello University, Zaria, Nigeria. The information derived from the literature has been duly acknowledged in the text and in a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any institution.

Rebecca IYANAM

Signature

Date

CERTIFICATION

This dissertation entitled, PREVALENCE OF SCHISTOSOMIASIS AMONG PRIMARY SCHOOL CHILDREN IN DAKACE DISTRICT, ZARIA LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA, NIGERIA BY IYANAM REBECCA, meets the regulations governing the award of the degree of Master of Science in Educational Biology of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to God Almighty, the creator of heaven and earth, the universe and everything therein.

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Finally, to all my friends and postgraduate students 2012-2013 set, I will always remember you for being there for me.

ABSTRACT

Urine and stool samples were collected from 540 students (9-14 years) in at Dakace district in Zaria Local Government Area of Kaduna State. The samples were examined for urinary and intestinal Schistosomiasis infection. Each student was interviewed and data collectors used a structured pre-tested questionnaire that included questions on socioeconomic status of the family and risk factors that may be associated with schistosomiasis infection. A standard filtration technique was used to diagnose and quantify ova of *S. haematobium* and *S. mansoni*. Ten millilitre (10 ml) of urine was filtered through 13 mm diameter in 12 µm pore size of nylon mesh filter using plastic syringe. The filter containing the filtrate was removed and placed on a clean microscopic slide and examined under a middle power objective (X40). After examining the whole field, microscopic slides containing eggs of *S. haematobium* were recorded as positive while absence of eggs was taken as negative. Stool samples were tested for the presence of *S. mansoni* eggs using the standard Kato Katz technique. Two slides from the same stool samples were prepared and examined for infection. Odds ratio and Pearson Chi square test was used to determine the association and relationship between age, school, risk factor and sex with schistosoma infection. An overall prevalence of 120 (22.22%) was recorded with *S. haematobium* and *S. mansoni* in all. *Schistosoma haematobium* recorded the highest prevalence of 14 (28.15%) in urine, while *S. mansoni* accounted for only 46 (17.04%) in stool samples examined. There were significant difference ($p < 0.05$) in the infection of schistosomiasis among different schools in Dakace district with the highest (34.44%) and lowest (7.78%) infection were obtained from Nagoyi Local Government Education Authority (L. G. E. A.) primary school and Kith and Kin Academy respectively. The age specific prevalence of schistosomiasis ranged between 23 (12.78%) in ages 9-10 to 54 (30.00%) in 13-14 years age group. The prevalence of

schistosomiasis was higher in males (14.07%) than their females (8.15%) counterpart. There were significant ($p < 0.05$) association between prevalence infection with source water (Well; OR = 1.529; Tap; OR = 2.053 and stream/river; OR = 2.125) and faecal disposal using pit latrines, OR = 1.117 and water systems, OR = 1.992. Schistosomiasis was not associated with fishing, swimming and washing in the river/stream. The prevalence of 22.22% was established in the selected schools in Dakace district of Zaria. Health education and large-scale chemotherapy for all school children to decrease the prevalence and intensity of infection would be highly suitable.

TABLE OF CONTENTS

Contents	Pages
Title	i
Declaration	iv
Certification	v
Dedication	vi
Acknowledgements	vii
Abstract	viii
Table of Contents	x
List of Tables	xiii
List of Figures	xiv
List of Plates	xv
List of Appendices	xvi
CHAPTER ONE	
1.0 INTRODUCTION	1
1.1 Background of the Study	4
1.2 Statement of the Research Problems	4
1.3 Justification	5
1.4 Aim	5
1.5 Objectives	5
1.6 Hypotheses	6
CHAPTER TWO	
2.0 LITERATURE REVIEW	7
2.1 Background on Schistosomiasis	7

2.2	Life Cycle of Schistosomiasis	7
2.2.1	Life cycle stages of shitosoma	9
2.2.1.1	<i>Adults</i>	9
2.2.1.2	<i>Eggs</i>	10
2.2.1.3	<i>Miracidium stage</i>	10
2.2.1.4	<i>Cercaria stage</i>	10
2.3	Diagnostic Morphological Features of the <i>Schistosoma</i> species	16
2.4	Differential Diagnosis	17
2.5	Geographical Distribution of Schistosomiasis	17
2.6	Pathogenesis	18
2.7	Treatment and Control	20
2.8	Vectors of Schistomiasis	21
 CHAPTER THREE		
3.0	MATERIALS AND METHODS	24
3.1	Study Area	24
3.2	Ethical Clearance	26
3.3	Study Design	26
3.3.1	Sample size estimation.....	26
3.3.2	Sample selection.....	28
3.3.3	Data collection.....	28
3.4	Microscopic Diagnosis of <i>Schistosoma</i> species Infection	29
3.5	Data Analyses	30
 CHAPTER FOUR		
4.0	RESULTS	31

4.1	Distribution of <i>Schistosoma</i> species among Schools.....	31
4.2	Age Specific Prevalence of Schistosomiasis among Pupils in Dakace District	33
4.3	Sex Specific Prevalence of Schistosomiasis among Pupils in Dakace District, Zaria	35
4.4	The Risk Factors Associated with Schistosomiasis Infections.....	37
4.5	The Mean Intensity of Schistosomiasis among School Pupils in Dakace District	40
CHAPTER FIVE		
5.0	DISCUSSION.....	43
CHAPTER SIX		
6.0	SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....	48
6.1	Summary	48
6.2	Conclusion.....	48
6.3	Recommendations.....	49
	REFERENCES.....	51

LIST OF TABLES

Tables	Pages
2.1	<i>Schistosoma</i> species geographical distribution and their snail vectors.....19
4.1:	The prevalence of <i>Schistosoma haematobium</i> and <i>S. mansoni</i> among primary schools pupils in Dakace district.....32
4.2:	Age specific prevalence of <i>S. haematobium</i> and <i>S. mansoni</i> among primary school pupils in Dakace district.....34
4.3:	Sex specific prevalence of Schistosomiasis infection among pupils in Dakace district36
4.4:	Risk factors associated with Schistosomiasis infection of pupils in Dakace district38
4.5:	Intensity of <i>Schistosoma haematobium</i> and <i>Schistosoma mansoni</i> Infection among Primary Schools in Dakace District.....41

LIST OF FIGURES

Figure	Page
2.1: Generalised life cycle of schistosomiasis.....	15
3.1: Zaria showing location of schools sampled	25

LIST OF PLATES

Plate	Pages
I: Adult stage of <i>Schistosoma</i>	11
II: Egg of <i>Schistosoma</i>	12
II: Miracidium of <i>Schistosoma</i>	13
IV: Cercarium of <i>Schistosoma</i>	14

APPENDICES

Appendices	Page
I: The egg of <i>Schistosoma mansoni</i>	60
II: The egg of <i>Schistosoma haematobium</i>	61
III: Horizontal view of <i>Schistosoma haematobium</i> egg	62
III: Questionnaire	63
IV: Informed Consent Form	

CHAPTER ONE

1.0

INTRODUCTION

1.1 Background of the Study

Schistosomes are important human and animal parasites throughout Africa, Asia and South America, predominantly in rural areas that support agriculture and inland fisheries. The distribution of *Schistosomes* are linked to that of their snail intermediate hosts (*Bulinus* and *Biomphalaria* spp.), which differ in their habitat preferences for slow-flowing or still waters (CDC, 2011). The impact of schistosomiasis has long been underestimated (Bergquist, 2002). It ranks second only to malaria as the most common parasitic disease, killing an estimated 280,000 people each year in the African region alone (CDC, 2011). The prevalence of schistosomiasis, like most parasitic disease is related to poverty and poor living conditions (Engels *et al.*, 2002).

Despite intensive efforts to control the disease, it has been found to affect nearly 240 million people worldwide each year and more than 700 million people live in endemic areas (WHO, 2010). Nonetheless, 85% of the cases reported annually occur in sub-Saharan Africa and over 150,000 deaths are associated with chronic infection caused by *S. haematobium* in the African region (Hotez and Kamath, 2009; WHO, 2010). Schistosomiasis with soil-transmitted helminthiasis continue to represent more than 40% of the disease burden caused by all tropical diseases, excluding malaria (Hotez and Kamath, 2009). The disease is common in the Niger basin and is found in every country within the West African sub-region (Brown and Wright, 1985; Hegertun *et al.*, 2013).

In Nigeria, one of the most severely affected countries in Africa, it is estimated that 101.28 million people are at risk of infection while 25.83 million are infected with *Schistosoma*

haematobium, *Schistosoma mansoni* and *Schistosoma intercalatum* (Chitsulo *et al.*, 2000). The risk and reemergence of urinary schistosomiasis is attributed to the range of snail habitats promoted by water development schemes such as dam construction (WHO, 2010). Furthermore, school age children who have frequent water contact are more vulnerable to schistosomiasis, and hence this age group that are often associated more frequently with schistosomiasis problems (Deribe *et al.*, 2011; Bala *et al.*, 2012).

Urogenital or urinary schistosomiasis is caused by *Schistosoma haematobium* while intestinal schistosomiasis is caused by *S. guineensis*, *S. intercalatum*, *S. mansoni*, *S. japonicum*, and *S. mekongi* (Hotez and Kamath, 2009). Other Schistosomes of veterinary importance reported in man include *Schistosoma bovis*, *Schistosoma mathei*, *Schistosoma hippopotami*, *Schistosoma sprinadalis* and *Schistosoma rohhaini* (Noble and Glem, 1982; Taylor and Naidu, 2013).

The intermediate snail host of *S. mansoni* is *Biomphalaria* spp. *Bulinus* snails are intermediate host for *S. haematobium* and *Oncomelania* snail for *S. japonicum* (Ukoli, 1984). The parasitic larvae of *Schistosoma* species live in fresh water. It has the ability to penetrate host skin, predisposing people to the risk of infection due to everyday activities such as washing laundry or fetching water. Human contact with water is thus necessary for infection by schistosomes. Animals such as dogs, cats, rodents, pigs, horses and goats serve as reservoirs for *Schistosoma* spp.

