PREVALENCE OF SCHISTOSOMIASIS AMONG PRIMARY SCHOOL PUPILS IN BIRNIN-GWARI LOCAL GOVERNMENT AREA, KADUNA STATE

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Declaration

I declare that the work in the thesis entitled **"Prevalence Of Schistosomiasis Among School Pupils In Birnin-Gwari Local Government Area, Kaduna State"** was carried out by me in the Department of Biological Sciences, under the supervision of Dr (Mrs) S.A. Luka and Prof. M.L. Balarabe. The information derived from the literature has been duly acknowledged in the text and a list of references provided. To the best of my knowledge and belief, no part of this project report was previously presented for another degree or diploma at any University.

_____ _____

Amina Alhassan Date

Certification

This research thesis titled ***"Prevalence Of Schistosomiasis Among Primary School Pupils In Birnin-Gwari Local Government Area, Kaduna State"*** meets the regulations governing the award of degree of Master of Science (M.Sc.) of Ahmadu Bello University, Zaria, and is approved for its contributions to knowledge and literary presentation.

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Dedication

This work is dedicated to all primary school children in Birnin Gwari Local Government Area.

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List of Abbreviations

AS	-	Acute schistosomiais
CDC	-	Center for Disease Control
CNS	-	Central nervous system
ELISA	-	Enzyme linked immunosorbent assay
FGS	-	Female genital schistosomiasis
HIV	-	Human immunodeficiency virus
HPV	-	Human papillomavirus
LGEA	-	Local Government Education Authority
OR	-	Odds Ratio
PCR	-	Polymerase chain reaction
rpm	-	Revolution per minute
STIs	-	Sexually Transmitted Infections
US	-	Ultasonography
WHO	-	World Health Organization

Abstract

A survey of schistosomiasis was carried out among primary school pupils between the ages of 6 – 17 years in ten primary schools that were selected randomly in Birnin Gwari Local Government Area of Kaduna State, between July 2010 and February 2011. Questionnaire as administered to obtain to demographic data. A total of 300 stool and urine were examined, comprising of 215 from males and 85 from females. The Formol-ether concentration and sedimentation techniques were used for laboratory analysis of the stool and urine samples respectively. The overall prevalence of *Schistosoma haematobium* was(36.0%) with 29.3% in males and 6.7% in females. Similarly, overall prevalence was higher in male than females. The highest prevalence was recorded in 15 – 17 age group. The overall prevalence of *Schistosoma mansoni* was 61(20.3%). The intensity of the disease was light (1-18 eggs per gram of feaces). The prevalence in males was 13.3% while in females it was 7.0%. higher prevalence was recorded in 6-8 years and 15 – 17 years age groups. There was an association between *Schistosoma haematobium* infection and terminal *Haematuria* (OR = 7.8) there was association between *S.haematobium, S. mansoni* infection and source of water (OR = 2.8). Prevalence of disease varied among different schools, highest prevalence was in Kungin Gayam(7.7%) followed by Tashar Keji (7.3%). Unguwan Sarkin Noma had the least. Other intestinal parasites were encountered in the faecal samples which includes Hookworm 25(8.3%), *Hymenolepis nana* 7 (2.3%), *Enterobius vermicularis* 4 (1.3%)and *Ascaris lumbricoides* 1 (0.7%). Species of snails encountered in the study area are *Bulinus* and *Biomphalaria.*

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Schistosomiasis, also known as bilharziasis or snail fever,is primarily a tropical parasitic disease caused by eggs of adult stages of the blood fluke known as *Schistosoma.* The name bilharziasis was coined from the name of Theodor Bilharz, a German pathologist, who first identified the worms in 1851 (Nawal, 2010; WHO, 2010a). Schistosomiasis is the second most prevalent tropical parasitic disease next to malaria, and is a leading cause of morbidity in endemic areas of Africa, Asia and South America (WHO, 1995). In some parts of Africa, the onset of haematuria due to urinary schistosomiasis is very common in adolescent boys, and due to lack of knowledge, it is seen as a normal phenomenon in some communities (Deswitz, 1981). It is estimated that over one third of the world's population, mainly those individuals living in the tropics and sub-tropics, are infected by parasitic worms (Schall *et al.,*1993).

The disease is said to be responsible for the annual loss of between 1.7 and 4.5 million disability adjusted life years (DALYs),but recent meta analysis challenges these burden estimates; they could be several-fold higher (Chitsulo *et al.,* 2000). Most of the burden of schistosomiasis is concentrated in sub-saharan Africa with the highest prevalence and intensities usually found in school-age children, adolescent and young

adults (Jordan *et al.,* 1993). Schistosomiasis has a negative impact on school performance of the pupils and the debilitation caused by untreated infections undermines social and economic development in heavily affected areas (Huang and Manderson, 1992).

After more than 20 years of schistosomiasis control programmes, chemotherapy has been shown to be a very important tool. Nevertheless, in medium and long term infections, good sanitary habits, good water supply, proper sewage drainage and health education seem to be the real tool in definitive schistosomiasis control (Katz *et al.*, 1998).Several environmental and socio-economic factors have been identified to be responsible for the continued persistence of intestinal parasitic infection in children. Some of these factors include poor sanitary conditions, unhygienic practices, lack of potable water, poor housing and poverty (WHO 1991, Edungbola and Obi 1992; Savioli *et al.,* 2003; Amuta *et al.,* 2004).Recent global estimate have indicated than more than a quarter of the world's populations are infected with one or more of the most common parasites; *Ascaris lumbricoides,* hookworm and *Trichuris trichuira* (Nawal 2010; WHO 2010a).

Helminth infections are more prevalent among school-aged children (Bundy and Medley, 1992). Maximum prevalence and intensities for *Ascaris lumbricoides* and *Trichuris trichiura* are achieved in children from 5-15 years of age while hookworm and schistosome infections are

usually at their peak in late childhood to early adulthood (Bundy and Medley, 1992).

Five species of schistosomes are pathogenic parasites of humans. Out of which *Schistosoma mansoni* and *Schistosoma haematobium* are the most common worms while *Schistosoma japonicum*, *Schistosoma mekongi* and *Schistosoma intercalatum* have a more limited distribution. Other species, such as *Schistosoma matheei* and *Schistosoma bovis* are occasional parasites of human and *Schistosoma incognitum* may also prove infective to humans. The disease caused by schistosomes, schistosomiasis *(*=bilharziasis*)*, is the most important disease of helminth origin and causes untold misery in about 75 countries (WHO, 1985). About 200 million people are said to be infected and 500-600 million people are exposed to the infection (Webbe, 1981). The Center for Disease Control and Prevention estimates that 150 to 200 million persons throughout the world are afflicted with schistosomiasis (CDC, 2010).

Control of schistosomiasis depends basically on the control of the snail vectors, a problem which presents an extremely complex ecological situation, and one which has been reviewed in a number of major publications (Jordan *et al.*, 1993; WHO, 1985; Nmorsi *et al.,* 2005; John *et al.,* 2008). Snails of the family planorbidae serve as intermediate hosts of *Schistosoma mansoni* and *Schistosoma haematobium. Schistosoma mansoni* is transmitted by snails of the genus *Biomphalaria* and S. *haematobium* by *Bulinus* species (Chandiwana, 1986; King *et al.,* 1988).

Salinity, temperature, velocity of the water and presence of aquatic vegetation support the snail colonies of the various genera. Snail population in any water reservoir starts to build up at the onset of the rainy season around May, they become abundant between October and December (Shurrock, 2001; Nmorsi *et al.*, 2005).

1.2 Statement of Research Problem

Schistosomiasis currently infects 200 million people in 74 endemic countries (WHO, 2010a). It affects primarily women and school – aged children. Infections occur when a person comes into contact with freshwater that is infested with schistosome cercariae and containing snail intermediate hosts. The infection can lead to stunted growth and development and in severe cases of bladder cancer and kidney, liver and spleen malfunctions (Kabatereine *et al.*, 2004). Schistosomiasis is prevalent in tropical and sub-tropical areas, especially in poor communities without access to safe drinking water and adequate sanitation. It is estimated that at least 90% of those requiring treatment for schistosomiasis live in Africa (Habib *et al.,* 2000).

Schistosomiasis infection is associated with rural agricultural and other human activities around the freshwater bodies such as swimming, fishing, washing and bathing in ponds, rivers and dams, where the snail intermediate hosts breed. Construction of earthered dams to facilitate the breeding/ ground for snails. Children are more prone to schistosomiasis infection due to their exposure to water bodies, through

fishing, swimming, washing and fetching water for household chores. These activities expose these children to the infective stage of the parasite from the intermediate hosts in these water bodies. Personal hygiene, attitude and play habits make children especially vulnerable to infection (John *et al.,* 2008). Women doing domestic chores, such as washing of clothes in infested water, are also at risk. Urogenital schistosomiasis is also considered to be a risk factor for HIV infection, especially in women. Approximately 10 million women in Africa have schistosomiasis during pregnancy (Mohammed *et al.*, 2007; John *et al.,* 2008).

The economic and health effects of schistosomiasis are considerable. In children, schistosomiaisis can cause anaemia, stunting and a reduced ability to learn, although the effects are usually reversible with treatment. Chronic schistosomiasis may affect people's ability to work and in some cases can result in death. In sub-saharan Africa, more than 200,000 deaths per year are due to schistosomiasis (WHO, 2010a).

