# PREVALENCE OF SCHISTOSOMIASIS IN RELATION TO THE OCCURRENCE OF INTERMEDIATE SNAIL HOST IN PARTS OF ZANGON-KATAF LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA

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**JANUARY, 2018**

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**MSc/Sci/8580/11-12**

**A THESES SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN EDUCATIONAL BIOLOGY**

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**JANUARY, 2018**

## DECLARATION

I declare that the work in this Thesis entitled "Prevalence of Schistosomiasis in Relation to the Occurrence of Intermediate Snail Host in Parts of Zangon-Kataf Local Government Area" has been carried out by me in the Department of Biology. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this Thesis was previously presented for another degree or diploma at this or any other Institution.

Usiwoghene UKOR ________________________ ________________________

Signature Date

## CERTIFICATION

This Thesis entitled "Prevalence Of Schistosomiasis in Relation to the Intermediate Snail Host in Parts of Zangon-Kataf Local Government Area, Kaduna State" by Usiwoghene UKOR meets the regulations governing the award of the degree of Master in Educational Biology of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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**ACKNOWLEDGEMENTS**

I am deeply grateful to God Almighty, Father of our Lord Jesus Christ, the fountain of all being and bliss for strength and encourage throughout the course of this work.

I am grateful to the Chairman and member of supervisory team, Dr. E. Kogi and Dr P.A. Wuyep for their patience, encouragement, time, immeasurable contribution with great knowledge displayed and imparted into my life.

Many thanks to Pastor and Mrs Samuel Shekari, for their love and kind heartedness shown to me by accommodating me throughout my stay at Zonkwa.

Dr and Mrs Sow, Dr (Mrs) K. Iyun for their counsel, prayers and financial assistance and my beloved fathers in the lord Rev. F. Onokpite, Ven. B. Oladosu for their innumerable prayers. My gratitude goes to the leadership of Bajju, Ikulu, Anghan and Atyp Chiefdom in Zangon-Kataf Local Government Area, Kaduna State for granting me permission as well as encouraging their subjects to consent in this study and Mr and Mrs Mark T. Katuka for showing me around to the people of the study area . Thanks to the lab technologists in Parasitology and Hydrobiology laboratory for their assistance throughout study.

To the Head of Department, PG Coordinator and all the Lecturers in the Biology Department for their cooperation and diligence. To Prof. Onoyase and Mr Tabita from Delsu Abraka, for standing in as my referee during my admission, my beloved postgraduate fellowship members for their immense encouragement, prayers, contribution and financial assistance.

To my beloved husband Capt UI Ishiekwene, my parents Mr and Mrs E Ukor for their ever increasing love and my siblings Mr E. Ukor, Mrs Uyoyou Ofuanni, Mr Ogaga Ukor, Mrs Oghale, Mr Akpona Ukor, Mrs Oreva for their unending kindness.The good lord will bless and keep everyone diligent and faithful till the day of His coming. More grace to exploit the nature for greater knowledge to make changes in the world.

# DEDICATION

This study is dedicated to God Almighty.

# ABSTRACTS

Urinary schistosomiasis and Intestinal schistosomiasis caused by *schistosoma haematobium* and *schistosoma mansoni* respectively constitute a great occupational hazard in rural areas of developing countries and a major public health problem in Nigeria. Efforts in this study were devoted to establish prevalence of urinary and intestinal schistosomiasis and risk factors in relation to the occurrence of the intermediate snail hosts in Zangon-Kataf LGA. A cross-sectional study was conducted using semi-structured questionnaire to collect anthropogenic data of the individuals. Urine and stool samples were collected from nine hundred and seventy (970) individuals for microscopic analysis for *S.haematobium* and *S. mansoni* eggs. Strategic water bodies were visited to establish the existence of intermediate snail hosts, *Bulinus* and *Biomphalaria*. A retrospective study was conducted between the periods of September 2004 and December 2010 from the hospital records of St. Lois hospital and General hospital in Zangon-Kataf Local Government headquaters. On the cross-sectional studies, a low prevalence of 10(1.65%) and 5(1.36%) Result was obtained for *Schistosoma haematobium* and *Schistosoma mansoni* respectively. Other parasites prevalent were 3(0.81%) for *Ascaris lumbricoides* and 3(0.81%) for *Trichuris trichiura*. The intermediate snail host screened were found to be absent in the water bodies in study area. The absence of the intermediate snail hosts in water bodies implies that there might be no active transmission of schistosomiasis in the study area, which could be as a result of the absence of stagnant water bodies, sufficient to support the breeding of the snail intermediate hosts during the period of the study. For the retrospective study, 19(0.56%) cases of *S.mansoni* infection and 4(0.2%) cases of *S. haematobium* infection were recorded, with 12 male and 7 female for *S. mansoni* and 1(0.05%) female and 3 male (0.15%) for *S. haematobium*. The highest number of cases (260) was of those who had *Entamoeba histolytica* at 7.76% prevalence. Other intestinal helminths results obtained showed relatively low prevalence (0.62%) with one or more intestinal parasites. The low prevalence result obtained for *Schistosoma haematobium* and *Schistosoma mansoni* and the non-existence of intermediate snail hosts of *Scistosoma haematobium* and *Schistosoma mansoni* (*Bulinus* and *Biophalaria* species) in this study indicates that urinary schistosomiasis and intestinal schistosomiasis is hypoendemic during the period of study in this area.