Various socio-epidemiological factors are responsible for transmission of the disease and level of infection; some of which include distance from transmission site, migration and emergence of new foci, urbanization, socio-economic status, sanitation, water supply patterns and level of faecal contamination of water source (Sammy *et al.*, 2011).

The provision of civilized swimming pools which is for recreational activities could serve as a good control measure for the spread of the disease (Gracio *et al.*, 1992). Wearing of footwear to protect the legs could also be a good protective measure against active penetration by the cerceriae of the *Schistosoma* (Sammy *et al.*, 2011). The geographical distribution of schistosomiasis in any locality depends on the distribution of the snail hosts and opportunities for infection of both the snail and human (Luka *et al.*, 2005; Pillay *et al.*, 2014).

School aged children are mostly infected with this silent destructive disease because it is easily contracted while bathing or swimming in water contaminated with the parasite that is shed by snails (Kabatereine *et al.*, 2004; Kanwai *et al.*, 2011). It has been estimated that every year, a child's risk of infection increases, peaking between the ages of 10 and 20 (Kabatereine *et al.*, 2004). However, the intensity of their infection, as measured by quantitative egg counts of faeces or urine, shows the heaviest burden in the youngest age group. The morbidity associated with childhood infection can result in cognitive and growth stunting that is irreversible (Nokes *et al.*, 1999).

Clinical manifestations of schistosomiasis are associated with the species-specific oviposition sites and the burden of infection (WHO, 2006). This parasitic infection imposes significant economic burdens on individuals, communities and nations (Blas *et al.*, 2006). Urinary schistosomiasis is a chronic disease usually characterised by haematuria, dysuria, urinary frequency but in highly endemic areas, more than 50% of children show moderate to severe urinary pathology (van der Werf, 2003). A survey in the year 2000 of the disease-specific mortality, reported that 70 million individuals, out of 682 million, had experienced haematuria and 32 million, dysuria associated with *S. haematobium* infection (van der Werf, 2003; Pillay *et*

al., 2014). It is associated with bladder and uretral fibrosis, sandy patches in the bladder mucosa and hydronephrosis that are commonly seen in chronic cases while bladder cancer is possible at late stage complication (Gryseels, 2006). The WHO estimates that out of these infected individual 18 million suffered cancers of the bladder and 10 million hydronephrosis (King *et al.*, 2005).

On the other hand, intestinal clinical manifestations include abdominal pain, diarrhoea, and blood in the stool. In advanced cases, hepatosplenomegaly is common and is repeatedly associated with ascites and other signs of portal hypertension (Mostafa, 1999). Genital disease is present in approximately one third of infected women (Poggensee *et al.*, 2001), resulting in a variety of vulvar and perineal disease, including ulcerative, fistulous, or wart-like lesions. Vulvar schistosomiasis may also facilitate the transmission of HIV (Stephenson *et al.*, 1989; Feldmeier *et al.*, 1995).

1.2 Statement of the Research Problems

The global burden of schistosomiasis has been estimated at 1.7–4.5 million disability-adjusted life years lost per annum (Molyneux *et al.*, 2005), but new research suggests that this estimate is a considerable underestimation of the true burden of schistosomiasis (Jia *et al.*, 2007). Children born in Nigerian villages are highly exposed to parasitic infection almost throughout their lifetime. According to the National Schistosomiasis Control Programme, the lack of adequate studies on schistosomiasis prevalence in some developing countries such as Nigeria and under developed countries has stalled the implementation of a treatment strategy. Schistosomiasis disease burden needs to be identified as a health problem in Dakace district, Zaria Local Government Area of Kaduna State, particularly among school children. The information on schistosomiasis disease in Dakace district is sketchy and therefore remains unknown.

1.3 Justification

Schistosomiasis is the most prevalent of the waterborne diseases and constitutes a serious health risk in rural areas of developing countries (Van der Werf, 2003; Pillay *et al.*, 2014). Children under 18 years of age are reported to be highly susceptible to the scourge of this disease. Schistosomiasis as a public health problem and has not been properly researched and documented in Dakace district of Zaria Local Government Area, Kaduna State. The information obtained may therefore serve as a guide to the schistosomiasis Control Programme of the State Ministry of Health in Kaduna State Nigeria and applying treatment plans for schistosomiasis in Dakace district.

1.4 Aim

To access the prevalence of schistosomiasis among primary school pupils in Dakace district, Zaria Local Government Area, Kaduna State.

1.5 Objectives

- i. To determine the prevalence of *Schistosoma mansoni* among primary school pupils in six selected primary schools in Dakace district of Zaria Local Government Area.
- ii. To determine the prevalence of *Schistosoma haematobium* in primary school pupils of six selected primary schools in Dakace district of Zaria Local Government Area
- iii. To determine the risk factors associated with schistosomiasis among primary school pupils in Dakace district.

1.6 Hypotheses

- i. There is no significant difference in the prevalence of *Schistosoma mansoni* in primary school pupils of six selected primary schools in Dakace district of Zaria Local Government Area
- ii. *Schistosoma haematobium* is not prevalent among primary school pupils in Dakace district of Zaria Local Government Area.
- iii. There are no risk factors associated with schistosomiasis infections among primary school pupils in Dakace district of Zaria Local Government Area.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Background on Schistosomiasis

Schistosomes are not hermaphroditic but dioecious, forming separate sexes. Adult worms have elongated tubular bodies, each male having a unique gynecophoral canal (schisto-soma = split body) in which a female worm resides. They live inside visceral blood vessels and are commonly known as blood flukes. They have digenetic life-cycles involving aquatic snails as obligate intermediate hosts (WHO, 2002). Eggs deposited in the circulation penetrate the gut or bladder to be excreted with faeces or urine. In water, the eggs release miracidia which infect snails and undergo asexual proliferation through sporocyst stages eventually releasing cercariae back into the water. Vertebrate hosts become infected by direct penetration of the skin. Infections may cause chronic debilitating diseases in humans and some domestic animals (Olveda *et al.*, 2008)).

2.2 Life Cycle of Schistosoma

Schistosomes have indirect digenetic life-cycles, involving sexual reproduction in vertebrate definitive hosts and asexual reproduction in snail intermediate hosts. Parasites are transmitted between hosts by motile aquatic stages which actively seek hosts. Human contact with water is thus necessary for infection by schistosomes. Various animals, such as dogs, cats, rodents, pigs, horse and goats serve as reservoirs for *S. japonicum*, and dogs for *S. mekongi* (Rine *et al.*, 2013). Female worms produce numerous eggs (200-3,000 per day) which seek to exit the host by penetrating the gut or bladder wall and being passed with host faeces or urine. In that time, they actively seek suitable intermediate hosts (amphibious snails) using chemotaxis and phototaxis despite absence of eyespots (Southgate *et al.* 2005). Under optimal conditions the eggs hatch and release miracidia, which swim and penetrate the specific snail intermediate hosts. The

miracidia invade the soft tissues of the snail and form a mother sporocyst near the site of penetration. Daughter sporocysts are produced 2-6 weeks after infection and they migrate to other organs in the snail (Stothard *et al.*, 2002).

Schistosomes do not produce redia stages; instead the sporocysts produce cercariae which are released into the water in their thousands beginning 4 weeks after infection. The stages in the snail include 2 generations of sporocysts and the production of cercariae. Upon release from the snail, the infective cercariae swim and periodically swim to surface of the water and then sink to bottom for up to three days. They are attracted to skin secretions and when they come into contact with a prospective definitive host in which they penetrate the skin of the human host within minutes and shed their forked tail, becoming schistosomulae. Inside the host, the schistosomula (little schistosomes) migrate through several tissues in blood and/or lymph to the portal vessels in liver, where they develop for 3 weeks (Satayathum *et al.*, 2006). Adult worms in humans reside in the mesenteric venules in various locations, which at times seem to be specific for each species. For instance, *S. japonicum* is more frequently found in the superior mesenteric veins draining the small intestine and *S. mansoni* occurs more often in the superior mesenteric veins draining the large intestine. However, both species can occupy either location and they are capable of moving between sites, so it is not possible to state unequivocally that one species only occurs in one location (Rine *et al.*, 201). *Schistosoma haematobium* most often occurs in the venous plexus of bladder, but it can also be found in the rectal venules. The females (measuring 7 to 20 mm; males slightly smaller) deposit eggs in the small venules of the portal and perivesical systems. The eggs are moved progressively toward the lumen of the intestine (*S. mansoni* and *S. japonicum*) and of the bladder and ureters (*S. haematobium*) they are eliminated with faeces or urine respectively (Atupele *et al.*, 2009).

Pathology of *S. mansoni* and *S. japonicum* schistosomiasis includes: Katayama fever, hepatic perisinusoidal egg granulomas, Symmers' pipe stem periportal fibrosis, portal hypertension and occasional embolic egg granulomas in brain or spinal cord. Pathology of *S. haematobium* schistosomiasis includes: hematuria, scarring, calcification, squamous cell carcinoma and occasional embolic egg granulomas in brain or spinal cord (Atupele *et al.*, 2009).

2.2.1 Life cycle stages of shitosoma

The parasitic larvae live in fresh water and can penetrate human skin, placing people at risk through everyday activities such as washing laundry or fetching water. Inside the victim's body, adult female worms lay thousands of eggs that cause significant damage to internal organs, most commonly from scarring the intestines, bladder, kidneys, liver, or lungs. Children suffer the most from schistosomiasis, which causes poor growth and impaired cognitive function. The disease is completely preventable and can be controlled through an annual cheap drug treatment, health education and access to safe water and sanitation (Oliveira *et al.*, 2004).

2.2.1.1 Adults

Mature adult *Schistosoma mansoni* (Plate I) are about 1 cm long. The male and female form a reproductive pair, with the female held by the male within a groove. Females release eggs, into the blood vessels. A pair may live for years within the host, the female producing thousands of eggs during this time (Swanner *et al.*, 2014).