1.3 Justification

Several investigations have been conducted on the prevalence of schistosomiasis and other helminths in humans in several localities in Nigeria. To the best of our knowledge, no such investigation/research has been conducted in Birnin Gwari Local Government Area. There are a lot of water bodies in the area where children often go for fishing and

swimming and can come in contact with the infective stage of the parasite. Children are at risk of the disease due to close proximity of irrigation farms and large dam reservoirs to their homes and their personal behaviours. It is with this background that the present study was designed.

1.4 Aim

To investigate the prevalence of schistosomiasis and other helminths among pupils of some primary schools in Birnin Gwari Local Government Area, Kaduna State.

1.5 Objectives

The study was therefore designed with the following objectives to:

i. determine the prevalence and intensity of schistosomiasis among primary school pupils in Birnin Gwari Local Government Area, Kaduna State.

ii. determine the age and sex specific prevalence of schistosomiasis infection in Birnin Gwari Local Government Area, Kaduna State.

iii. determine the risk factors associated with the transmission of schistosomiasis to primary school pupils in Birnin Gwari Local Government Area, Kaduna State.

iv. identify the potential snail intermediate hosts in water bodies in the area.

1.6 Hypotheses

i. Schistosomiasis is not prevalent among primary school pupils in Birnin Gwari Local Government Area.

ii. The age and sex of primary school pupils are not associated with the prevalence of schistosomiasis in the study area.

iii. There is no specific risk factor associated with the transmission of schistosomiasis to primary school pupils in Birnin Gwari Local Government Area,Kaduna State.

iv. The snails are not vectors of schistosomiasis in the study area.

CHAPTER TWO

LITERATURE REVIEW

2.1 Background

Schistosomiasisis is a parasitic disease caused by blood flukes (Trematodes) of the genus *Schistosoma*. About 700 million people are at risk of schistosomiasis infection in 76 countries. The disease is endemic among people whose agricultural work, domestic chores and recreational activities expose them to infested water (WHO, 2010a). Schistosomiasis is the third most devastating tropical disease in the world, out of which 85% of infected individuals live in Africa (WHO, 2010b). *Schistosoma* species was discovered by Theodore Bilharz, a German surgeon while working in Cairo. He first identified the etiological agent, *Schistosoma haematobium* in 1851 (Nawal, 2010).

Schistosomes are transmitted to humans through contact with water containing the snail intermediate host that habours the infective stage of the parasite i.e. the cercaria (Shurrock, 2001; Corachan, 2002; WHO, 2010a).

2.2.0 The Parasite – *Schistosoma*

2.2.1 Classification

Kingdom - Animalia

Phylum - Platyhelminthes

Class - Trematoda

Sub-class - Digenea

Order - Strigeiformes

Family - Schistosomatidae

Genus - *Schistosoma*

2.2.2 Diversity of *Schistosoma* Species and their Geographical Distribution

There are about fifteen species of schistosomes that are prevalent in different areas of the world and produce different symptoms. Some of the important species are: *Schistosoma mansoni, Schistosoma haematobium, Schistosoma mekongi, Schistosoma japonicum* and *Schistosoma intercalatum. Schistosoma mansoni* is widespread in Africa, the Eastern – Mediterranean, the Caribbean and South America and can only infect humans and rodents. *Schistosoma mekongi* is prevalent only in the Mekong river basin in Asia. *Schistosoma japonicum* is limited to China and the Philippines and can infect mammals, such as pigs, dogs and water buffalos, in addition to humans. As a result, it can be more difficult to control disease caused by this species. *Schistosoma intercalatum* is found in Central Africa. *Schistosoma haematobium* occurs predominantly in Africa and the eastern Mediterranean (WHO, 1995; Leder and Weller, 2009). Three out of these species are of vast medical importance, these include *S. haematobium* that causes urinary schistosomiasis and *S. mansoni* plus *S. japonicum* which cause intestinal schistosomiasis.

2.3.0 Life cycle of *Schistosoma*

The life cycle of schistosomes are different from those of other trematodes. Each of the schistosome species requires a snail intermediate host in order to complete its life cycle because humans become infected by penetration of cercaria through intact skin rather than through the ingestion of matacercaria (Fig. 1). Cercaria consists of a body containing glands whose material is used to penetrate skin and a bifurcated tail that is lost when the cercaria penetrates the skin (Fig.2). Once the cercaria have successfully entered the host, the organism is termed a schistosomulum (Sher and Moser, 1981). The schistosomulum migrates through the tissues and finally invades a blood vessel. On entry into the blood vessels, the schistosomulum is carried to the lungs and then to the liver. Once within the liver sinusoids, the worms begin to mature into adults. Adults of *S. haematobium* are found primarily in the blood vessels of the vesical, prostrate and uterine plexuses. The adults of *S. mansoni* and *S. japonicum* are found in the inferior and superior mesenteric veins respectively. The worms form pairs (male and female), with the female lying in the gynecophoric canal of the male (Fig. 3). Sexual maturity of female schistosomes depend on the presence of mature male worms. The female worm has been shown to have selective gene expression in the reproductive tract in the presence of male worms, whereas females separated from male worms lose this capability (Menrath *et al.*, 1995). Exploitation of these genetic differences may be of

value in drug research thereby reducing host morbidity (Drew and Brindley, 1995).

Schistosomes have oral and ventral (acetabulum) suckers at the anterior end. The worm surface is a tegument containing a syncytium of cells. The body of the male worm, which is flattened behind the ventral sucker, appears cylindrical as it curves to form the gynecophoric canal to clasp the female worm. The female worm is long, slender, and cylindrical in cross section.

Eggs are deposited in the small venule in the intestine and rectum (*S. japonicum* and *S. mansoni)*;or the venules of the bladder (*S. haematobium).* A mature female worm can produce 300 to 3000 eggs per day depending on the species. The eggs are immature when first laid and takes approximately 14 days to develop into mature miracidia. The eggs are nonoperculate and contain spines characteristics of each species. Oviposition takes place intravascularly, and they find their way through the tissues either in the lumen of the bladder and urethra (*S. haematobium)* or into the intestine (*S. mansoni* and *S. japonicum)* to be released from the body in the urine or feaces.

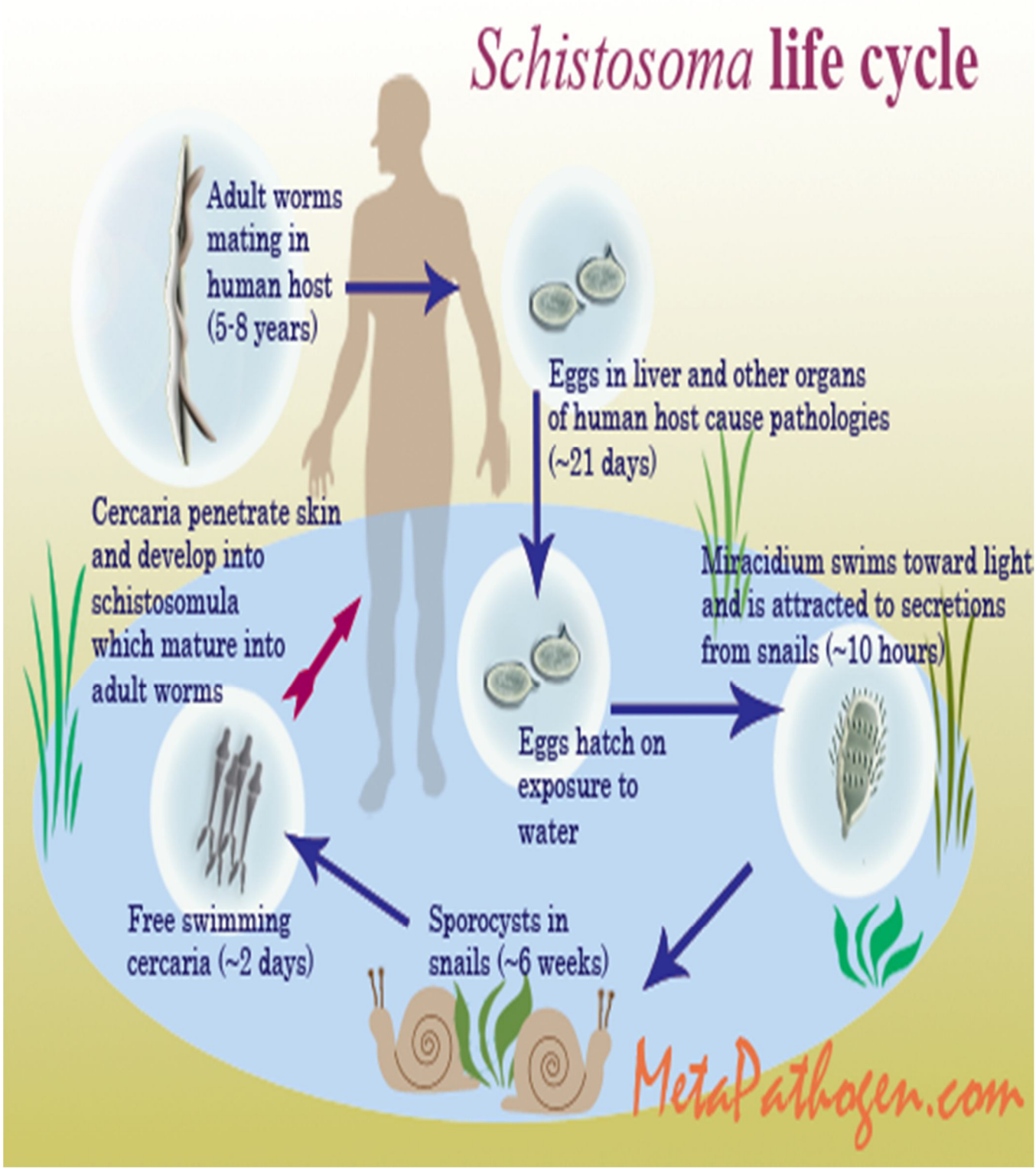


Fig.1. Life cycle of *Schistosoma*
Source: Centre for Disease and Control (CDC 2010).