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# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the Study

Schistosomiasis is a parasitic disease of humans caused by parasitic fluke of the genus *Schistosoma*. There are five most common species that infect humans. These species include, *S. mansoni*, found in Africa and South America; *S. haematobium*, found in Africa and the Middle East; *S. intercalatum*, found in Central and West Africa; *S. japonicum*, found in China, Southeast Asia, and the Philippines; and *S. mekongi*, found in parts of Southeast Asia (Sturrock, 2001). *Schistosoma guineensis* has been recently discovered in as one of the common important schistosome species that infect humans (Webster *et al.*, 2006). It was identified 2003 in the western Africa, mainly in Cameroon, Equatoral Guinea, Gabon, Nigeria etc (WHO 2010). Schistosomiasis is also referred to as Bilharziasis. This is because it was discovered by Theodore Bilharz (1951), a German surgeon working in Cairo who first identified the etiological agent, *Schistosoma haematobium* (Ross *et al.*, 2006).

Schistosomes are helminth parasites whose adult forms live in the blood stream of humans, hence, the name blood flukes. The two species present in Africa are *Schistosoma haematobium* and *Schistosoma mansoni* (Cunin et al., 2003). Their life cycle involves two hosts (a definitive host and an intermediate host). The definitive host for both species is man, while the intermediate host for *S. mansoni* and *S. haematobium* are snails of the genus *Biomphalaria* and *Bulinus* species respectively. The species differ as follows: their predilection site (i.e.final location) in the human host, the species of the intermediate (snail) host involved in their life cycle, the pathology they induce and the number, size and shape of the eggs they produce.

The presence of *Schistosoma haematobium* and *Schistosoma mansoni* in Africa had brought about two major forms of schistosomiasis affecting humans in Africa. These are the urinary and intestinal schistosomiasis, which are caused by *Schistosoma haematobium* and *Schistosoma mansoni* respectively (Colley *et al.*, 2014).

Schistosomiasis usually manifests as a chronic and debilitating disease in humans. It is the most prevalent of the waterborne diseases and one of the greatest risks to health in rural areas of developing countries. The disease is common in tropical and sub-tropical areas, especially in poor communities that have low access to usable water bodies and adequate sanitation (Ogbe, 2002). Urinary schistosomiasis affecting the urinary tract involves *Schistosoma haematobium* with an appropriate aquatic snail intermediate host called *Bulinus* species. The worms live in the blood vessels of the bladder and rectum. Only about half of the eggs are excreted in the urine, the other half stay in the body, damaging other vital organs majorly in the urinary system. It is the eggs and not the worm itself that causes damage to the bladder and other organs in the body (Agrawal, 2012).

Intestinal schistosomiasis, caused by *Schistosoma mansoni*, affects the gastrointestinal tract of humans (Pier et al., 2004). The adult *S. mansoni* parasites are found predominantly in the small inferior mesenteric blood vessels surrounding the large intestine and caecal region of the host. Eggs are deposited mainly in the wall of the lower bowel. The finding of the schistosomal eggs in body of an infected person is a clue to the diagnosis of schistosomiasis (Gryseel, 2006, Feldmeier and Poggensee, 1993).