2.2.1.2 Eggs

Schistosoma mansoni egg (Plate II) has a characteristic lateral spine. The miracidium stage can be seen within the egg that is passed out through the wall of the host's intestine. The circulation

of eggs in the blood cause much of the pathology associated with schistosomiasis, as they become trapped in the liver and other internal organs. The eggs in the intestine pass out of the body with faeces and if they come into contact with fresh water, hatch into a free-living stage called the miracidium (Swanner *et al.*, 2014).

2.2.1.3 Miracidium stage

The miracidium (Plate III) is a short-lived free-swimming stage of *Schistosoma mansoni* that infects snails. It swims about in the water, propelled by the cilia that cover their body, never feed and live for about a day. Miracidia must locate and infect another freshwater snail host to continue the life-cycle. Within the snail, a miracidium transforms into a sporocyst, a factory for producing the next life-cycle stage, the cercaria (Swanner *et al.*, 2014).

2.2.1.4 Cercaria stage

The cercaria (Plate IV) is the stage of *Schistosoma mansoni* that infect humans. The sporocyst produces cercariae through asexual reproduction, so that one miracidium can produce thousands of genetically identical cercariae. Somewhere around 3-4 weeks after being infected, the snail begins to shed cercariae into the water (Figure 2.1).



Plate I: Adult stage of *Schistosoma mansoni* (Collings *et al.*, 2011)



Plate II: Egg of *Schistosoma mansoni* (Collings *et al.*, 2011)

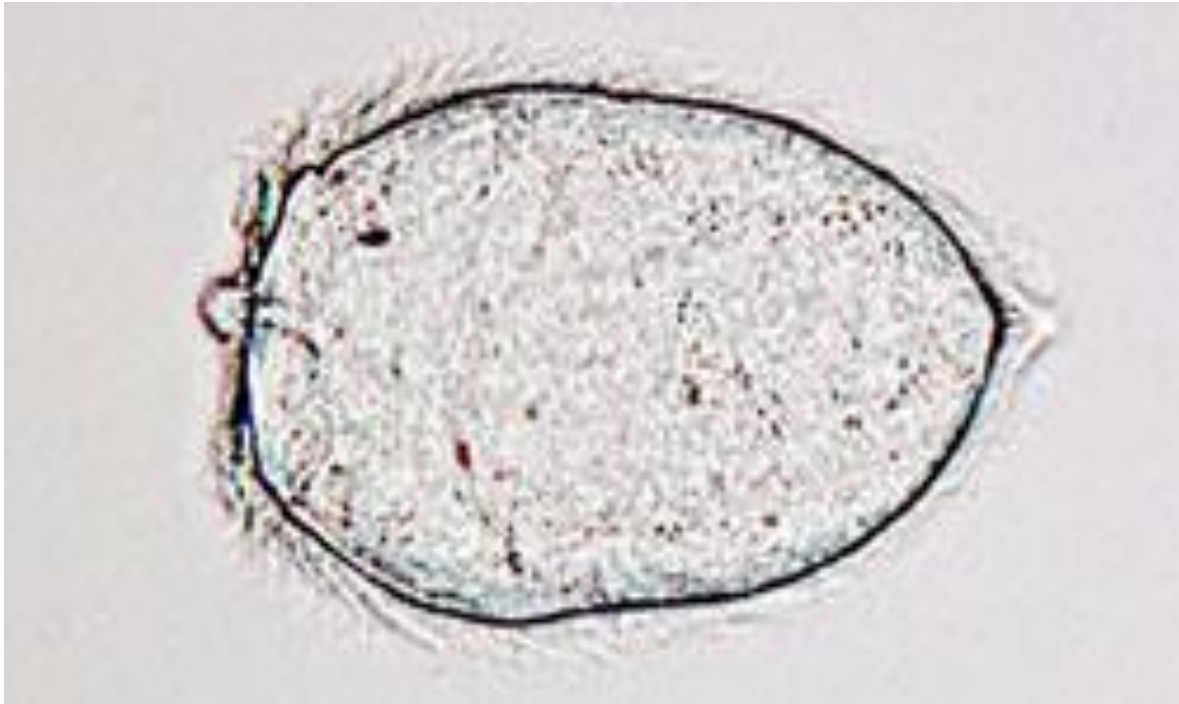


Plate III: Miracidium of *Schistosoma* (Collings *et al.*, 2011)



Plate IV: Cercarium of *Schistosoma* (Collings *et al.*, 2011)

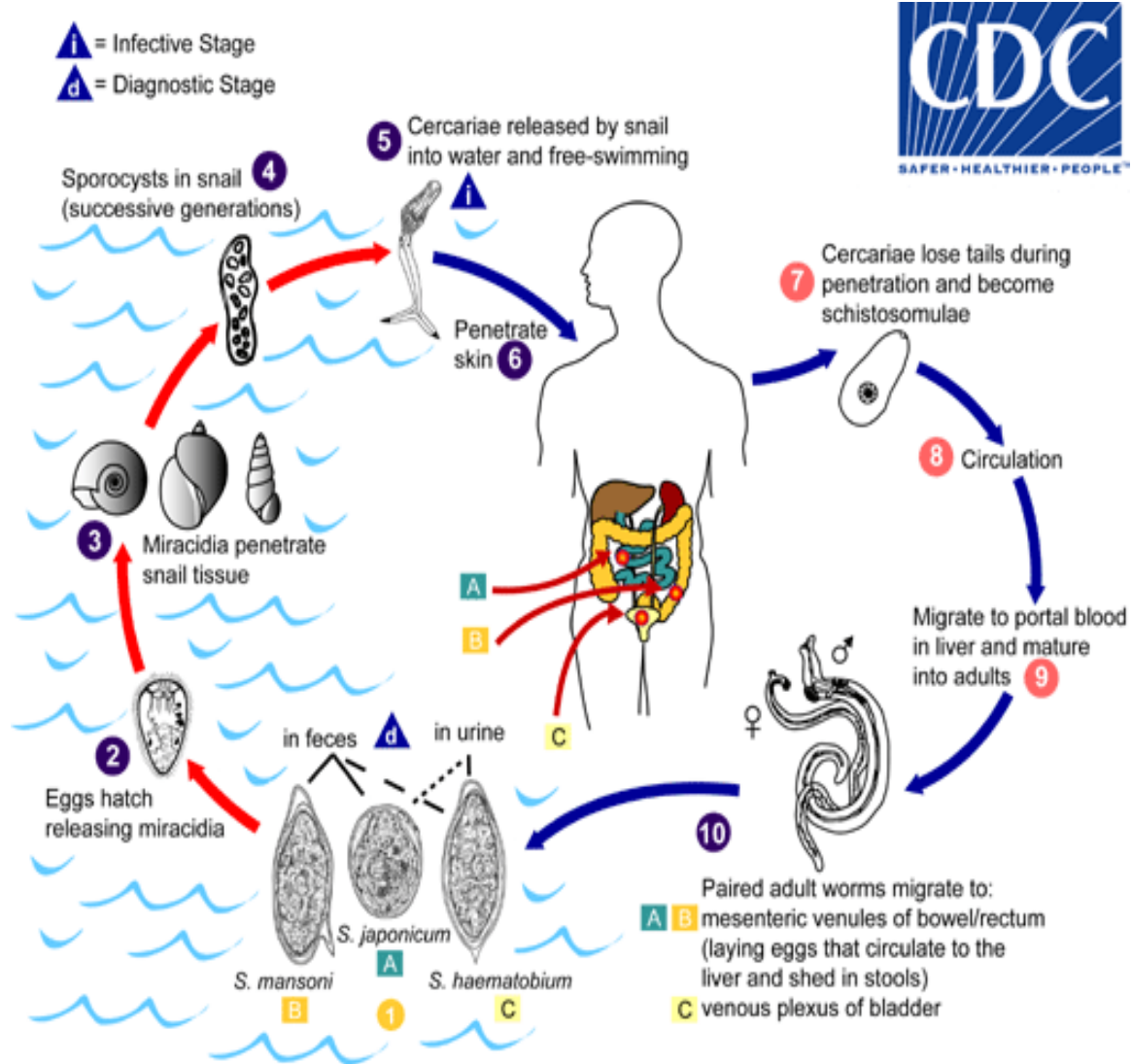


Figure 2.1: Generalised life cycle of schistosoma (CDC, 2011)

Like miracidia, cercariae do not feed, live for about a day and propel themselves with an actively beating tail, swimming tail-first through the water. The cercaria is the stage that infects humans. Cercariae infect their human host by penetrating through the skin. In about a month, the cercariae have developed into mature schistosomes that have formed pairs, migrated to the blood vessels around the intestine and have begun to produce eggs (Swanner *et al.*, 2014).

2.3 Diagnostic Morphological Features of the *Schistosoma* species

Blood flukes form five different developmental stages which include eggs, miracidia, sporocysts, cercariae and adult worms. Eggs are round to oval in shape, operculate (hinged at one end) and contain a developing embryonic larva (miracidium). Differences in egg morphology can be used to distinguish between *Schistosoma* species: *S. mansoni* producing oval eggs (115-175 x 45-7µm) with a sharp lateral spine; *S. japonicum* forming round eggs (70-100 x 50-70µm) with a rudimentary lateral spine; and *S. haematobium* producing oval eggs (110-170 x 40-70µm) with a sharp terminal spine. Miracidia are elliptical free-swimming larval stages (~200µm long) covered with cilia. Sporocysts appear as pleomorphic sac-like bodies which contain developing cercariae. Mature cercariae are elongate free-swimming larval stages (400-600µm long) consisting of a tapering head (with prominent penetration glands) and a forked tail (furcocercous). Adult flukes are elongate tubular worms (10-20mm long), with rudimentary oral and ventral suckers. Males are shorter and stouter than females and they have a longitudinal cleft (gynecophoral canal or schist) in which the longer slender female lies folded (Steinmann *et al.*, 2006; Collins *et al.*, 2011).