Egg migration is through the tissues and is facilitated by the release of enzymes through the eggshell by the miracidium. These enzymes help digest the tissues. Eggs making their way through the tissue into the lumen contain a mature miracidium that is released when the egg is in contact with water. The actively swimming miracidium seeks a suitable snail host, which it penetrates. Within the snail, the miracidum develops into a mother sporocyst, which in turn produces daughter sporocysts. The daughter sporocysts develop in the pancreas of the snail and produce cercariae. The miracidium, which may be either female or male, gives rise to cercariae, which are of the same sex as the miracidium. The cercaria are released from the snail into freshwater, where they may infect humans by penetrating the skin.

Although the basic life cycles of schistosomes are similar, there are many species differences that allow one to easily differentiate among them. These differences include; morphological differences, development, and differentiation; intermediate snail host species; and pathologic changes.

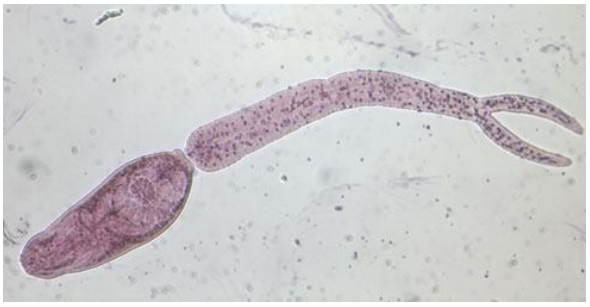


Fig. 2: Cercaria of *Schistosoma* species



*Fig 3.*Adults male and female *Schistosoma* species *in copula.*

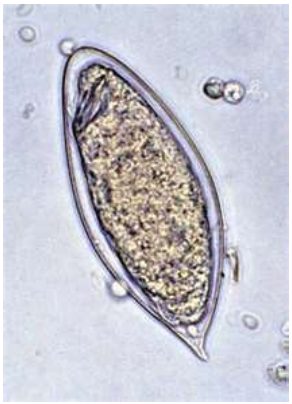


*Fig 4.*Egg of *Schistosoma haematobium*



*Fig 5.*Egg of *Schistosoma mansoni*

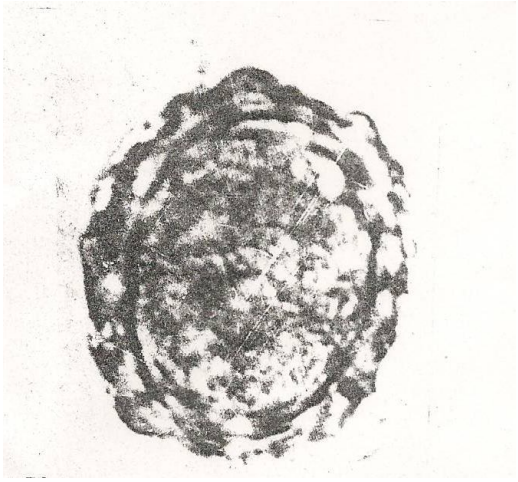


Fig 6: Egg of *Ascaris lumbricoides*

Source: WHO, 2010a



Fig. 7: Egg of Hookworm

2.4 Diagnosis of schistosomiasis

Diagnosis of schistosomiasis is established by demonstrating the eggs in urine or faeces microscopically. Detection of haematuria by reagent strip testing, the main symptom of urinary schistosomiasis due to *S. haematobium* infection, may be a simpler and cheaper alternative for identifying communities in need of treatment (Lengeler *et al.,* 1991). Macrohaematuria can be detected with the help of a questionnaire by asking individuals if they pass blood in urine or by visual examination of urine samples (Friedman *et al.,* 2007). Since 1970, ultrasonography has been applied to visualize lesions in bladder wall caused by trapped *S. haematobium* eggs (Abdel – Wahab *et al.,* 1992). Imaging methods have also been found to be very useful in the diagnosis of schistosomiasis. Ultrasonography is a sensitive means of assessing hepatosplenic disease with periportal fibrosis or urinary obstruction. It can also demonstrate spleenomegaly and urethral obstruction. This method is not suitable for large scale use in control, but it is accepted as a relatively simple non-invasive method in hospitals or research settings (Hatz *et al.,* 1992).

Chest radiographs may show patchy infiltrates in acute schistosomiasis and can indicate pulmonary hypertension and corpulmonale in end-stage chronic infection, if present. Scanning may be useful in the evaluation of CNS disease or in the detection of periportal fibrosis.

The finding of *Schistosoma* eggs in the stool and urine supports a definitive diagnosis. Urine samples can be examined qualitatively after centrifuging. However, eggs are not shed at a steady rate during the day, and quantitative egg counts are useful for determining the degree of infestation and response to therapy. Therefore, 24-hour urine collections may be recommended. Stool specimen may be examined in a thick smear clarified with glycerol (Kato-Katz technique) or by formol-ether concentration technique. Quantitative evaluation allows assessment of the degree of infection and treatment response. Hatching assays may be performed on fresh stool specimens to distinguish active from treated infection because dead eggs may be shed for up to 1 year after treatment.

There are several immunological methods for the diagnosis of Schistosomiasis and these include: The enzyme-linked immunosorbent assay (ELISA) which is helpful in the diagnosis of infection. The test requires the services of highly trained personnels and is specific and sensitive. Polymerase chain reaction (PCR) is another useful serological technique for the diagnosis of schistosomiasis.

2.5 Prevalence of schistosomiasis in Nigeria and other parts of the world

Schistosomiasis is endemic in Nigeria. Studies on schistosomiasis has been conducted in all parts of the country. Research in Nigeria on schistosomiasis shows that *S. mansoni* and *S. haematobium* are the parasites prevalent in the country. In Edo State, Nigeria, Ugbomoiko

(2000) conducted a study on urinary schistosomiasis and observed 30.5% prevalence of haematuria in the population. The prevalence of infection in the derived savannah zone was said to be completely higher than in other geographical zones. It was shown that the peak of transmission of *Schistosoma haematobium* occurred during the dry season (December to May) and lowest during the peak of heavy rains (June to September).The marked reduction in transmission, observed during the rains was said to be due to either the suppressive effect of low temperature condition on the biological productivity of the schistosome infective stage in the snail host or reduction in human water contact activities.

A survey on urinary schistosomiasis was conducted among 180 pupils in three schools in Belwa Local Government Area of Adamawa State, Nigeria and an overall prevalence of 49 (27.2%) was recorded (Duna and Bristone, 2000).

Mbah and Useh (2008) studied a relationship between the transmission of urinary schistosomiasis and prevailing socio-economic factors in some villages in Lagdo District of the Republic of Cameroon and *Schistosoma haematobium* was confirmed amongst 39.2% of the study population. Mixed infections of *S. mansoni* and *S. haematobium* occurred in only 4.5% of the pupils.

Luka *et al.* (2001) studied the prevalence of schistosomiasis among primary school pupils in Lere Local Government Area of Kaduna State. A

total of 142(12.3%) and 132 (11.3%) pupils had eggs of *Schistosoma haematobium* and *Schistosoma mansoni* respectively. Adeoye and Akabogu (1996) recorded 40% prevalence of *S.haematobium* in urine samples collected from the people of Ado odo / Ota area of Ogun State, Nigeria.

Agbolade *et al.* (1996) carried out studies on the prevalence of urinary schistosomiasis in 356 pupils from Ago – Iwoye in Ogun state. Prevelance of 6.5% was recorded in the study population.

Akogun and Obadiah (1996) recorded a 65.8% prevalence of *S. haematobium* compared with the prevalence of proteinuria (62.8%) and the history of previous haematuria (65.8%). More than 87.8% of those with ova of *S. haematobium* could recall previous cases of haematuria while 83.7% of pupils with protenuria had history of heamaturia.

Ofoezie *et al.* (1996) studied the status of schistosomiasis and some other helminth infections in eight irrigation schemes in Sokoto, Katsina and Kebbi states. They recorded an overall prevalence of 22.3% for *S. haematobium* and 14.5% for hookworm infection. The intensity of *S. haematobium* ranged from 20 to 8,142 eggs / 10ml urine.

Agbolade *et al.* (2007) recorded a 66.2% prevalence of intestinal helminthes in Southwest of Nigeria out of which *Schistosoma mansoni* was recorded in 2.3% and *Schistosoma haematobium* was recorded in 0.6% of the study population.

Arinola (2007) studied the epidemiology of *Schistosoma haematobium* in Ilie village, Osun State. The study showed that few class teachers habour the eggs of *S. haematobium* while in all classes of at least 40 pupils, all the pupils had *S. haematobium.*

Okpala *et al.* (2004) conducted a study on the prevalence of schistosomiasis in 300 apparently healthy primary school pupils in Apata and Laranto areas of Jos. They recorded an overall prevalence of 0.67%. Students that got their water supply from the river and pond were mostly infected, while lower prevalence was recorded among those that use tap water.

Marieke *et al.* (2004) carried out a baseline prevalence study of *S. haematobium* infection based on bladder pathology by ultrasound. The calculated baseline prevalence was 13% in school children and 3% for other members of the community. Apparently, school children had more problems with the bladder.