The perpetuation of the schistosomes' life cycle requires water contamination by human sewage (Kings, 2010). The two species of schistosome commonly affecting man have similar life-cycle and develop over a succession of stages: such as egg, miracidium, first stage sporocyst, second stage sporocyst, cercaria, schistosomulum and adult. The basic life-cycle has an alternation of generations, with the sexual generation of adult schistosomes in the definitive vertebrate host (human), and an asexual stage in an intermediate snail hosts, *Bulinus* species for *S. haematobium* and *Biomphalaria* for *S. mansoni* (Sturrock, 2001).

Schistosomiasis occurs in more than 70 countries, mainly in Africa, East Mediterranean and South America. At least 200 million people in74 countries are infected with schistosomiasis and at least 600 million are at risk of infection (Moth, 2004).The disease is believed to affect over 200 million people with an estimated 97% of the infections concentrated in Africa (Fenwick, 2006).

The transmission of schistosomiasis takes place only in areas where specific fresh water snail is present and there is contact between the human population and infested water. This occurs when an infected person urinates or defecates in water bodies that serve as source of drinking or bathing, thereby introducing eggs which hatch into larva that infect the snail hosts (Jack *et al.*, 2015). Other socio-epidemiological factors could also be responsible for transmission of the disease and level of infection. Among such factors are; distance from infection site, migration and emergence of new foci, urbanization, socio-economic status, sanitation, water supply patterns and level of faecal contamination of water source. Its occurrence is directly linked to the presence of the snail intermediate hosts (el Kholy *et al.*, 1989).

Schistosomiasis is one of the main occupational hazards encountered in rural areas of developing countries, particularly affecting agricultural and fishing populations. Women doing domestic chores in infested water, washing clothes, are also at risk. Inadequate hygiene and play habits that bring them to have contact with cercariae infested water make children especially, vulnerable to infection (WHO, 2016). Increasing population size and the corresponding needs for power and water, often result in development schemes particularly construction of dams and environmental modifications that also lead to increased transmission.

The pathology of schistosomiasis involves the deposition of eggs in different organs. Male and female worm pairs causes disease by releasing highly immune reactive eggs into tissues of the digestive and urinary tracts in the body system (King, *et al*., 2006). Schistosomiasis symptoms and signs depend on the number and location of these trapped eggs in the tissues. The classic sign of urinary schistosomiasis is haematuria. Fibrosis of the bladder and ureter, and kidney damage are sometimes diagnosed in advanced cases. Bladder cancer is another possible late-stage complication. Intestinal schistosomiasis can result in abdominal pain, diarrhoea, and blood in the stool. Liver enlargement is common in advanced cases, and is frequently associated with an accumulation of fluid in the peritoneal cavity and hypertension of the abdominal blood vessels (Colley *et al.*, 2014).

Schistosomiasis has a low mortality rate, but however, as it is commonly a chronic illness, it can cause serious damage to internal organs, and may weaken the body's resistance to other infections. The initial stages of inflammatory reactions are readily reversible while in latter stages, the pathology is associated with collagen deposition and fibrosis, resulting in organ damage that may be only partially reversible. Schistosomes' species can also take on host proteins hence resulting in malnourishment (Uneke *et al.*, 2006).

## 1.2 Statement of Problem

Although there is an in-depth knowledge of *Schistosoma* infection–related pathology, but the knowledge that *schistosomiasis* is one of the neglected tropical diseases (Mathers *et al.*, 2007) of which clinical manifestation is minimal as well as the poor mobilisation of infection, is a misunderstanding of what schistosomiasis does to the average person (King *et al*., 2005; King and Dangerfield-Cha, 2008).

The snail intermediate hosts of *Schistosoma haematobium* and *Schistosoma mansoni* which are *Bulinus* and *Biomphalaria* species respectively, if found to inhabit water bodies of any location, their surface waters might be infested with cercaria, the infective stage of the parasite, which is the source of infection with *Schistosoma* species depending on the human water contact activities of that location. Therefore, the transmission of schistosomiasis and consequent risk of human infection is usually focal (Adeyeba and Ojeaga, 2002), such that the specific geographical distribution and of severe morbidity can be restricted to a particular location.

The lack of construction of dam and reservoir that could enhance and encourage irrigation farming among the dwellers of Zangon-kataf Local Government, since it is dominated by agricultural population

### 1.3 Justification

Prevalence of schistosomiasis in Nigeria and surveys reporting the prevalence in some towns' and villages has been documented (Ozumba *et al*., 1989; Adewumi *et al*., 1990; Emejulu *et al*., 1994; Edungbola *et al*., 1998; Biu *et al*., 2000; Adeyeba and Ojeaga, 2002 and Ude *et al*., 2009), but the status of the occurrence and distribution of schistosomiasis and the snail intermediate hosts in part of Zangon-Kataf Local Government Area is not known to have been documented to the best of our knowledge, and it could be a focal point for the transmission of the disease.