2.4 Differential Diagnosis

Infections are conventionally diagnosed by the detection of fluke eggs in faecal or urine samples often after concentration by sedimentation/flotation or filtration techniques. The eggs are sufficiently characteristic to facilitate specific diagnosis. On occasion, microscopy of rectal biopsies has been used to diagnose *S. haematobium* infections. Immunoserological tests have been developed to detect host antibodies against infection but they have experienced cross-reactivity problems and cannot discriminate between previous and active infection. More recently, molecular techniques have been used to detect parasite antigens or DNA in host samples; some tests showing good correlations with parasite burdens (Rutherford, 2000).

2.5 Geographical Distribution of Schistosomiasis

Schistosomes are important human and animal parasites throughout Africa, Asia and South America, predominantly in rural areas supporting agriculture and inland fisheries. Parasite distribution is linked to that of their snail intermediate hosts, which differ in their habitat preferences for slow-flowing or still waters. Many human activities also influence parasite distribution, especially the construction of irrigation channels and dams, and flood irrigation of crops. It has been estimated that over 200 million people may be infected worldwide. Infections have been recorded throughout human history, first being mentioned in ancient Egyptian papyri dated from 2000-1000 BC (Kloos and Rosalie, 2002).

Haematuria (bloody urine) became the scourge of Napoleon's army in northern Africa at the turn of the 18th century, and the disease later became known as bilharzia in honour of the discoverer of the causative agent. *Schistosoma* spp. vary in their specificity for intermediate hosts, some

only developing in humans (and possibly primates) while others may infect domestic and wild animals (Table 2.1), acting as reservoirs for human infection (Donald and McNeil, 2009).

2.6 Pathogenesis

Schistosomiasis (or bilharziasis) is unusual amongst helminth diseases for two reasons as much of the pathogenesis is due to the eggs (rather than larvae or adults) and most of the pathology is caused by host immune responses (delayed-type hypersensitivity and granulomatous reactions). The course of infection is often divided into three phases: migratory, acute and chronic (Freitas *et al.*, 2010). The migratory phase occurs when cercariae penetrate and migrate through the skin. This is often asymptomatic, but in sensitized patients, it may cause transient dermatitis ('swimmers itch'), and occasionally pulmonary lesions and pneumonitis. The acute phase (sometimes called Katayama fever) is coincident with first egg release and is characterized by allergic responses (serum sickness due to overwhelming immune complex formation), resulting in pyrexia, fatigue, aches, lymphadenopathy, gastrointestinal discomfort and eosinophilia. The chronic phase occurs in response to the cumulative deposition of fluke eggs in tissues and the host reactions that develop against them. Not all the eggs laid by female worms successfully penetrate the gut or bladder walls, many are swept away in the circulation and become trapped in organs where they elicit strong granulomatous responses (Geffen *et al.*, 2007).

Table 2.1 *Schistosoma* species geographical distribution and their snail vectors

Parasites Species	Definitive host	Site of infection	Egg Excretion	Snail vector	Geographical location
<i>S. haematobium</i>	Humans primates	Veins of urogenital system	Urine	<i>Bulinus</i>	Africa

<i>S. mansoni</i>	Humans, rodent	Intestinal mesenteric vein	Faeces	<i>Biomphalaria</i>	Africa, America
<i>S. japonicum</i>	Humans, ruminants,	Intestinal mesenteric vein	Faeces	<i>Oncomelania</i>	SE Asia
<i>S. intercalatum</i>	Humans, rodents, cattle	Intestinal mesenteric vein	Faeces	<i>Bulinusi, Physopsis</i>	Africa
<i>S. mekongi</i>	Dog/cat/humans	Intestinal mesenteric vein	Faeces	<i>Oncomelania</i>	SE Asia
<i>S. bovis</i>	Ruminants	Intestinal mesenteric vein	Faeces	<i>Bulinus</i>	Africa, SE Asia, Middle East, Europe
<i>S. mattheei</i>	Ruminants	Intestinal mesenteric vein	Faeces	<i>Bulinus</i>	Africa, Middle East

Source (CDC, 2011)

Eggs become surrounded by inflammatory cells forming characteristic pseudotubercles which may coalesce to form larger granulomatous reactions (polyps). The encapsulated eggs die and eventually calcify. The resultant effects on host organs and tissues are manifold, and include intestinal polyposis, abdominal pain, diarrhoea, glomerulonephritis, pulmonary arthritis, cardiovascular problems including heart failure, and periportal (Symmer's clay pipe-stem) fibrosis (Sadjjadi *et al.*, 2001). Portal hypertension often leads to hepatomegaly, splenomegaly, ascites, and sometimes gross enlargement of oesophageal and gastric veins (varices) which may burst. Cerebral granulomas have been associated with focal epileptic convulsions, while spinal cord granulomas may cause transverse myelitis. Infections by *S. haematobium* often cause haematuria (blood in urine) and progressive disruption of the bladder wall may lead to carcinoma (Freitas *et al.*, 2010).

2.7 Treatment and Control

The drug of choice for the treatment of all *Schistosoma* spp. is praziquantel, a single oral dose being very effective, with low toxicity and good tolerance, even in severe clinical cases. Nitridazole and metrifonate are effective against *S. haematobium*, and oxamniquine against *S. mansoni*, but they have mild side-effects (WHO, 2013). While timely treatment is effective, cured individuals rapidly become re-infected in endemic areas. Various control programmes have therefore been developed based on mass chemotherapy in conjunction with preventive measures, including improved sanitation, snail vector control, modifying habitats and farming practices, and public education campaigns (WHO, 2013). Water contamination can be reduced by preventing the ingress of parasite eggs as well as curtailing the asexual amplification cycle in snail hosts. The provision and use of latrines contains sources of infection, and modern biocomposting toilets appear to be effective in killing parasite eggs when used properly (Abou-

zeid *et al.*, 2012). Snail populations may be reduced by the strategic use of molluscicides (niclosamide or copper sulphate), draining marshes and swamps, and clearing channels of vegetation. Irrigation practices can be modified to avoid long-standing still waters, and different or improved crops can be used which are less dependent on lengthy immersion in water. In endemic areas, farmers (and visitors) need to be aware of the dangers of immersion in potentially contaminated waters. Considerable resources have been devoted to the development of cellular, subcellular and recombinant vaccines, and promising results have been obtained with animal models of disease (WHO, 2013).

2.8 Vectors of Schistosomiasis

Vectors of schistosomiasis are the snails – *Bulinus globosus*, as intermediate host of *S. haematobium* and *Biomphalaria pfeifferi*, the intermediate host of *S. mansoni* (Anosike *et al.*, 2001). The *Schistosoma* parasite undergoes part of its development in fresh water planorbid snails, which serve as intermediate hosts. These planorbid snails usually attach themselves to aquatic vegetation which serves as food, microhabitats and protects them from being washed away by moving water currents. They are also used by the snail vectors as repository for their eggs (Ofori, 1999). Land contours, soil composition, hydrography, and climate all have a significant effect on snail population dynamics (Frederico and Constança, 1994). Although any physical, chemical, or biological factor can have a significant effect on population dynamics, a few factors especially those related to climate (temperature and rainfall) are of particular importance in the natural history of planorbid snails (Frederico and Constança, 1994). These intermediate host snails occur in ponds, dams, lakes, slow sections of streams, drains and irrigation canals, marshes and swamps (Obeng, 1997). Various genera of these planorbid snails have been associated with specific parasite types. For example *Bulinus* sp. is responsible for

hosting the *Schistosoma haematobium* parasite while *Biomphalaria* and *Oncomelania* spp. are responsible for hosting *S. mansoni* and *S. japonicum* respectively (Ayanda, 2009; Madsen *et al.*, 2008). Comprehensive ecological researches on schistosome vectors in the Western and Northern parts of Nigeria started about two and a half decades ago with the works of Asumu (1975) in Ibadan and environs and Tayo and Jewsbury (1978) in Malumfashi district of the then Kaduna State (now Katsina State). Several reports from various parts of Nigeria on human intestinal helminthes include those of Awogun *et al.* (1995), Nwaorgu *et al.* (1998) and Adeyeba and Akinlabi (2002). Urinary schistosomiasis due to *S. haematobium* infection is also endemic in many parts of Nigeria (WHO, 1993).

Being freshwater organisms, they inhabit limited physical spaces, but they continue to grow throughout their life span. They are found in a wide variety of habitats, and in particular in shallow, lentic, and lotic bodies of water with weak currents. In general they are highly, or at least relatively, resistant to desiccation (Floyd *et al.*, 2008). They live under a narrowly defined range of conditions, in terms of temperature, salinity, and pH; the optimal temperature for their development is 20-26°C, and they maintain themselves at a lower limit of 18°C and an upper limit of 30-32°C; *B. glabrata* is inhibited at sodium chloride concentrations of 6,000 ppm., and the optimal pH for development is in the range of 7.0-8.0 (Gabriel *et al.*, 2014). Planorbid snails are not found in all bodies of fresh water, not even in all those that might be considered capable of meeting their basic requirements. They occupy the second trophic level in the food chain, but are also capable of living saprophytically. They are hermaphrodite, albeit with a preferential tendency for heterofertilization (Keiser and Utzinger, 2005).

These features give planorbids certain special characteristics, even though, in terms of population dynamics, they conform to the general pattern expected of freshwater animals (Keiser and Utzinger, 2005).

It is also noteworthy that *Biomphalaria* snails do not maintain stable populations. Striking fluctuations occur, at times seasonally, at times on an *ad hoc* basis as a result of human activity, and at times for no reason that is as yet understood. Certain human activities such as landfilling, diversion of watercourses, pollution, and so forth can have a catastrophic effect on population levels (Odiere *et al.*, 2012).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

Zaria is situated on latitude 11° 4'12" N and longitude 74° 2' E at an altitude of 675 metres above sea level with the population of 975228 people (Laah *et al.*, 2011). Zaria, initially known as Zazzau, was also the capital of the Hausa kingdom of Zazzau. However, human settlement predates the rise of Zazzau, as the region, like some of its neighbors, had a history of sedentary Hausa settlement, with institutional but pre-capitalist market exchange and farming (Smith, 1960; Maiwada and Renne, 2007).