Currently, about 120 million people are symptomatic with severe clinical schistosomiasis (WHO, 2010a). More than 200,000 deaths are recorded per year due to schistosomiasis in sub-Saharan Africa (Corachan, 2002). Women washing clothes in infested water are at risk of infection (Houston *et al.,* 2007). Poor personal hygiene and the attitude of children in playing and swimming in water has made the children to be more vulnerable and susceptible to infection. Statistics has shown that about forty million women of child bearing age are infected.

The prevalence and intensity of infection rises with age and peaks usually between 15 to 20 years. In adults, there is no significant change in the prevalence of the disease, but the parasite burden or the intensity may decrease (Leder and Weller, 2009; Shurrock, 2011). Worldwide, 1 in every 30 individuals has *Schistosoma* infection (Leder and Weller, 2009). Urogenital schistosomiasis is considered to be a risk factor for HIV infection, especially in women (WHO, 2010a).

In Brazil and Africa, the movement and migration of refugees to urban areas introduces the disease to new locations. Increasing population size and corresponding needs for power and water have led to increased transmission. Infections are not uniformly distributed within communities. It has been estimated that 5-10% of an endemic community may be heavily infected, and the remainder may have mild-to-moderate infections. The risk of infection is highest amongst those who live near lakes or rivers. In Uganda, transmission does not occur at altitudes greater than 1,400m or where the annual rainfall is less than 900 mm (WHO, 2010b).

2.5.2 Age and sex specific prevalence of schistosomiasis

The age and sex specific prevalence of schistosomiasis varies from one area to the other. In a study conducted on schistosomiasis, the pattern of infection was found to be similar in both male and female with peak of prevalence and intensity occurring in 11-15 years (Ugbomoiko, 2000). The infection varied with age reaching the peak among children

aged 11-13 years old and dropping sharply thereafter. Males are found to be mostly infected than their female counterparts. This is due to their exposure to outdoor activities like swimming and fishing in water bodies where the snail intermediate hosts are found.

Galadima *et al.* (1992) carried out a survey in Kore, a small agricultural village situated close to the Ahmadu Bello University dam and waste treatment plant, in Zaria emirate, northern Nigeria and showed that 8 out of 34 males (23.53%) and 4 out of 26 female (5.38%) were infected with *S. mansoni*.

Mbah and Useh (2008) conducted a study on schistosomiasis in Cameroon and reported the highest prevalence in the 5-9 years age group (45.7%). The highest prevalence was recorded among the male (23.5%) than the females (15.7%). Luka *et al.* (2001) showed that the highest prevalence (19.6%) of *S. haematobium* infection was observed in the age group 13 years and above while *S. mansoni* prevalence was high (18.2%) in the age group 10 – 12 years. The prevalence of the disease was significantly higher among males than females ($p < 0.05$). Adeoye and Akabogu (1996) conducted a survey among residents of Ado /Ota area of Ogun State and recorded a prevalence of 48.6% in the age group 11 – 20 years followed by 43.2% in 1-10 years age group. The females had higher prevalence of infection compared to males. The mean intensity in the population was 8 eggs per 10ml of urine, intensity in males almost doubled that of females. In a similar study conducted in Sokoto, Katsina

and Kebbi states, the peak prevalence of schistosomiasis among males was 39.3% in the 10-26 years age group and 19.4% for females in the 30-31 years age group (Ofoezie *et al.,* 1996).

2.5.3 Intermediate hosts of schistosomes

Schistosoma mansoni is transmitted by *Biomphalaria* snails while *S. haematobium* is transmitted by *Bulinus* species. Ekwunife *et al.* (2008) investigated some aspects of the biology and population parameters of *Bulinus globosus* and *Bulinus truncatus* which are snails implicated in the transmission of urinary schistosomiasis in Agulu Lake Area of Anambra State, Nigeria. The incubation period for the two species was 7-14 days while 21% of the eggs were for both species. The highest rate of ovipositon by *B. globosus* was 261.64 ± 52.84 at week 18.

The snail intermediate host of *Schistosoma haematobium,* i.e. *Bulinus globosus,* were found attached to water hyacinth *(Eichornia crassipes)* in Era stream at the project site (Adeoye and Akabogu, 1996).

Four freshwater bodies in parts of Southwest Nigeria selected on the basis of water contact activities were investigated for aquatic snails, *Bulinus globosus, Bulinus senegalensis* and *Biomphalaria pfeifferi* were found to support bifurcated cercariae (Agbolade *et al.,* 1996). Nwabueze and Opara (2007) encountered four species of snails in riverine communities of Delta State, Nigeria where *Bulinus (Physopsis) globosus* predominated.

Luka *et al.* (2005) studied the ecology and distribution of snail intermediate host of schistosomiasis in three districts of Lere Local Government Area of Kaduna State. The number and percentages of the snails collected from the nine villages were: 920 (20.1%) *B. forskali; 1310* (28.7%)*B. globosus;* 1110 (24.3%) *B. pfeifferi* and 1215 (26.6%) *Lymnaea natalensis.*

2.6.0 Pathology of Schistosomiasis

2.6.1 Acute phase of schistosomiasis

Tissue migration of *Schistosoma* larvae may cause a hypersensitivity reaction. Although most clinical manifestations are benign, some maybe severe and may require hospitalization. If acute schistosomiasis (AS) is not suspected clinically and treated appropriately, it can result in severe morbidity or death. Nonimmune travelers are especially prone to this disease manifestation. After a single exposure to a freshwater pond in Tanzania, 86% of tourists developed AS. Symptoms of AS include cough, fever, and fatigue (King *et al.,* 1988). Symptoms usually appear 2-12 weeks after exposure.

The eggs of schistosomes cause Katayama fever and schistosomiasis. The exact pathophysiology is not known. It occurs 4-6 weeks after infection, at the time of the initial egg release. It is reported most commonly with *S. japonicum* but also has been reported with *S. mansoni.* Katayama fever is believed to be due to the high worm and egg

antigen stimuli that result from immune complex formation and lead to a serum sickness—like illness (Badmos *et al.,* 2006).This syndrome is due to immunological reactions to *Schistosoma* eggs trapped in tissues not granuloma formation. Antigens released from the eggs stimulates a granulomatous reaction comprises of T cells, macrophages, and eosinophils that results in clinical disease. Symptoms and signs depend on the number and location of eggs trapped in the tissues. Initially, the inflammatory reaction is readily reversible. In the latter stages of the disease, the pathology is associated with collagen deposition and fibrosis, resulting in organ damage that may be only partially reversible. Eggs can end up in the skin, brain, muscle, adrenal glands and eyes. As the eggs penetrate the urinary system, they can find their way to the female genital region and form granulomas in the uterus, fallopian tube, and ovaries. CNS involvement occurs because of embolization of eggs from the portal mesenteric system to the brain and spinal cord via the paravertebral venous plexus (Friedman *et al.,* 2007).

2.6.2 Chronic schistosomiasis

Chronic schistosomiasis results mostly from host responses to eggs retained in tissues. Most patients are asymptomatic or mildly symptomatic and do not require medical attention. Only a small proportion of the endemic population harbor a heavy worm burden that later leads to clinical complications (Terada, 2009).

a. Gastrointestinal schistosomiasis

The most common complication is periportal fibrosis, also termed Symmers clay pipestem fibrosis. This leads to portal hypertension and gastrointestinal hemorrhage. Liver failure is uncommon, except in persons with concomitant chronic hepatitis or cirrhosis. Of those with *S. mansoni, S. japonicum,* and possibly *S. mekongi,* 4-8% develop shepatosplenic disease (Badmos *et al.,* 2006).A co-infection of either Hepatitis B and C and *S. mansoni* have been shown to give rapid progression of liver disease.

b. Urinary tract schistosomiasis

This can lead to renal failure due to obstructive uropathy, pyelonephritis or bladder carcinoma (occurring usually 10- 20 years after the initial infection). In addition, immune complexes that contain worm antigens may deposit in the glomeruli, leading to glomerulonephritis and amyloidosis (Terada, 2009).

c. Female genital schistosomiasis

Schistosoma haematobium causes lesions in the female lower genital tract (i.e. cervix, vulva, vagina). Female genital schistosomiasis (FGS) has been identified as a major social and medical problem that may facilitate the spread of some sexually transmitted diseases such as HIV and human papillomavirus (HPV) (Terada, 2009).

d. Coexistence of sexually transmitted infection and urogenital schistosomiasis

One study found that, in women with *Schistosoma haematobium* infection in Madagascar, 35% have co-existing sexually transmitted infections (STIs) like *Neiserria gonorrheae, Chlamydia trachomatis, Mycoplasma genitalium* and *Trichomonas vaginalis*, as compared with 17% of the men. This is found to be more common in younger populations (15-24 years) than older populations. The association becomes stronger with greater parasite burden (Argemi *et al.,* 2009).

e. Pulmonary arterial hypertension in schistosomiasis

This is an important complication that develops in about 7.7% of patients with hepatosplenic disease in *S. mansoni, S. japonicum,* and possibly *S. mekongi* infections. The prevalence of the disease worldwide is estimated to exceed 270,000 individuals (Badmos *et al.,* 2006).

f. Central Nervous System (CNS) schistosomiasis

Most cases of cerebral schistosomiasis are observed with *S japonicum.* Central nervous system (CNS) involvement occurs in 2-4% of all *S. japonicum*infections. One million people in China are estimated to be infected with *S. japonicum (*Lapa *et al.,* 2009) Cerobellar nodular enhancing lesions can occur with *S. japonicum*. *S. japonicum* causes 60% of all *Schistosoma* brain infections because of its smaller egg size (Nmorsi *et al.,* 2005). However, CNS schistosomiasis can also occur with other

species. Spinal schistosomiasis usually presents as transverse myelitis and is primarily due to *S. mansoni* infection because of the larger egg size (Nmorsi*et al.,* 2005). *Schistosoma haematobium* can infect the brain or the spinal cord. The distribution of *S. mekongi* is limited to the Mekong River basin in Laos and Cambodia, where some 140,000 people are estimated to be at risk for this infection. Temporal mass causing paraesthesias of the arm and leg with dysphasia has been described with *S. mekongi* infection (Friedman *et al.,* 2007). Neurologic symptoms can develop months after the infection. Cauda equina syndrome, anterior spinal artery syndrome and quadriparesis can occur. Most of the lower spinal cord is affected (Nmorsi *et al.,*2005).