This work will provide a baseline information on the status of distribution of the disease in the study area which could be the basis for designing and implementing control strategies if need be.

## 1.4 **Aim**:

The aim of this study is to determine prevalence of urinary and intestinal schistosomiasis in relation to the occurrence and distribution of the snail intermediate hosts and the risk factors that may expose humans to infection in part of Zangon-Kataf Local government area of Kaduna state, Nigeria.

## 1.5 Specific Objectives

The objectives of this study were to

1. determine the prevalence of urinary and intestinal schistosomiasis in Zangon-Kataf Local Government Area.
2. determine possible anthropogenic factors that could influence the prevalence of urinary and intestinal schistosomiasis in Zangon-Kataf Local Government Area of Kaduna state.
3. determine the occurrence and infective status of the snail intermediate hosts in the study area
4. carry out a retrospective analysis of the prevalence of schistosomiasis in the study area using hospital records

## 1.6 Hypotheses

1. Urinary schistosomiasis and intestinal schistosomiasis do not occur in Zangon-Kataf Local Government Area.
2. Anthropogenic factors do not significantly influence the prevalence of urinary and intestinal schistosomiasis in Zangon-Kataf Local Government Area of Kaduna state.

3. The intermediate snail host for human schistosomes do not occur in Zangon-Kataf Local Government Area.
4. There is no significant difference in the prevalence of schistosomiasis between the cross-sectional and retrospective studies.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

The genus *Schistosoma*, commonly known as blood-flukes, are parasitic flatworms responsible for a highly significant group of infections in humans termed schistosomiasis. Adult flatworms parasitize blood capillaries of either the mesenteries or plexus of the bladder, depending on the infecting species. They are unique among trematodes and other flatworms, in that they are dioecious with distinct sexual dimorphism between male and female. Thousands of eggs are released and reach either the bladder or the intestine, according to the infecting species. Some examples of *Schistosoma* species are as follows: *Schistosom abomfordi*, *Schistosoma bovis*, *Schistosoma curassoni*, *Schistosoma datta*, *Schistosoma edwardiense*, , *Schistosoma guineensis*, *Schistosoma harinasutai*, *Schistosoma hippotami*, *Schistosoma incognitum*, *Schistosoma indicum*, *Schistosoma intercalatum*, *Schistosoma japonicum*, *Schistosoma kisumuensis*, *Schistosoma leiperi*, *Schistosoma mansoni*, *Schistosoma margrebowiei*, *Schistosoma mattheei*, *Schistosoma mekongi*, *Schistosoma ovuncatum* (Agrawal, 2012). The focus of this study is on *Schistosoma haematobium* and *Schistosoma mansoni*.

Schistosomes are helminthes parasites that live in the blood system hence called blood flukes. They are digenetic trematode worms of the genus *Schistsoma*, the adults of which live in the urinary or mesenteric blood vessels. There are over 16 species of schistosomes known to affect man (Loker, 2009). The genus name *Schistosoma*, came from the Greek word, schistos, meaning cleft, and soma, meaning body. They are predominantly found in bodies of fresh water with irrigation systems, because the environment remains generally stable. Schistosome species may have been brought to the Western Hemisphere during the African slave trade when a number of susceptible intermediate snail hosts may have been introduced, possibly in the casks of drinking water that were brought with the slaves (Bogitsh, *et al*., 2005). Schistosomes feed on blood particles through anaerobic glycolysis (Rumnajek, 1987). Schistosomes are highly dependent on their host metabolism.

## 2.1 The Causal Agents.

### 2.1.1 *Schistosoma haematobium*

*Schistosoma haematobium* is an important digenetic trematode. It is commonly found in Africa and the Middle East. This parasite causes urinary schistosomiasis in many countries, including Nigeria (Agbolade and Odaibo 1996) and is the world's leading cause of hematuria.