Zaria's economy is primarily based on agriculture. Staple crops are guinea corn and millet, and cash crops include cotton, groundnuts and tobacco (Gihring, 1984).

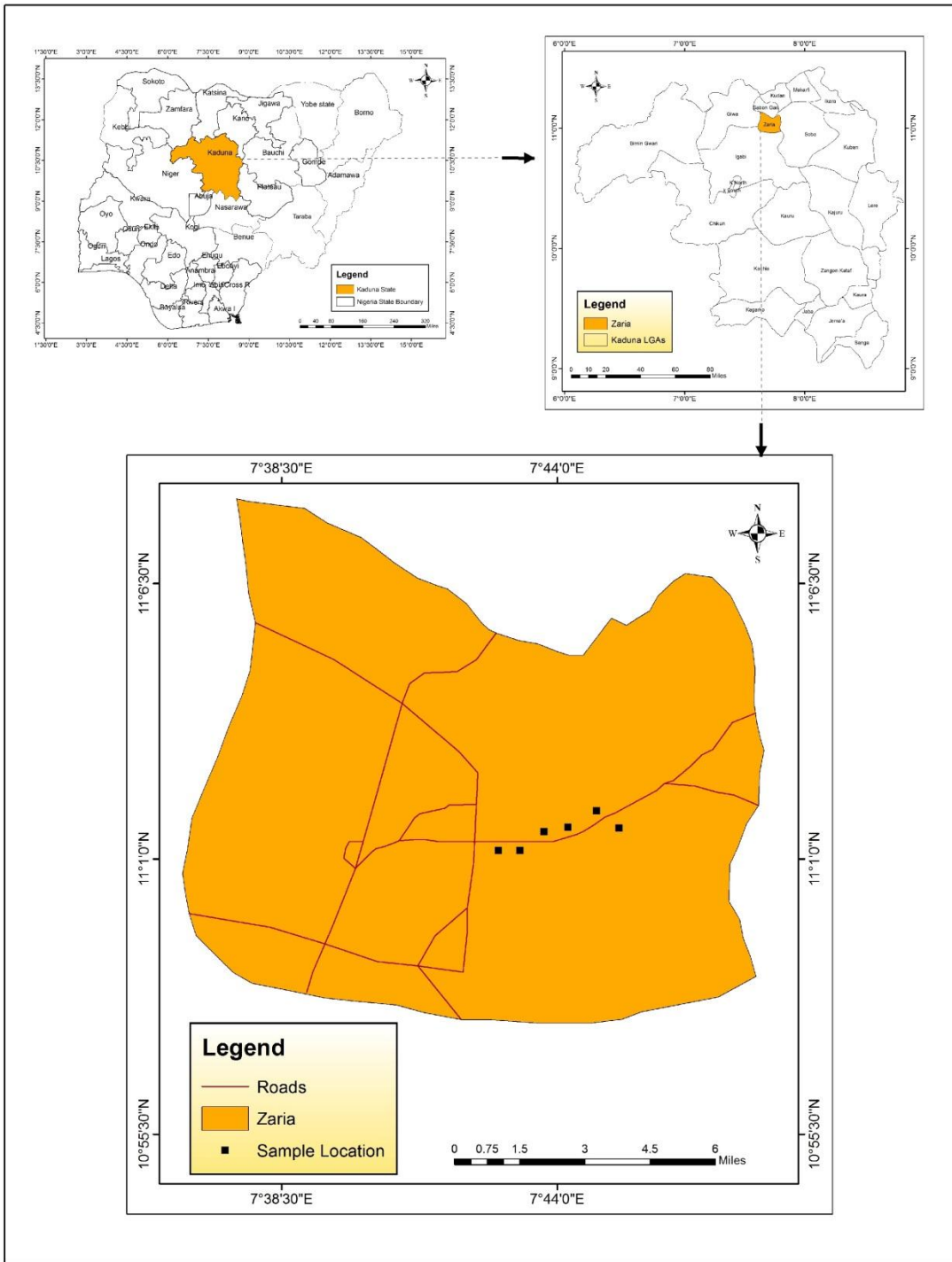


Figure 3.1: Zaria showing Location of Schools Sampled
 Source: Modified from the Administrative Map of Zaria 2015.

The city is considered by some to be a main center of Hausa culture. Zaria is not only a market town for the surrounding area, it is the home of numerous artisans, from traditional crafts like leather work, dyeing and cap making, to tinkers, printshops and furniture makers (Maiwada and Renne, 2007). Zaria is also the center of a textile industry which for over 200 years, has made elaborately hand-embroidered robes that are worn by men throughout Nigeria and West Africa (Dan, 2010).

Zaria is north of the rail junction at Kaduna, it has equal rail access to the seaports at Lagos and Port Harcourt. However, currently only the railway between Lagos and Kano is functional, as the eastern line of Nigeria's rail network is not operational. This means that Zaria currently has rail access to Lagos and Kano to the north, but not Port Harcourt (Maiwada and Renne, 2007).

3.2 Ethical Clearance

The study protocol was approved by the Medical Ethics Committee of the Ahmadu Bello University, Zaria. The head of households and children were informed about the study objectives, methods and the priority of the consent for inclusion of children. Moreover, they were informed that they could withdraw their children from the study without any consequences. The written and signed or thumb-printed informed consents were taken from parents or guardians on behalf of their children (Appendix IV).

3.3 Study Design

3.3.1 Sample size estimation

The sample size was estimated using the “World Health Organization Manual for Estimation of Sample Size for Hypothesis Testing” (Lwanga and Lemeshow, 1991). The sample size was estimated using a 5% sampling error, estimating the prevalence of schistosomiasis.

$$N = \frac{Z^2 Pq}{L^2}$$

Where:

N= sample size

Z= standard normal distribution at 95% Confidence Interval = 1.96

P= prevalence rate of 20.30% (0.20) from Alhassan *et al.* (2013)

q= 1 – p= 1- 0.20 = 0.80

L= the allowable error, which is taken as 5% = 0.05

Substituting the values in the formula:

$$N = \frac{(1.96)^2 \times 0.20 \times 0.80}{(0.05)^2}$$

$$N = \frac{3.84 \times 0.16}{0.0025}$$

N= 245.76 approximately 246

Accordingly, 246 was the minimum number of samples collected for each specimen of urine and stool for all the schools. A total of five hundred and forty (540) samples of urine and stool were collected from the six schools visited based on the availability of samples.

3.3.2 Sample selection

All pupils who were attending primary schools in Dakace district during the time of data collection were eligible to participate in this study. The sample was selected using a stratified

sampling technique (De Cassia *et al.*, 2007). First, the district was divided into two as private and public primary schools for the examination of urinary and intestinal schistosomiasis where a total of 6 schools sampled. The sample size of 540 was estimated using a prevalence estimate of 20.30% at 0.05 level of significant. Secondly, the number of schools and estimated population of pupils' in each stratum was obtained from the district education office. Based on the population distribution of pupils' within the strata and the prior decision to choose 90 pupils from each selected school, a total of 6 schools were used. Studies have shown that Lot-Quality Assurance Scheme approaches provide the ability to identify communities with a high prevalence of schistosomiasis with high levels of sensitivity and specificity, even at very small maximum sample sizes (Roberto *et al.*, 2007). Finer classification of schools according to categories of prevalence were achieved with moderate sample sizes of ≥ 15 and have been found to be more accurate with extremely low probabilities of making gross classification errors. Thirdly, sampling was conducted in two stages. In the first stage, the primary sampling units of the schools were selected with a probability proportional to number of schools in the strata. A list of schools in each stratum was compiled and using computer generated random numbers schools in each stratum were selected and arrived the schools used.

3.3.3 Data collection

Children were interviewed by trained Health Surveillance Assistants (HSAs) and community health nurses using a questionnaire (Appendix III) that was adapted from the 2002 national prevalence survey (Bowie *et al.*, 2004). To reduce bias and improve the performance of the questionnaires, questions about schistosomiasis were disguised among other health related questions. The questionnaire was pre-tested and modifications were made after discussions with HSAs, teachers and district health office staff. Risk factors included household water source,

child's knowledge of nearby open water sources (open water source, defined as any open water body including lakes, springs, rivers, streams, ponds, swamps and dams), frequency of contact with open water sources; also factors such as dysuria or passing blood in urine and stool within the past month, history of *S. haematobium* infection and treatment. Other activities observed include urban or rural location, proximity of school to an open water source that may lead to swimming after school by students and household socio-economic status (SES) such as fishing.

Pupils were supplied with 20 ml screw top plastic containers and asked to submit urine and stool samples in separate container between 0900 hrs and 1400 hrs. The samples were labelled and immediately transported to the Entomology and Parasitology Laboratory of Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria

3.4 Microscopic Diagnosis of *Schistosoma* species

A standard filtration technique was used to diagnose and quantify the ova of *S. haematobium* and *S. mansoni*. Ten millilitre (10 ml) of urine was measured and mixed using stirrer in which it was allowed to pass through 13 mm diameter and 12 µm pore size of nylon mesh filter (Costar Corporation, USA) supported with plastic syringe. The filter containing the residues including *S. haematobium* eggs was removed and placed on a clean microscopic slide to be examined under various power objectives. After examining the whole field at X40, X100 and X400 magnifications of microscope containing eggs of *S. haematobium* were recorded as positive while absence of eggs was taken as negative. Intensity of infection was determined for positive samples and recorded as number of eggs per 10 ml of urine. The intensity was classified as light infection for less than 50 eggs/10 ml of urine and heavy infection for more than 50 eggs/10 ml of urine (Cheesebrough, 2005).