2.7 Socioeconomic Importance of schistosomiasis

Schistosomiasis is the second most socio-economically devastating parasitic disease after malaria in terms of socio-economic and public health importance in tropical and subtropical areas. Schistosomiasis is a good example of an environmental danger to older children. At least 100 million children aged 5 – 14 years are infected with schistosomiasis (WHO 1991). These children tend to wash and bath in canal or pond water infested with the parasites, because their families lack clean water.

Several environmental and socio-economic factors have been identified to be responsible for the continued persistence of intestinal parasites in children, some of these include poor sanitary conditions,

unhygienic practices, absence of portable water, poor housing and poverty (WHO 1991, Edungbola and Obi 1992; Crompton and Savioli, 1993; Amuta *et al.,* 2004; Nwoke 2004).

2.8 Treatment of schistosomiasis

Several medications have been developed against schistosomiasis, such as praziquantel (Biltncide), oxamniquine and metrifonate and have been shown to be safe and effective. Praziquantel is effective against all forms of schistosomiasis and has few side effects. This drug is given in either two or three doses over the course of a single day. Oxamniquine is typically used in Africa and South America to treat intestinal schistosomiasis. Metrifonate has been found to be safe and effective in the treatment of urinary schistosomiasis. Patients are typically checked for the presence of living eggs at three and six months after treatment. If the number of eggs excreted has not significantly decreased, the patient may require another course of medication (King, 2009).

2.9 Prognosis of schistosomiasis

If treated early, prognosis is very good and complete recovery is expected. The illness is treatable, but people can die from the effects of untreated schistosomiasis. The severity of the disease depends on the number of worms, or worm load, in addition to how long the person has been infected. With treatment, the number of worms can be substantially reduced, and the secondary conditions can be treated. The goal of the

World Health Organization is to reduce the severity of the disease rather than to completely stop transmission of the disease. There is, however, little natural immunity to reinfection. Treated individuals do not usually require retreatment for two to five years in areas of low transmission. The World Health Organization has made research to develop a vaccine against the disease one of its priorities.

2.10 Prevention and control of schistosomiasis

Prevention of the disease involves several targets and requires long term community commitment. Infected patients require diagnosis, treatment and education about how to avoid reinfecting themselves and others. Adequate healthcare facilities need to be available, water systems must be treated to control snail populations, and sanitation must be improved to prevent the spread of the disease.

After more than 20 years of schistosomiasis control programmes, chemotherapy has been shown to be a very important tool. Nevertheless in medium and long term control programmes, sanitation, water supply, sewage draining and health education seem to be the real tools when the aim is persistent and definitive (Katz *et al.,* 1998).

To avoid schistosomiasis in endemic areas the Centre for Disease Control of the United States of America gave the following advice for personal protection:

- contact the CDC for current health information on travel destinations.
- upon arrival, ask an informed local authority about the infestation of schistosomiasis before being exposed to freshwater in countries that are likely to have the disease.
- do not swim, stand, wade, or take baths in untreated water.
- treat all water used for drinking or bathing water can be treated by letting it stand for three days, heating it for five minutes to around 122°F (around 50°C), or
- treating drinking water chemically, with chlorine.
- Should accidental exposure occur, infection can be prevented by hastily drying off or applying alcohol to the exposed area.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

The study was carried out in Birnin Gwari Local Government Area, which is one of the twenty three (23) Local Government Areas (LGA) of Kaduna State, Nigeria. The LGA is located in the eastern part of the State. It is divided into thirteen (13) districts, and has an area of 6,185Km^2 and an estimated population of 252,363 (Census, 2006). The local government lies geographically between latitude 10°44'52"N – 11°19'59"Nand longitude 6°38'32"E - 7°19'59"E (Figure 8). The inhabitants are predominantly farmers, traders and civil servants. Their sources of water include wells, rivers, streams, pipe-borne water and dams. The supply of tap water is periodically.

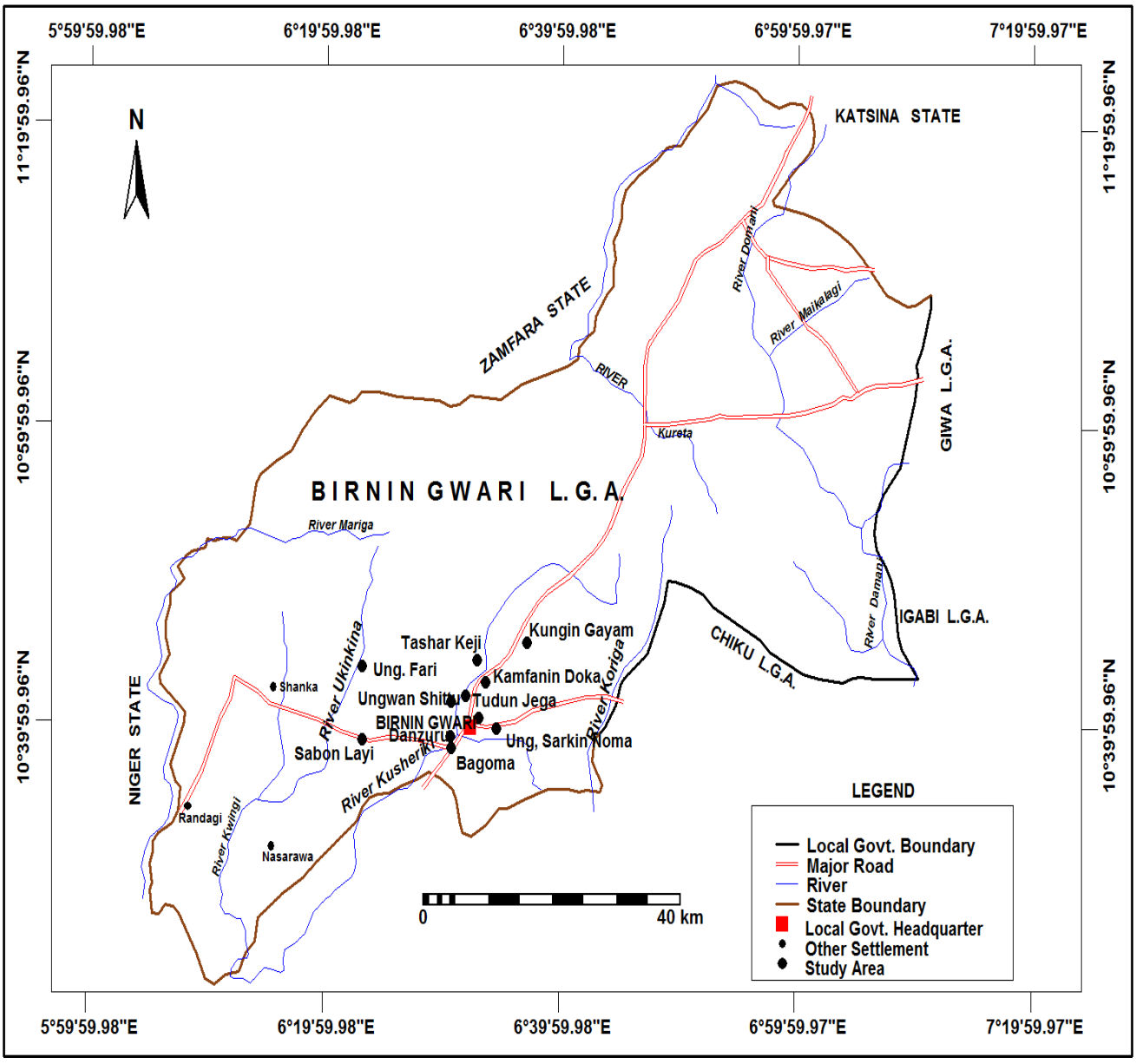


Fig. 8: Map of Birnin Gwari Local Govt. Area Showing the Study Area
Source: Adapted and modified from Administrative map of Kaduna state

3.2 Study Population

The study population comprises children of primary school age. Ten primary schools were selected randomly for the study. Ethical clearance was sought and received from the Education Secretary. Permission was sought from the district head of the study area. The Headmasters of the selected schools were visited and briefed on the purpose of the research and dates were fixed for sample collection.

The study population comprised of 215 boys and 85 girls aged between 6 – 17 years. Each pupil selected for the study was given 2 labelled specimen bottles, one for stool and the other for urine collection.

3.3 Determination of Sample Size

The sample size was determined using the method of Sarmukaddan and Garad (2006) to calculate the sample size using the equation below:

$$n = \frac{Z^2pq}{L^2}$$

Where n = sample size

Z = standard normal distribution at 95% confidence interval =1.96

p = prevalence rate, which is taken as 75%=0.75

q = 1-p=1-0.75=0.25

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

$$\text{Therefore } n = \frac{1.96^2 \times 0.75 \times 0.25}{0.05^2} = 288.12 \approx 300$$

3.4 Collection of Samples

Faecal and urine samples were collected separately in specimen bottles from school children. The samples were collected between 10 am-12 noon in each of the schools.