*Schistosoma haematobium* are parasitic blood flukes that live in the portal system of the bladder. Adult males are 10 to 15 mm long. They have an indirect life cycle involving the snail intermediate host *Bulinus* species. The male have deep grooves called gynecophoric canal in which adult females typically lie. Males have many small nodules (tubercles) on their dorsal surfaces and many tiny spines on their suckers and inside their gynecophoral canals. Females are longer (16-22 mm), smoother, and more slender. Both sexes have two suckers, one anterior and one ventral, which are used to grip the venule wall. *S. haematobium* was coined from the Greek word, '***haima***', meaning blood {a root word, which was most likely used in indication of the characteristic expression of blood in the urine caused by *S. haematobium* (Cox, 2003) (figure 2. 1).

### 2.1.2 *Schistosoma mansoni*

*Schistosoma mansoni* is responsible for intestinal schistosomiasis, a disease that affects nearly 300,000,000 people, living around Africa and South America especially in Brazil, Venezuela, Surinam and Guyana (Stothard, 2005). *S. mansoni* was detected for the first time in 1908 by the Brazilian medical doctor, Pirajada Silva at Brazil. This discovery then led to the partition and

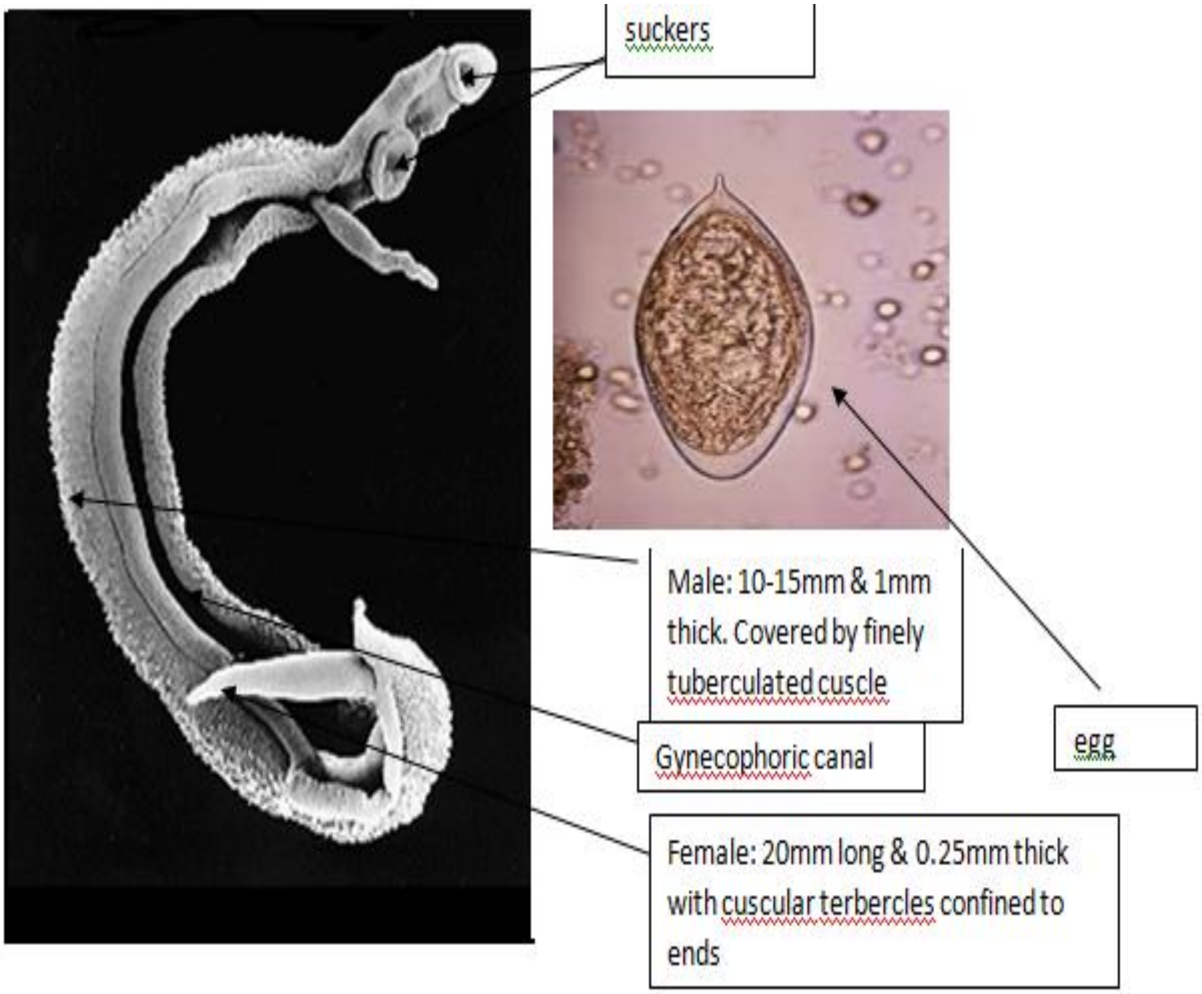


**Figure 2.1**: Morphology of ***Schistosoma haematobium.*** Source: www.google

subsequent unveiling of the mixed identities of *S. haematobium* and *S. mansoni* into two different individual species. *S. mansoni* is named after Sir Patrick manson, who first identified it in Formosa Taiwan. Subsequently, cases of intestinal schistosomiasis were discovered (Gracio *et al*., 1992). Morphologically it possesses an oral sucker which surrounds the mouth of the adult, and a ventral sucker located posterior to the bifurcation of the gut. There is an oesophagus with distinct oesophageal glands, but no pharynx is present (Neves, 2001). Paired caeca come together posteriorly, forming a single caecum that extends the remaining length of the schistosome body. *Schistosoma mansoni* is dioecious and sexually dimorphic. The adult male (up to 10 mm in length) is more robust than the female and possesses a body groove called a gynaecophoric canal. The female, which is longer and look slender than the male (10 to 14mm in length), is held within the groove of the male. The uterus can be long or short, depending on the position of the ovary relative to the female genital pore (Bogitsh, *et al*., 2005). They communicate through chemical means. Individuals have several receptors, including several ligand-gated channels that respond to chemical changes in the internal environment of their host. Once inside of their host, intermediate or definitive, they are not known to make many changes to its chemistry, but they are thought to protect