Stool samples were tested for the presence of *S. mansoni* eggs using the standard Kato Katz technique (Cheesebrough, 2005). Two slides from the same stool samples were prepared and examined to ensure identification of infection.

The intensity of infection was calculated by counting the total number of eggs obtained from all infected pupils divided by the number of pupils positive for *S. haematobium* and *S. mansoni*. The intensity was expressed in number of egg per millilitre and gram for urine and stool respectively.

3.5 Data Analyses

The prevalence of *Schistosoma* infection was determined according to the method of Margilis *et al.* (1982). Chi-square test was used to determine the association between each risk factor and the prevalence of infection. The odds ratio (OR), for each factor, was also calculated to determine association between risk factors prevalence.

CHAPTER FOUR

4.0

RESULTS

4.1 Distribution of *Schistosoma* species among School Children

The prevalence of *Schistosoma haematobium* and *S. mansoni* among primary school students in Dakace district is shown in Table 4.1. A total of 540 pupils in six schools each were recruited for this study; urine samples (45) and stool (45) were obtained from each school in Dakace district. The prevalence of *Schistosoma* infection differed among the schools. Kith and Kin Academy had the least prevalence of 7/540 (1.30%) and the highest 31/540 (5.74%) was obtained in Nagoyi L. G. E. A. Busy Brain had a prevalence of 5.19% for both infection by *Schistosoma haematobium* and *Schistosoma mansoni*; each species of parasites had a prevalence of 3.15% and 2.59% respectively. In Kith and Kin Academy, overall prevalence was 1.30%, *S. haematobium* was 0.74% and *S. mansoni* was 0.56%. The overall prevalence of the parasites in Zion International was 18/540 (3.33%) out of which *S. haematobium* had 1.85%, while *S. mansoni* was 1.48%. The overall prevalence in pupils of Haruna Soba L. G. E. A. was 15/540 (2.78%); prevalence of *S. haematobium* was 1.85%, while *S. mansoni* was 0.93%. Nagoyi L. G. E. A. primary school had the highest overall prevalence of 31/540 (5.74%), 3.15% and 2.59% for *S. haematobium* and *S. mansoni* respectively. Mixed infections of *S. haematobium* and *S. mansoni* were recorded in 21/540 (3.89%) in Usman Isa L. G. E. A. The prevalence of *S. haematobium* was 13 (2.41%) and 8 (1.48%) for *S. mansoni*.

Table 4.1: Prevalence of *Schistosoma haematobium* and *Schistosoma mansoni* among primary school pupils in Dakace district, Zaria

Schools	No. examined	No. positive (%)	No. positive for <i>S. haematobium</i> (%)	No. positive for <i>S. mansoni</i> (%)
Busy brain	90	28 (5.19)	20 (3.70)	8 (1.48)
Kith and Kin	90	7 (1.29)	4 (0.74)	3 (0.56)
Zion International	90	18 (3.33)	10 (1.85)	8 (1.48)
Haruna Soba L.G.E.A.	90	15 (2.78)	10 (1.85)	5 (0.93)
Nagoyi L.G.E.A.	90	31 (5.74)	17 (3.15)	14 (2.59)
Umaru Isa L.G.E.A.	90	21 (3.89)	13 (2.41)	8 (1.48)
Total	540	120 (22.22)	74 (13.70)	46 (8.52)
	Chi-square	24.69	18.02	10.90
	Df	5	5	5
	P value	0.000	0.003	0.53

No. positive = Combined infection of *Schistosoma haematobium* and *S. mansoni*

Total degree of freedom = $(6-1)(3-1) = 10$

4.2 Age Specific Prevalence of Schistosomiasis among Pupils in Dakace District

The prevalence of *S. haematobium* and *S. mansoni* among the age groups of primary school children in the six selected schools in Dakace district is shown in Table 4.2. There was significant association ($p < 0.05$) of mixed infection schistosomiasis in primary school pupils. Pupils between ages 9-14 years in primary three to primary six participated in the study. The prevalence ranged between 23 (12.78%) in ages 9-10 to 54 (30.00%) in 13-14 years age group. Pupils infected by *Schistosoma haematobium* 74/540 (27.41%) were more as compared to *S. mansoni* 46/540 (17.04%). There were 180 pupils who participated from classes 1 to 3; ages 9-10 that were infected by *S. haematobium* totaling 14 (15.56%). The number of infected pupils with *S. haematobium* in the age group 11-12 was 26 (28.89%). The highest number of pupils infected with *S. haematobium* in ages 13-14 had a prevalence of 34 (27.41%). The highest prevalence of 20 (22.22%) infection was obtained in the ages 13-14, while ages 9-10 years had the least infection by *S. mansoni* in primary school pupils. Pupils in the age group 11-12 years had 17 (18.89%) prevalence of *S. mansoni*.

Table 4.2: Age Specific Prevalence of *Schistosoma haematobium* and *Schistosoma mansoni* among primary school pupils in Dakace district, Zaria

Age group	No. examined	No. positive (%)	<i>Schistosoma haematobium</i> (%)	<i>Schistosoma mansoni</i> (%)
9-10	180	23 (12.78)	14 (15.56)	9 (10.00)
11-12	180	43 (23.89)	26 (28.89)	17 (18.89)
13-14	180	54 (30.00)	34 (37.78)	20 (22.22)
Total	540	120 (22.22)	74 (27.41%)	46 (17.04)
	Chi-square	15.88	9.52	4.68
	Df	2	2	2
	P value	0.000	0.009	0.097

4.3 Sex Specific Prevalence of Schistosomiasis among Pupils in Dakace District, Zaria

The sex specific prevalence of schistosomiasis infections among primary school pupils of Dakace district is presented in Table 4.3. There was a significant association ($p < 0.05$) of infection in males and females. There were 44/270 (16.30%) mixed infection of *S. haematobium* and *S. mansoni* in females. In males, 78/270 (28.15%) were infected by both *S. haematobium* and *S. mansoni* in all the schools investigated. The number of infected males were significantly ($p < 0.05$) higher than the females. The odds ratio value of 1.97 for the infections with *S. haematobium* and *S. mansoni* showed association between sex and the prevalence of infection. The prevalence of 23.33% infection with *S. haematobium* was recorded for both sexes in all the schools in which 74/270 pupils were infected. The number of females infected by *S. haematobium* was lower than the males. The prevalence of *S. haematobium* was 24 (17.78%) in females and 50 (37.04%) in males. There was statistically significant difference ($p < 0.05$) in prevalence between females and males. The odds ratio (1.97) analysis showed a strong association between sex and *S. haematobium* infection. Prevalence of *S. mansoni* in females and males were 14.82% and 19.26% respectively, but there was no significant difference ($p > 0.05$) of infection between the females and males.

Table 4.3: Sex Specific Prevalence of schistosomiasis infection among Pupils in Dakace District, Zaria

Total				
Sex	No. examined (%)	No. positive (%)	<i>S. haematobium</i> positive (%)	<i>S. mansoni</i> positive (%)
Female	270	44 (16.30)	24 (17.78)	20 (14.82)
Male	270	76 (28.15)	50 (37.04)	26 (19.26)
Total	540	120 (22.22)	74 (27.41)	46 (17.04)
	Chi-square	10.37	10.59	0.855
	Df	1	1	1
	P value	0.001	0.001	0.355
	Odds ratio	1.97	2.330	1.332
	Class interval	1.300-2.998	1.386-3.917	0.724-2.449

The infection rate for *S. mansoni* in both females and males were 46 (21.11%). The males had higher infection 26 (19.26%) than females 20 (14.82%). There was no significant ($p>0.05$) difference in prevalence between the two sexes.

4.4 The Risk Factors Associated with Schistosomiasis Infections

The infection associated with the daily activities of the pupils involved in this study in the schools is shown in the Table 4.4. Factors such as water source, method of faecal disposal, fishing, swimming and washing in the river/stream, presence of blood in urine and stool were examined. There were three sources of water supply, well, tap and stream/river. There were significant association ($p<0.05$) of infection between pupils that used well as source of water supply and the other sources. The odds ratio (OR = 1.529) also showed association of infection in respondents that chose their source of water supply. The number of students that used well as source of their water supply were 222/540 (41.11%) in which 40/540 (10.02%) were infected by either *S. haematobium* or *S. mansoni*. There was association between infection and source of water (Well; OR = 1.529; Tap; OR = 2.053; River/Stream; OR = 2.125).

Table 4.4: Risk factors associated with Shistosomiasis Infections of pupils in Dakace district

Risk factors	No. examined	No. positive (%)	No. negative (%)	Chi-square	Df	p-value	Odds ratio	95 % CI
Water source								
Well	222	40 (10.02)	182 (81.98)	3.855	1	0.050	1.529	0.999-2.341s
Tap	90	12 (13.33)	78 (86.67)	4.937	1	0.026	2.053	1.077-3.913s
Stream/river	228	68 (29.82)	160 (70.18)	13.95	1	0.000	2.125	1.302-2.460s
Total	540	120	420					
Faecal disposal								
Pit latrine	250	53 (21.20)	197 (78.80)	0.281	1	0.598	1.117	0.734-1.680ns
Water system	31	4 (12.90)	27 (87.10)	1.652	1	0.199	1.992	0.683-5.810ns
Bush	259	63 (24.32)	196 (75.76)	1.272	1	0.259	0.792	0.527-1.189ns
Total	540	120	420					
Fishing								
Yes	50	21 (42.00)	29 (58.00)	12.47	1	0.000	0.35	0.191-0.639ns
No	490	99 (20.20)	391 (79.80)					
Total	540	120	420					
Swimming								
Yes	65	33 (50.77)	32 (49.23)	34.84	1	0.000	0.217	0.127-0.373ns
No	475	87 (18.32)	388 (81.68)					
Total	540	120	420					
Washing								
Yes	56	24 (42.86)	32 (57.14)	14.58	1	0.000	0.34	0.193-.604ns
No	484	96 (19.84)	388 (80.16)					
Tota	540	120	420					
Blood in urine								
Yes	11	4 (36.36)	7 (63.64)	1.30	1	0.254	0.49	0.141-1.708ns
No	529	116 (21.93)	413 (78.07)					
Total	540	120	420					
Blood in stool								
Yes	55	13 (23.64)	42 (76.36)	0.071	1	0.790	0.915	0.474-1.766ns
No	485	107 (18.29)	378 (81.71)					
Total	540	120	420					

s = significant association

ns = not significantly associated

There were no significant difference ($p > 0.05$) between schistosomiasis infections with the method of fecal disposal. The respondent that used pit-latrines as their option were 250 (46.30%) with the prevalence rate of 53/250 (21.20%) and the remaining participant tested negative 197/250 (78.80%) for schistosomiasis spp. infection.