A total of 30 pupils per school between the ages of 6-17 years were randomly selected. The primary schools selected were: Kamfanin Doka, Tudun Jega, Kungin Gayam, Bagoma Model, Tashar Keji, Sabon Layi, Unguwan Sarkin Noma, Unguwan Fari, Danzuru and Unguwan Shittu Local Government Education Authority (LGEA). The samples were labelled and transported to the laboratory for analysis.

3.5 Administration of Questionnaires

Structured questionnaires were administered to the pupils from as samples were collected. Demographic data obtained were name of school, sex and age of the pupils, sources of water for drinking and household activities, housing sanitation, parents' occupation, types of toilets, history of bloody stool and terminal haematuria and outdoor activities of the pupil such as swimming and fishing in water bodies.

3.6 Laboratory Analysis of Samples

3.6.1 Urine Samples

Urine samples were examined by centrifugation technique (Ukaga *et al.,* 2002). Ten millilitre (ml) of each urine sample was centrifuged at 1,500 revolutions per minute (rpm) for five minutes. The supernatant was decanted and the sediment was examined under the light microscope for eggs of *S.haematobium.*

3.6.2 Faecal Samples

Faecal samples preserved in 10% formalin were analysed using the sedimentation and formol – ether concentration techniques for the detection of eggs of *Schistosoma mansoni*. 4gm of stool was put in 10mls of 10% formalin and mixed thoroughly for fixation to take place. The mixture was strained through the gauzed one size into a 15ml centrifuge tube and 0.85% sodium chloride (NaCl) solution was added and centrifuged for 10mins at 5000rpm; the supernatant fluid was decanted and the sediment was resuspended in normal saline or 10% formalin; 4-5ml of ethyl acetate was added to extract the debris from faecal material. The mixture was shaken vigorously for about 30 seconds, centrifuged for 10mins at 5000rpm. The supernatant was discarded leaving the sediment. A small amount of the sediment was added to a slide, a drop of iodine solution was placed on the slide to stain the faecal sample covered with a cover slip and examined under a low power magnification of a research microscope (Wentworth, 1988; Ukaga *et al.,* 2002).

3.6.3 Intensity of infection

The total number of eggs of *S. haematobium* counted for all infected pupils was divided by the number of pupils positive for the infection to give the intensity of infection as eggs per 10ml of urine. For *S. mansoni*, intensity of infection was derived by counting the total number of eggs obtained from all infected pupils, divided by the number of pupils positive for *S. mansoni* and then divided by 4 to get the intensity as egg per gram of stool.

3.7 Snail Survey

Snail surveys were carried out in order to identify the active sites of transmission of the disease in the area. Community ponds, dams and other water bodies around the area served as habitats for the snail intermediate hosts. Snail collection was conducted using a long handled scoop net. The net was pushed through the vegetation in the water in order to collect the snails.

3.8 Statistical Analysis

The prevalence of schistosomiasis in the area was calculated. The Chi-squared test was used to determine the association between factors and prevalence. Odds ratio (OR) was determine to show association between the factor and infection rate/prevalence. Overall, age and sex specific prevalence of the disease were calculated and expressed as percentage (%).

CHAPTER FOUR

RESULTS

4.1 *Schistosoma haematobium* Survey

The overall prevalence of *Schistosoma haematobium* infection was 108 out of 300 representing 36.0% of the study population (Table 1). The prevalence and intensity of *S. haematobium* by school showed that the highest prevalence of *S. haematobium* was recorded in Danzuru primary school 18(60.0%), followed by Kamfanin Doka 16(53.3%), 13(43.3%) in Sabon Layi, 11(36.7%) in Kungin Gayam, 10(33.3%) in Tudun Jega, 9(30.0%) in Bagoma model, Tashar Keji and Unguwan Fari respectively, 7(23.3%) in Unguwan Shittu, the least prevalence was recorded in Unguwan Sarkin Noma Primary school where 6 pupils representing 2% of the study population were infected (Table 1). The prevalence of *S. haematobium* in males was 88(29.5%) in females 20(6.7%). The infection distribution by age among males showed that the highest prevalence of 9.7% was recorded in the age group 15 – 17 years and above. The age group 9 – 11 ranked second with 7.7% of pupils infected. The age group with the lowest prevalence was the 6 – 8 years age group where 5.3% males were infected. In females, the highest prevalence of 2.7% was recorded in the 12 – 14 years age group followed by 2.0% in the 15 – 17 years and above age group. The lowest prevalence of 0.7% was recorded in the 6-8 years age group (Table 2). On a general note, the highest prevalence of infection was recorded among the males than the females.

Table 1: Prevalence and Intensity of *S. haematobium* by school in Birnin Gwari Local Government Area.

School / LGEA	No. examined	No. infected (%)	Intensity /10ml of urine
Kamfanindoka	30	16 (53.3)	3.5
TudunJega	30	10 (33.3)	2.4
KunginGayam	30	11(36.7)	3.7
Bagoma model	30	9(30.0)	2.4
TasharKeji	30	9(30.0)	2.6
SabonLayi	30	13(43.3)	3.3
UnguwanSarkinNoma	30	6(20.0)	1.0
UnguwanFari	30	9(30.0)	2.3
Danzuru	30	18(60.0)	0.3
UnguwanShittu	30	7(23.3)	1.0
Total	**300**	**108 (36.0)**	

Table 2: Age and sex specific prevalence of *Schistosoma haematobium* infection in school children.

	Male			Female		
Age group (years)	No. Examined	No. Infected (%)	Age specific prevalence (%)	No. Examined	No. Infected (%)	Age specific prevalence (%)
6-8	26	16	5.3	20	2	0.7
9-11	36	23	7.7	19	4	1.3
12-14	32	20	6.7	18	8	2.7
15-17	30	29	9.7	21	6	2.0
TOTAL	**215**	**88**	**29.3**	**85**	**20**	**6.7**

The overall intensity of *Schistosoma haematobium* in the primary schools showed that Kungin Gayam had the highest level of intensity of 3.7 while Unguwan Sarkin Noma and Unguwan Shittu had the least intensity of 1.0 (Table 1).

Statistical analysis showed that there was statistically significant difference in prevalence between males and females ($P<0.05$).

Chi square test showed that there was no significant difference between the prevalence rates in the different age groups ($P>0.05$).

4.2 *Schistosoma mansoni* Survey

Of the 300 stool samples collected, 40 males representing 13.3% and 21 females representing 7.0% of the study population were infected . There was significant difference ($P<0.05$) in prevalence between male and females.

Highest prevalence of *S. mansoni* was recorded in Tashar Keji 13(43.3%) followed by Kungin Gayam primary school 12(40.0%), 7(23.3%) in Bagoma model, 7(23.3%) in SabonLayi, 6(20.0%) in Unguwan Fari and 3(10.0%) in Kamfani Doka, Unguwan Sarkin Noma Primary school, Danzuru and Unguwan Shittu respectively (Table 3).

The prevalence of *S. mansoni* in males was 40(13.3%) and in females 21(7.0%). Distribution of infection by age among males showed that the highest prevalence of 12 (4.0%) was in the age group 12 – 14 years. The age group 6 – 8 and 15 – 17 ranked second with 3.3% prevalence. The age group with the lowest prevalence was the 9 – 11

years age group 2.7% males were infected. In females, the highest prevalence of 2.3% was recorded in the 12 – 14 years age group followed by 2.0% in the 9 – 11 years age group. The lowest prevalence of 1.3% was recorded in the 6-8 years and 15 – 17 years age group (Table 4). The overall intensity of *Schistosoma mansoni* the primary schools showed that Tashar Keji had the highest level of intensity of 0.75 while Danzuru, Unguwan Shittu, Unguwan Sarkin Noma and Kamfanin Dokahad the least intensity of 0.10 (Table 3).

Chi square test showed that there was no significant difference between the prevalence rates in the different age groups ($P>0.05$).

Table 3: Prevalence and Intensity of *S. mansoni* by school in Birnin Gwari Local Government Area.

School/LGEA	No. examined	No. infected (%)	Intensity / gram of feaces
Kamfanindoka	30	3(10.0)	0.50
TudunJega	30	4(13.3)	0.19
KunginGayam	30	12(40.0)	0.10
Bagoma model	30	7(23.3)	0.21
TasharKeji	30	13(43.3)	0.15
SabonLayi	30	7(23.3)	0.25
UnguwanSarkinNoma	30	3(10.0)	0.33
UnguwanFari	30	6(20.0)	0.75
Danzuru	30	3(10.0)	0.5
UnguwanShittu	30	3(10.0)	0.57
Total	**300**	**61(20.3)**	

Table 4: Age and sex specific prevalence of *Schistosoma mansoni* infection in school children.

		Male			Female		
	Age group (years)	**No. Examined**	**No. Infected (%)**	**Age specific prevalence (%)**	**No. Examined**	**No. Infected (%)**	**Age specific prevalence (%)**
	6-8	26	10	3.3	20	4	1.3
	9-11	36	8	2.7	19	6	2.0
	12-14	32	12	4.0	18	7	2.3
	15-17	30	10	3.3	21	4	1.3
TOTAL		**215**	**40**	**13.3**	**85**	**21**	**7.0**

4.3 Prevalence of *Schistosoma mansoni* and other intestinal parasites

Other intestinal parasites were encountered in the faecal samples apart from *Schistosoma mansoni*. *Schistosoma mansoni* was recorded in 61 pupils representing 20.3%, hookworm in 25 pupils representing 8.3%, *Hymenolepis nana* in 7 pupils representing 2.3%, while *Enterobius vermicularis* was recorded in 4 pupils representing 1.3%, and *Ascaris lumbricoides* was recorded in one pupil representing 0.7% of the study population (Table 5). Mixed infections were recorded in four pupils representing 1.3% of the study population. Mixed infections of *S. mansoni* and Hookworm was recorded in 2 pupils representing 0.67% of the study population, while mixed infections of *S. mansoni* and *Enterobius vernicularis,* and *S. mansoni* and *Ascaris lumbricoides* were each recorded in 1 pupil representing 0.3% of the study population.