themselves from localized immune system signals and enzymatic activity by releasing their own signals that lessen or weaken the signals of the host. Individuals live independently in freshwater during the miracidium stage for a short time. Under this condition, the parasite is sensitive to temperature and pressure changes (Berriman and El-Sayed, 2009; Verjovski-Almeida, 2003). As a parasite, the dietary needs of *Schistosoma mansoni* are almost solely fulfilled by the host. The parasite mainly gains nourishment from the blood of the host, feeding on proteins and monosaccharide. Specifically, *Schistosoma mansoni* consumes a lot of glucose, which the parasite uses to generate energy that it requires for reproduction and other activities. If the host is malnourished, then there are negative effects on the development of the parasite. For example, males of *Schistosoma mansoni* have been known to have smaller testes when found in a malnourished host than when found in a well-nourished host. Similarly, the ovaries of females are smaller and less abundant when found in a malnourished host (Neves, 2001). *S. mansoni* location and distribution is permitted by the broad geographic range of susceptible species of fresh water snails and vary depending on region and time of the year.

**2.2 Epidemiology and Risk Factors of Schistosomiasis**

Epidemiology of schistosomiasis refers to the prevalence, incidence and intensity of infection by a particular schistosome in man. The prevalence rate gives the proportion of subjects who are infected at a given point in time. Within an endemic area, focal transmission of schistosomiasis is the most common while prevalence and intensity of infection vary widely from one locality to another (Leighton *et al*., 2000). Prevalence of infection is usually lower in those areas closer to the main roads than farther away, a pattern that usually coincides with urbanization but not limited to the distribution of piped water. Manifestations are more common and usually more severe in visitors than in residents of endemic areas and typically last for several weeks. Schistosomiasis affects approximately 207 million people worldwide and has been declared “a major public health problem” by the World Health Organization (WHO, 2006). Schistosomiasis rather than threatening prosperous and well-informed citizens of nations with good medical services, they attack area of world’s poorest people, people in isolated rural villages, crowded refugee camps, and urban slums that lack health care, sanitation and safe drinking water (Barnabas *et al*., 2011). And not only do these diseases thrive among the poor, they actually promote poverty by weakening, maiming, stigmatizing and isolating their victims by destroying their ability to work, learn and contribute to their families and communities (Hotez, 2006).