There was association between use of pit latrine as source of faecal disposal (OR = 1.117) and schistosomiasis; and there was also association between use of water system (OR = 1.992) and schistosomiasis. Thirty one (31) of the pupils had water system toilets for disposing faeces in their homes, and 4 (12.90%) were infected by both *S. haematobium* and *S. mansoni*. Defecation in the bush was most frequently preferred 256 (47.96%) by the pupils and 63 (24.32%) were positive for schistosomiasis. Fishing activity was not popular (9.26%) among the pupils of all the selected schools; only 21 (42.00%) were positive for schistosoma infections. On the contrary, there were 490 (90.74%) respondent that did not participate in fishing but they were infected with either *S. haematobium* or *S. mansoni* having a prevalence of 99 (20.20%).

There was significant difference ($p < 0.05$) in infections between those that participated in fishing and those that did not fish at all. The odds ratio (OR = 0.35) analysis showed that fishing is not associated with schistosomiasis infections. The activity in relation to swimming and not swimming in the stream/river was significantly higher ($p < 0.05$). There were 65 (12.04%) pupils who participated in one form of swimming or the other in stream and river out of which 33 (50.77%) were infected with schistosomiasis. There were 475 (87.96%) pupils that did not swim in stream and river but 87 (18.32%) were tested positive for either of the two parasites. The number of pupils that were at risk of infections in connections with washing in the stream/river were 56 (10.37%) and 24 (42.86%) were positive for the infections with schistosomiasis. A total

of 484 (89.63%) were not at risk of schistosomiasis infection by washing activity in the stream/river but 96 (19.84%) were infected by either *S. haematobium* or *S. mansoni* while those who tested negative were 388 (80.16%). Some pupils experienced blood in their urine but not all were infected with schistosomiasis. There were 11 (2.04%) pupils that had blood in urine, only 4 (36.36%) were positive for the infections and 7 (63.64%) were negative. The remaining 529 (97.96%) of the pupils did not experience blood in the urine but 116 (21.93%) were positive for schistosomiasis while 413 (78.07%) did not have the infections. A total of 55 (10.19%) pupils had experienced blood in stool in which only 13 (23.64%) tested positive for the infections. Five hundred and eighty-five, 585 (89.81%) respondents did not experience blood in their stools but 107 (22.06%) were positively infected with schistosomiasis and 378 (77.94%) were negative. There was no significant difference ($p>0.05$) of infection between respondents that had blood in their urine and those that did not have it; similarly, those that blood was observed in their stool also did not differ significantly ($p>0.05$) from those that tested negative.

4.5 The Mean Intensity of Schistosomiasis among School Pupils in Dakace District

The intensity of schistosomiasis in the selected primary school pupils in Dakace district is shown in Table 4.5. Generally, the mean intensity was light in all the primary schools sampled. The overall mean intensity per 10.00ml of urine and 1.00g of stool sample was 3.57 ± 0.28 egg/ml and 3.15 ± 0.31 egg/g respectively.

Table 4.5: Mean Intensity of *Schistoma haematobium* and *Schistosoma mansoni* Infection among Primary Schools in Dakace District

Schools	No. sampled	No. positive (S. h.)	Mean Intensity for S. h. \pm S.E	No. positive (S. m.)	Mean Intensity for S. m. \pm S.E
Busy brain	90	20	3.11 \pm 0.40	8	3.38 \pm 0.73
Kith and Kin	90	4	4.00 \pm 0.41	3	3.00 \pm 0.58
Zion International	90	10	2.70 \pm 0.50	8	3.50 \pm 0.63
Haruna Soba L.G.E.A.	90	10	3.70 \pm 0.67	5	4.40 \pm 1.12
Nagoyi L.G.E.A.	90	17	4.41 \pm 0.72	14	3.50 \pm 0.66
Umaru Isa L.G.E.A.	90	13	3.62 \pm 0.98	8	2.38 \pm 0.57
Total	540	74	3.57 \pm 0.28	46	3.15 \pm 0.31

Total degree of freedom (6-1)(2-1) = 5

Key:

No. = Number

S.E. = Standard Error

S. h. = *Schistosoma haematobium*

S. m. = *Schistosoma mansoni*

The mean intensity of *Schistosoma haematobium* decreased in this order: Nagoyi (4.41 egg/ml) had the highest followed by Kith and Kin (4.00 egg/ml), Haruna Soba (3.70 egg/ml), Umaru Isa (3.63 egg/ml), Busy brain (3.11 egg/ml) and the least was Zion international (2.70 egg/ml). The mean intensity of infection by *S. mansoni* was higher in the population of pupils attending Haruna Soba (4.40 egg/g) followed by, Zion international (3.50 egg/g), Nagoyi (3.50 egg/g), Busy Brain (3.38 egg/g), Kith and Kin (3.00 egg/g) and Umaru Isa (2.38 egg/g).

CHAPTER FIVE

5.0 DISCUSSION

Schistosomiasis is of public health concern especially in developing countries where school-aged children are prone to the disease, particularly when they are exposed to water bodies containing the infective intermediate host. The prevalence of infection was significant ($p < 0.05$) among the students examined in this study. The overall prevalence of *S. haematobium* and *S. mansoni* infection was 22.22%. The highest prevalence of *S. haematobium* was recorded in Busy Brain primary school followed by Nagoyi L.G.E.A. primary school, while the least was in Kith and Kin Academy. Generally, higher prevalence of *S. haematobium* recorded than *S. mansoni*. The least prevalence of schistosomiasis in Kin and Kin Academy may be associated with their low contact with streams and rivers containing the infective stages of *Schistosoma*, whereas the opposite is the case with other pupils from other schools (Busy Brain, Nagoyi L.G.E.A.). This study is similar to a report by Bowie *et al.* (2004) in which more children of a school in Malawi had higher prevalence of *S. haematobium* than *S. mansoni*.

Furthermore, Kanwai *et al.* (2011) reported high prevalence of 60.84% at Dumbin Ladan and attributed it to the presence of infested ponds within the hamlet which serve as the major source of water for domestic purposes, thereby predisposing the children to the risk of infection; while the lowest intensity was recorded in the hamlets which have boreholes. Safe water supply plays an important role in the control of urinary schistosomiasis (Okoli *et al.*, 2006; Chigozie *et al.*, 2007). There was much scientific evidence that socio-demographic variables and contact with unsafe water are associated with infection with schistosomiasis. Studies in different settings have been carried out describing vulnerable parts of the population, such as school children, types of behaviour related to a higher risk of acquiring the infection, as is the case with household,

occupational and leisure activities, or involving socio-economical status and its correlation to the diseases (Lima e Costa, 1983; Cairncross *et al.*, 1996; da Silva *et al.*, 1997; Barbosa and Barbosa 1998; Moza *et al.*, 1998; Bethony *et al.*, 2004; Gazzinelli *et al.*, 2006).

There was statistically significant association ($p < 0.05$) in prevalence of schistosomiasis infections among the age groups in the six different schools. The prevalence of schistosomiasis was observed to be more in the age group 13-14 with a prevalence of 30.00%. Infection by *S. haematobium* was higher than *S. mansoni* in the age groups. The increase in rate (14 to 34) of *Schistosoma* infection with increase in age group may be attributed to the possible contact of the students with the predisposing factors such as river/streams. It can also be linked to the playing habit of the students in the infected environment. This could be associated with the excessive mobility and adventurous nature of children at this age, hence, they may become more exposed to water containing the intermediate hosts of the parasites while swimming/playing or fetching water for domestic purposes or helping in agricultural activities. The proximity to the source of water that contains vectors of the disease might also lead to the prevalence observed in these age groups. This is in agreement with previous reports by Raja'a *et al.* (2000); Gryseels *et al.* (2006); Matthys *et al.* (2007); Deribe *et al.* (2011) that reported on schistosomiasis infections in their independent study. The fetching of water and living close to a stream and/or a water pool were identified as significant risk factors for schistosomiasis. Water storage, streams, dams and pools may all provide favourable breeding sites for snails and therefore, potentially, support the continued transmission of schistosomiasis (Sady *et al.*, 2013).

Schistosoma infection differs significantly ($p < 0.05$) between male and female pupils attending the selected schools in Dakace district of Zaria. There were more males infected with both *S.*

haematobium and *S. mansoni* than the females. Though, the prevalence of *S. mansoni* was slightly more in males but did not differ significantly ($p < 0.05$) from the females; and the prevalence of *S. haematobium* in males were twice that of females. The high prevalence associated with males may be related to their constant contact with water bodies that harbours snail vectors of schistosomiasis. It may also be attributed to the greater exposure of males to the parasite because of their water contact activities like fishing, swimming and farming in irrigation schemes. Conversely the low prevalence in females in this study may be due the fact that they are more protected in this part of the country than the boys, they do not visit the dam, and had lesser water contact. These findings are similar to the report of Kanwai *et al.* (2011) in Dumbi hamlet, Zaria, where more infection was recorded in males than females and was linked to the activities such as washing, bathing, swimming and watering cattle in which the males are more involved within the various water bodies. These activities increase the frequency of contact with the infested water bodies (Rudge *et al.*, 2008; Sandy *et al.*, 2013). The result of this study is similar to many other reports in other countries, Niger and Central Sudan respectively (Garba *et al.*, 2010; Ahmed *et al.*, 2011).