Table 5: Prevalence of *Schistosoma mansoni* and other intestinal parasites (n = 300)

Parasites	**No. infected**	**Percentage**
Schistosoma mansoni	61	20.3
Hookworm	25	8.3
Hymenolepis nana	7	2.3
Enterobius vermicularis	4	1.3
Ascaris lumbricoides	1	0.3
Total	98	32.7

4.4 Response from the questionnaire

The responses of the pupils to the questionnaires and the results of statistical analysis to show association between the different factors / variables were summarized.

The responses were divided into factor positive and negative and the number of pupils that have the disease and those did not have the disease. Odds ratio greater than one indicate there were associations between the factors and the prevalence of the disease.

Use of pipe borne water had odds ratio value of 1.4, use of pond water had odds ratio value of 2.4, use of river and stream water odds ratio of 2.8, all these outcomes showed strong associations between source of water and infection.

Water contact activities showed that fishing had an odd ratio of 1.3. history of blood in stool and in urine showed odds ratio values of 3.0 and 7.8 respectively. These outcomes show that those that go fishing were 1.3 times more likely to come down with the disease. There was strong association between the age of the pupils and the disease. The occupation of the parents showed that businessmen, drivers and fishermen had odds ratio of 1.69, 1.98 and 3.32 respectively. All indicating strong association between factors and prevalence of the disease (Table 6).

Table 6: Effects of some factors in the epidemiology of Schistosomiaisis in Birnin Gwari Local Government Area, Kaduna State.

Factor	No. Examined	No. infected.	Odds Radio Value	95% C.I.
Source of water				
Pipe borne	27	17	1.4	0.83-1.54
Well	196	102	0.6	0.66-0.098
Pond	8	6	2.4	0.89-2.03
River/stream	34	26	2.8	1.14-1.77
Borehole	45	18	0.8	0.64-1.27
Water contact activities				
Swimming	75	41	0.9	0.76-1.22
Do not swim	40	24	1.2	0.82-1.42
Fishing	51	32	1.4	0.90-1.45
No fishing	60	33	0.9	0.75-1.25
Both fishing and swimming	31	15	0.7	0.58-1.23
None of the above	43	24	1.0	0.74-1.32
Blood in stool and urine				
Bloody stool	27	21	3.0	1.14-1.80
Normal stool	67	33	0.6	0.61-1.04
Bloody urine	31	10	7.8	1.77-2.66
Normal urine	81	14	0.1	0.15-0.40
Occupation (parent)				
Businessmen	102	66	1.7	1.02-1.51
Civil servants	36	16	0.6	0.52-1.12
Drivers	24	17	2.0	0.97-1.70
Fishermen	38	30	3.3	1.22-1.82
Farming	100	40	0.4	0.48-0.81

4.6 Snail Survey

Table 7 shows the snail species that were recovered in some of the water bodies in Birnin Gwari Local Government Area. *Bulinus* species were the predominant snail species encountered in the area. They were found in all the water bodies (Plate I),followed by *Biomphalaria* species which was found in three out of the five water bodies that were sampled (Plate II).

The snail was high in UnguwanFari, Danzuru, and Sabon Layi villages followed by Tashar Keji and Kamfanin Doka. Most of the information gathered revealed that wells in the study area were said to dry up easily thereby exposing most members of the populace to snail intermediate host.

Table 7: Snail Survey in Some of the Water bodies in Birnin Gwari Kaduna State Local Government Area.

Village	**Types of water bodies**	**Snail genus**
Unguwan Fari	Dam, streams	*Biomphalaria* and *Bulinus*
Danzuru	Dam, river	*Biomphalaria* and *Bulinus*
Tashar Keji	Ponds	*Bulinus*
Sabon Layi	Streams, ponds	*Biomphalaria and Bulinus*
Kamfanin Doka	Pond, river	*Bulinus*



Plate I: *Bulinus globosus*



Plate II: *Biomphalaria pfeifferi*

CHAPTER FIVE

DISCUSSION

The study has revealed that Birnin Gwari Local Government Area is endemic for schistosomiasis, with a prevalence of 56.3% among primary school children sampled in the area. In this study, higher prevalence rates of *S. haematobium* and *S. mansoni* recorded are close to those recorded in other areas in Nigeria where surveys have been conducted (Akogun *et al.,* 1996; Luka *et al.,* 2001).

The prevalence of the disease in different villages and individual schools were not the same despite the similarities of the local topography and climatic conditions in the area. There was a significant association between settlement that are closest to the pond while other helmet that were farthest from the pond showed no significant association (Kanwai *et al., 2010)*This outcome could be attributed to the closeness or distance of the community from the ponds and streams, how long these water bodies can support transmission before drying up and the presence and abundance of the snail intermediate hosts in water bodies that serveas transmission tools.

In this present study, higher prevalence of schistosomiasis was recorded in Kungin Gayam primary school with 23(76.7%) followed by Tashar Keji 22(73.3%), Danzuru 21(70.0%). Unguwan Sarkin Noma had the lowest prevalence 9(30.0%). This result could be due to the fact that

in those areas the pupils often go and swim thereby exposing themselves to the infective stage of the parasite.

In this study, higher prevalence were recorded in males than females. This result could be due to the fact that males make more frequent contact with water than females because in traditional African settings, females are mostly associated with indoor activities than males. The males are fond of going to the streams and ponds to swim and bath, thereby becoming more exposed to the snail intermediate hosts in such water bodies. There was an association between the disease and sex (OR=1.58) but the association is not significant, because the lower limit of 95% confidence limit is less than one. The difference was not statistically significant (P>0.05).

The age group 15-17 years had 49 pupils infected followed by age group 12-14 years, 47 pupils were infected, the 9-11 years, had 41, then 6-7 years had the least of number of 32 pupils infected. This shows that prevalence of infection increased from the younger to older pupils. The prevalence of infection in age groups 12-14 and 15-17 shows that there is an association between the age of the pupils and the prevalence of the disease (OR = 2.98 and OR=2.02). The association is also significant with the lower limit greater than 1.23 and 1.08. There was no association in the age group 6-8 and 9-11. This could be due to the fact that at these ages the children are not greatly exposed to water bodies compared to others.

The source of water for drinking, bathing and household use exposes the pupils to intermediate hosts that aids in the transmission of the infection (Amuta *et al.,* 2004; Nwoke 2004). Those who solely depend on water from the wells and river/stream were highly infected as compared to those who rely on borehole and pipe-borne water(OR = 2.8)

The higher prevalence recorded among individuals that use water from streams / rivers is due to the fact that the intermediate hosts of the parasites are found in such water bodies. The inability of government to provide clean safe water exposes them to these intermediate hosts. The people living in poor unhygienic conditions may not be informed or aware of the transmission routes of the disease and may not have received any form of health education talk on the transmission and control of Schistosomiasis therefore, they are likely to continuously contaminate the water bodies by indiscriminate defecation or urination, this agreed with the findings of Luka *et al.,* 2001; Amuta *et al.,* 2004; Mbah *et al.,* 2008; Leder *et al.,* 2009 and others.

Intestinal parasites other than *S. mansoni* were also recorded among the pupils in the study area. Mixed infections recorded could be due to the ability of parasites to live together in the same host without harming each other. The low prevalence of mixed infection is due to the fact that the first parasite that invades the host circulates its antigen round the body of the host thereby making it difficult for another parasite to survive and get established in the same host. Hookworm

infection also causes blood in stool, some of the pupils reported passing blood in stool but no *S. mansoni* seen in their stool. These outcomes could be due to hookworm infection, which also causes blood to be passed in the stool.

Water contact activities of the pupils showed that recreational activities such as swimming and fishing tend to increase the transmission of schistosomiasis from intermediate hosts to man. This study showed a strong association between fishing and prevalence of infection i.e. those that swim were said to be more likely to become infected. This is due to the fact that the long time they spend in water gives the cercaria enough opportunity to come in contact with the skin of man while in water. The sources of water for drinking and bathing also expose the pupils to infested water (Marieke *et al.,* 2004; Arinola, 2007).

The history of bloody stool and terminal haematuria which are symptoms commonly associated with *S. mansoni* and *S. haematobium* infection respectively was more frequently recorded in infected males than females. This may be attributed to the fact that young males are more frequently affected because they are more involved in outdoor activities than the female subjects who are always at home.

Relationship between occupation of parents and infection rate of their children revealed that the children of businessmen had the highest prevalence rate of the disease, followed by the children of farmers and fishermen. The children of drivers and Civil servants had the least

infection rate. There is an association in the occurrence of schistosomiasis by occupation of parent for business men, drivers and fishermen but the association is significant for only businessmen and fishermen. There was no statistically significant difference in the prevalence rate of schistosomiasis in children of businessmen, fishermen and farmers (Mbah *et al.*, 2008).