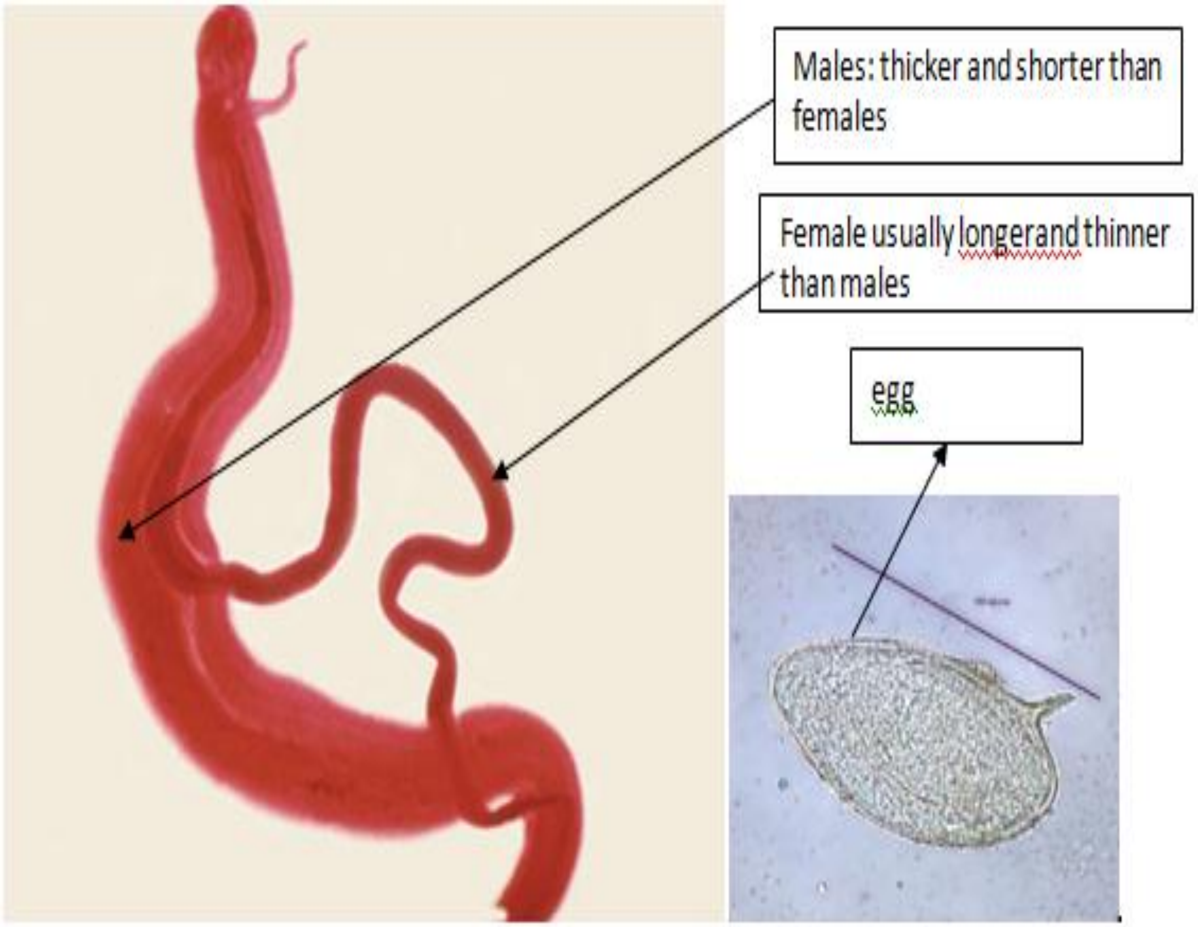


**Figure 2.2:** Morphology of *Schistosoma mansoni*. Source: www.google

About 85% of worldwide schistosomiasis infections are in Africa. Within sub-Saharan Africa, Nigeria is the country with the most cases of human schistosomiasis, of about 29 million in 2008 (Hotez and Kamath, 2008). In highly disease-endemic areas, prevalence rates can exceed 50%, from the findings of Bala et al., (2012) at Abarma, Zamfara state among expatriates living in such areas. In Nigeria, schistosomiasis is widespread in both rural and urban communities, with prevalence ranging between 2% and 90%. A vast majority of cases occur among the poor and marginalized (Oladejo and Ofoezie 2006; Opera *et al*., 2007). Schistosomiasis typically display a high degree of over dispersion or aggregation, whereby the majority of the parasites are harboured in a minority of human host and the degree of this over dispersion often varies significantly between locations and between species.