Males usually have higher prevalence of schistosomiasis infection than females and this was attributed to religious and cultural reasons or to water contact behavior (El-Khoby *et al.*, 2000; Raja'a *et al.*, 2000; Haidar, 2001; Matthys *et al.*, 2007; Garba *et al.*, 2010; Deribe *et al.*, 2011; Ahmed *et al.*, 2012). This study revealed significant associations of prevalence of schistosomiasis with the age and sex of pupils. Based on questionnaire, risk factors such as source of water and methods of fecal disposal were associated with schistosomiasis infection. Others such as fishing, swimming, washing in the stream/rivers, presence of blood in urine and stool did not show significant association with the schistosomiasis infection. The low association of infection with

the risk factors may be due to the inability of the respondent to provide useful information in relation to schistosomiasis. Studies have shown that repeated examination of urine and stool specimens over consecutive days and exercises prior to urine collection improve egg detection (Doehring *et al.*, 1983; Lengeler *et al.*, 2002). It is possible to have an infected child reporting hematuria and blood in stool with no ova detected per urine and stool samples which might be inability of the children to differentiate between parasites and food fibre in the stool.

The intensity of the infection of *S. haematobium* and *S. mansoni* was generally light. Mean intensity of *S. haematobium* was lowest in Zion International primary school and the highest was associated with Nagoyi L.G.E.A. Mean intensity of infection with *S. mansoni* was slightly higher in Haruna Soba L.G.E.A. primary school. Low mean intensity recorded in this study in all the schools could be as a result of sampling time that was done in the early hours of the day. Cowper (1963) and Sandy *et al.* (2013) reported that maximum excretion of eggs of schistosome occurs after midday, but that period could not be utilized during this present work because, most students prior to mid-day they disappear from; making sampling difficult. This might have contributed to the low level of intensity of infection. This study is agreement with the findings of Alhassan *et al.* (2013) that reported low mean intensity of 1-18 eggs per gram of stool in Primary School Children in Birnin-Gwari Local Government Area, Kaduna State, Nigeria.

CHAPTER SIX

6.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

A total of five hundred and forty (540) samples of urine (270) and stool (270) were collected from schoolchildren in six schools in Dakace, Zaria, Kaduna State. The prevalence of 22.22% was established in the selected schools sampled in Dakace District, Zaria for the two infections. Prevalence of *S. haematobium* was higher (13.70%) than that of *S. mansoni* (8.52%). The risk factors such as source of water supply well (OR = 1.52); tap (OR = 2.053); and stream (OR = 2.125); and faecal disposal (pit latrine; OR = 1.117; water system; OR = 1.992) were associated with both *S. haematobium* and *S. mansoni*. Males (28.15%) were more exposed to infection than females (16.30%). In conclusion, *S. haematobium* and *S. mansoni* infection were recorded in all the schools sampled.

6.2 Conclusions

The results obtained show that the Dakace district area is endemic for urinary and intestinal schistosomiasis infection.

- i. The prevalence of *Schistosoma haematobium* was found to be 13.70% in this study.
- ii. *Schistosoma mansoni* prevalence in this study was established to be 8.52%.
- iii. There was relationship between risk factors (source of water supply and faecal disposal) and the *Schistosoma* infection among primary school students attending some selected schools in Dakace. There was significant association ($p < 0.05$) between schistosomiasis infection and age groups that attended the selected schools in Dakace. The study also revealed that schistosomiasis infection was highly prevalent in male (28.15%) than their female (16.30%) counterpart.

6.3 Recommendations

Based on the result of this study, the following recommendations are made:

- i. All the villages in the Dakace district need access to pipe borne water to reduce contact with infested waters.
- ii. Further intervention studies to determine the best and cost-effective strategies to provide treatment to children and communities in the affected areas are required.
- iii. Prevalence of schistosomiasis in adult need to be evaluated as this study did not cover them.
- iv. Ecological studies are also needed to identify transmission foci to facilitate implementation of ecologically targeted control measures.
- v. There is need to carry out snail study in Dakace district to establish the source of infection.
- vi. Health education and large-scale chemotherapy for all school children to decrease the prevalence and intensity of infection would be highly suitable.
- vii. It is therefore, recommended that intervention programmes are required by government and private organization to reduce the disease burden in Dakace District and its environs; similar study need to be carried out in the neighbouring district.

CONTRIBUTION TO KNOWLEDGE

Title: The Prevalence of Schistosomiasis in Primary School Pupils of Dakace District, Zaria
Local Government Area, Kaduna State, Nigeria

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Programme: MSc. Biology Education

The study has contributed to the scientific knowledge as follows:

- i. The prevalence of *Schistosoma haematobium* was 13.70% in Dakachi district, Zaria, Nigeria
- ii. *Schistosoma mansoni* prevalence in this study was established to be 8.52%.
- iii. There was significant association of infection risk factor: source of water supply (Well, 10.02%; tap, 13.33%; stream/river, 29.82%). Age group 13-14 had the most prevalence of 30.00%. The study also revealed that schistosomiasis infection was highly prevalent in male (28.15%) than female (16.30%) counterpart.

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APPENDIX

Appendix I: The egg of *Schistosoma mansoni*



Appendix II: The egg of *Schistosoma haematobium*



Appendix III: Horizontal view of *Schistosoma haematobium* egg



Appendix III: Questionnaire



AHMADU BELLO UNIVERSITY, ZARIA
FACULTY OF SCIENCE
DEPARTMENT OF BIOLOGICAL SCIENCES



RESEARCH QUESTIONNAIRE

DECEMBER, 2014

Questionnaire on “The Prevalence of Schistosomiasis on Primary School Children in Dakace District of Zaria Local Government Area, Nigeria”.

This questionnaire is part of the research exercise; it is intended to provide necessary and basic information needed for the research for appropriate evaluation and conclusion. All information obtained will be treated as confidential and be used only for the research purpose. Please correctly fill or tick answers as required. **Thank you.**

1. Reference Number:
2. Sex i. Male [] ii. Female []
3. Age i. 9-10 [] ii. 11-12 [] iii. 13-14 []
4. Source of water supply i. Well [] ii. Tap [] iii. Stream/River []
5. Method of fecal disposal i. Pit latrine [] ii. Water system [] iii. Bush []
6. Fishing i. Yes [] ii. No []
7. Swimming i. Yes [] ii. No []
8. Washing i. Yes [] ii. No []
9. Blood in urine i. Yes [] ii. No []
10. Blood in stool i. Yes [] ii. No []

Appendix IV: Informed Consent Form



DEPARTMENT OF BIOLOGICAL SCIENCES
SCHOOL OF POSTGRADUATE STUDIES
AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA.



INFORMED CONSENT FORM (ICF)

DECEMBER, 2014

This Informed Consent Form is for student in selected Schools in Dakace District of Zaria Local Government, Area, Kaduna state, Nigeria. We are inviting you to participate in this research work titled “The Prevalence of Schistosomiasis on Primary School Children in Dakace District of Zaria Local Government Area, Nigeria”

Human schistosomiasis is a chronic disease caused by the flukes belonging to the genus *Schistosoma* (CDC, 2011).

The impact of schistosomiasis has long been underestimated which rivals that of malaria and tuberculosis (Bergquist, 2002). It ranks second only to malaria as the most common parasitic disease, killing an estimated 280,000 people each year in the African region alone. The prevalence of schistosomiasis like most parasitic disease is related to poverty and poor living conditions (Engels *et al.*, 2002).

Schistosomiasis affects nearly 240 million people worldwide each year and more than 700 million people live in endemic areas. Nonetheless, 85% of the cases reported annually occur in sub-Saharan Africa and over 150,000 deaths are associated with chronic infection caused by *S. haematobium* in the african region (Hotez, 2009; WHO, 2010).

The disease is common in the Niger basin and is found in every country within the West African sub-region (Brown and Wright, 1985). In Nigeria, one of the most severely affected countries in Africa, it is estimated that 101.28 million people are at risk of infection while 25.83million are infected with *Schistosoma haematobium*, *Schistosoma mansoni* and *Schistosoma intercalatum* (Chitsulo *et al.*, 2000).

School aged children are mostly infected with this silent destructive disease because it is easily contracted while bathing or swimming in water contaminated with the parasite that is shed from snails and infect by penetrating human skin (Kabatereine *et al.*, 2004; Kanwai *et al.*, 2011). Because of their play habits and hygiene, children are particularly at risk for the infection. It has been estimated that every year, a child’s risk of infection increases, peaking between the ages of 10 and 20 (Kabatereine *et al.*, 2004).

I, **REBECCA IYANAM** a Postgraduate Student of the Department of Biological Sciences, Ahmadu Bello University, Zaria will be undertaking this research work.

To assess the prevalence of schistosomiasis burden in some selected schools among primary school students in Dakace district of Zaria Local Government Area of Kaduna State. This study will provide information on the status of schistosomiasis infection among the primary school children from which the magnitude of the infection will be defined towards prompt intervention to save the lives of the people in Dakace District of Zaria Local Government Area, Kaduna State. Therefore, the need to institute public health measures to reduce disease burden and transmission.

Your participation will involve stool and urine sample taken from you early in the morning using pre-labelled specimen EDTA bottles. I will appreciate your participation in this study. All information obtained will be treated confidential and used only for the purpose of this research. All investigations will be free. You can withdraw from the research exercise at any point in time.

Kindly fill the space below if you have given your consent to participate.

I..... give my consent to participate in this study. I have been duly informed of the process and have given my free will and not under any pressure whatsoever.

..... Date.....
Signature of subject

..... Date.....
Signature of witness

..... Date.....
Signature of investigator