The population dynamics of snails is said to have direct effect on parasite transmission. Snail sampling was done in some of the water bodies in the area. *Bulinus globosus* that is involve in transmission of *S. haematobium* and *Biomphalaria pfeifferi* for *S. mansoni* were encountered in the water bodies. The result showed that the predominant snail species encountered in the area were the *Bulinus* species, which are intermediate hosts of *S. haematobium.* This outcome could be due to the better adaptability of *Bulinus* species to local ecological factors such as rainfall pattern, topography and lack of proper drainage system. High prevalence of *S. haematobium* might be attributed to abundance of *Bulinus* species in the study area which enhances the distribution of the parasite.

CHAPTER SIX

SUMMARY, CONCLUSION, RECOMMENDATION

6.1 Summary

An overall prevalence of *Schistosoma haematobium* was 36.0% out of 300 pupils examined. The prevalence varied within the primary schools ranging from Damzuru, Kamfanin Doka, Sabon Layi, KunginGayam, Tudun Jega, Bagoma, Unguwan Shittu to Unguwan Sarkin Noma.

The prevalence of the disease by age among the males showed that the highest prevalence was recorded in the age group of 15 – 17 years, followed by age group of 9-11 years. While among the females, the highest prevalence was recorded in the 12 – 14 age group followed by in the age group 15 – 17 years.

The prevalence of *S. mansoni* was 20.3% varied from one primary school to another. The intensity of and it infection was light with the intensity ranging from 1 to 18 eggs per gram of faeces.

With regards to the responses of the pupils to the questionnaires, relating the associations between various epidemiological variables and the disease, Odds ratio value greater than 1 indicated associations between fishing, use of pond water, stream water with the disease prevalence.

6.2 Conclusion

In conclusion, the study had provided an idea on the prevalence of schistosomiasis infection among primary school children in Birnin Gwari Local Government Area. The prevalence of schistosomiasis among primary school children examined showed that schistosomiasis is a serious public health problem, The prevalence rate is higher in males than in females.

6.3 Recommendation

Therefore to reduce the morbidity of schistosomiasis in these areas, target or selective chemotherapy should be carried out using praziquantel. A community health eradication campaign and adequate health education should be promoted on the control of the disease. Since this is a predominantly childhood infection, children should be educated on the mode of transmission of the disease and the pathology of the disease and therefore encourage them to adopt control measures. Portable water should be provided in the community with other basic amenities to promote the level of good living in the rural communities, thereby avoiding the use of pond, river and stream water.

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APPENDICES

Appendix I

QUESTIONNAIRE

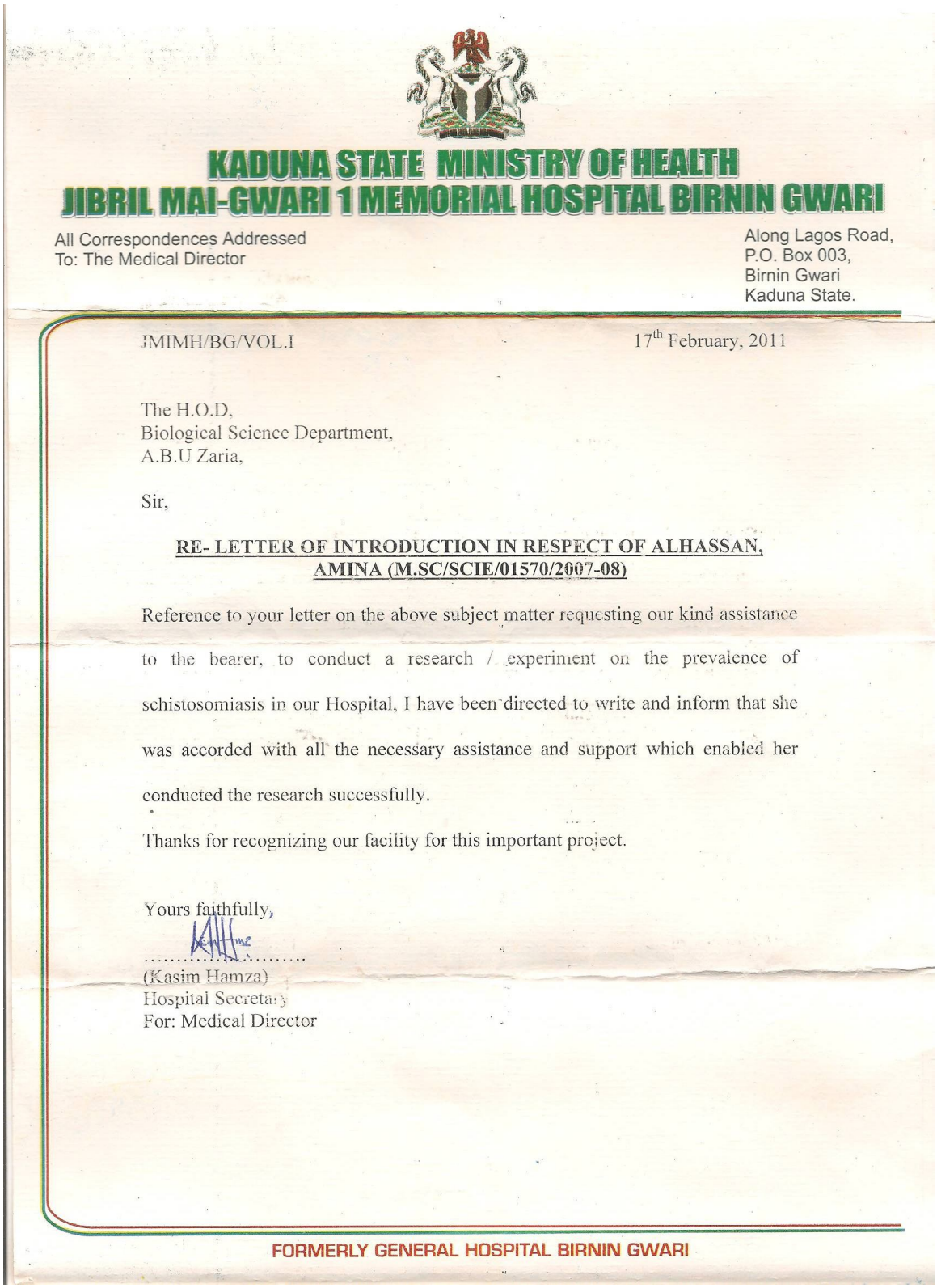
Kindly complete the following question. The questionnaire seek to determine the prevalence of schistosomiasis among school children in Birnin GwariLocal Gov't Area, Kaduna State

It is strictly for academic purpose. Results obtained will be treated with absolute confidentiality.

School _____
Individual number_____
Kindly tick the correct options or fill in the spaces where necessary.
Place of residence:

1. Parent's occupation_____
2. Sex_____
3. Date of birth / age_____
4. Source of drinking water. a. Pipe-borne [ ] b. Well [ ] c. Pond/rain [ ] d. River / stream [ ] e. Borehole [ ]
5. What are the methods of feacal disposal? a. Bush [ ] b. Pit latrine [ ] c. Water – closet toilet [ ]
6. Is any pond present around the house? a. Yes [ ] b. No [ ]
7. Does the child go there to play or goes to:
   i. Play a. Yes [ ] b. No [ ]
   ii. Wash a. Yes [ ] b. No [ ]
   iii. Swim a. Yes [ ] b. No [ ]
   iv. Fishing a. Yes [ ] b. No [ ]
   v. Both fishing and swimming a. Yes [ ] b. No [ ]
   vi. None of the above a. Yes [ ] b. No [ ]
8. Do you pass:
   i. urine with blood a. Yes [ ] b. No [ ]
   ii. normal urine a. Yes [ ] b. No [ ]
   iii. stool with blood a. Yes [ ] b. No [ ]
   iv. normal stool a. Yes [ ] b. No [ ]
9. If (8) yes, for how long? a. 1 month [ ] b. 2 months [ ] c. 3 months [ ] d. other specify_____
10. Any treatment administered? a. Yes [ ] b. No [ ]

Appendix II



KADUNA STATE MINISTRY OF HEALTH
JIBRIL MAI-GWARI 1 MEMORIAL HOSPITAL BIRNIN GWARI

All Correspondences Addressed
To: The Medical Director

Along Lagos Road,
P.O. Box 003,
Birnin Gwari
Kaduna State.

JMIMH/BG/VOL.I

17th February, 2011

The H.O.D,
Biological Science Department,
A.B.U Zaria,

Sir,

RE- LETTER OF INTRODUCTION IN RESPECT OF ALHASSAN, AMINA (M.SC/SCIE/01570/2007-08)

Reference to your letter on the above subject matter requesting our kind assistance to the bearer, to conduct a research / experiment on the prevalence of schistosomiasis in our Hospital, I have been directed to write and inform that she was accorded with all the necessary assistance and support which enabled her conducted the research successfully.

Thanks for recognizing our facility for this important project.

Yours faithfully,

.....
(Kasim Hamza)
Hospital Secretary
For: Medical Director

FORMERLY GENERAL HOSPITAL BIRNIN GWARI

Appendix III

PRIMARY EDUCATION BOARD
KDSPEB
P.M.B. 2333
KADUNA
KADUNA STATE
WORKING TO IMPROVE PRIMARY EDUCATION IN THE STATE

LOCAL GOVERNMENT EDUCATION AUTHORITY

Birnin Gwari Local Government

P.O Box 42 Birnin Gwari

Our Ref:_____ Date: 17TH February,2011

Your Ref:_____

The Head of Department,
Department of Biological Science,
Faculty of Science,
Ahmadu Bello University Zaria.

Sir,

REPORT

I am directed to write and to inform you that, the student in person of Alhassan Amina has concluded her assignment successfully as requested.

Thanks for your usual co-operation.

YOURS AHMED MOHAMMED (P.R.S)
FOR EDUCATION SECRETARY