The disease has been reported from several locations in Nigeria {Bello *et al*, 2003 in Sokoto (60.8% and 2.92%) for *S. haematobium and S. mansoni* respectively; Emejulu *et al*., 1994 in Anambra state; Okoli and Odiabo, 1999, in South-western Nigeria, Ibadan; Mafiana *et al*., 2003 in Ogun state (71.9%); Nwabueze and Opara (2007) in Delta (increased from 21.9% to 91.4% within March 2003 and February 2005); Oniya and Olofintoye, 2009 in Ondo}.The incidence of the disease (10.0% and 2.0% for *S. haematobium and S. mansoni* respectively) in north easthern Nigeria was reported by Bigwan *et al*., (2012) but limited their study to the Maiduguri Metropolis. Study on cofactors influencing prevalence and intensity of *schistosoma haematobium* infection in sedentary Fulani settlement of Dumbi, Igabi .L.G.A of Kaduna state has been documented (Kanwai *et al*., 2011); Alhassan *et al*., (2013) recorded 36.0% for *S. haematobium* at Birnin Gwari L.G.A. and Luka *et al*., (2015) documented 12.30% for *S. haematobium* among primary school children in Lere L.G.A. both of Kaduna state. Report of schostosomiasis (74.0%) in Zamfara state has been recorded (Ladan *et al*., 2012). More so, areas where worm infections were a way of life, schistosomiasis infections became mistaken for “normal” health. Thus, these gaps tended to make schistosomiasis invisible in global health policy assessments.

### 2.3 Transmission and Life Cycle of *Schistosoma* Species

The male and female Schistosome form a reproductive pair, with the female held by the male within the gynecophoric canal. Females release eggs, into the blood vessels. A reproductive pair may live for years within the host and the female producing thousands of eggs are effective during this time. Eggs pass through the wall of the host's intestine or bladder and are eventually passed out of the body with faeces or urine. When the eggs come in contact with fresh water, they hatch into a free-living stage called the miracidium.

Miracidia swim about in the water and are propelled by the many cilia that cover them. They never feed and they live for about 24 hours. Miracidia must locate and infect specific intermediate snail hosts, that is, *Bulinus* for *Schistosoma haematobium* or *Biomphalaria* for *Schistosoma mansoni*, to continue the life-cycle (Sturrock, 2001). Within the snail, a miracidium transforms into a sporocyst – a factory for producing the next stage, the cercaria. The sporocyst produces cercariae, the infective stage, through asexual reproduction, of which one miracidium can produce many thousands of genetically identical cercariae, which infect human host. Within 3-4 weeks after being infected, the snail begins to shed cercariae into the water. Like miracidia, cercariae do not feed. They live for about 24 hours and propel themselves with an actively beating tail through the water.

Cercariae infect their human host by penetrating through the skin. In about a month, the cercaria develops into mature schistosomes that form pairs that migrate to the blood vessels around the intestines or bladder and begin to produce eggs. Eggs are passed into water bodies through human urine or faeces and the cycle is repeated as illustrated in Fig 2.3.

## 2.4 The Hosts

*Schistosoma* species undergo alternation of generation in their basic life cycle as the different stages live in different hosts. While adults live in human blood vessels, miracidium live for a short time in fresh water before infecting snails, cercariae develop in the snail and are released into freshwater before infecting humans. Schistosome species live in two hosts, a definitive host (human) and an intermediate host (snail). The definitive host of *S. haematobium* and *S. mansoni* is human, where sexual reproduction occurs and most highly developed form of the parasite mature to adult stage for sexual reproduction.

### 2.4.1 The Intermediate Snail Host

In 1915, Lieper, an English scientist, discovered the intermediate snail hosts of schistosome species. Snails of the genus *Bulinus* is the intermediate host for *S. haematobium* while those of the genus *Biomphilaria* is for *S. mansoni*. The intermediate snail host is for larva development and multiplication of schistosome parasite. Each *Schistosoma* species possess a single intermediate snail host, where a number of asexual reproductive stages occur. Each stage of the schistosome species exhibits certain behaviour that favours success in their specific environment. The presence of aquatic weeds and favourable physicochemical conditions in water has been found to provide a conducive environment for the vectors to thrive and hence sustain schistosomiasis transmission in streams (Yirenya-Tawiah *et al*., 2011).

The miracidium is the larval stage that enters the snail intermediate host by penetration. Four factors that are involved in the penetration of miracidia into their respective intermediate host according to Wadji (1966) include: (a) Ciliary action which press larva against snail, (b)

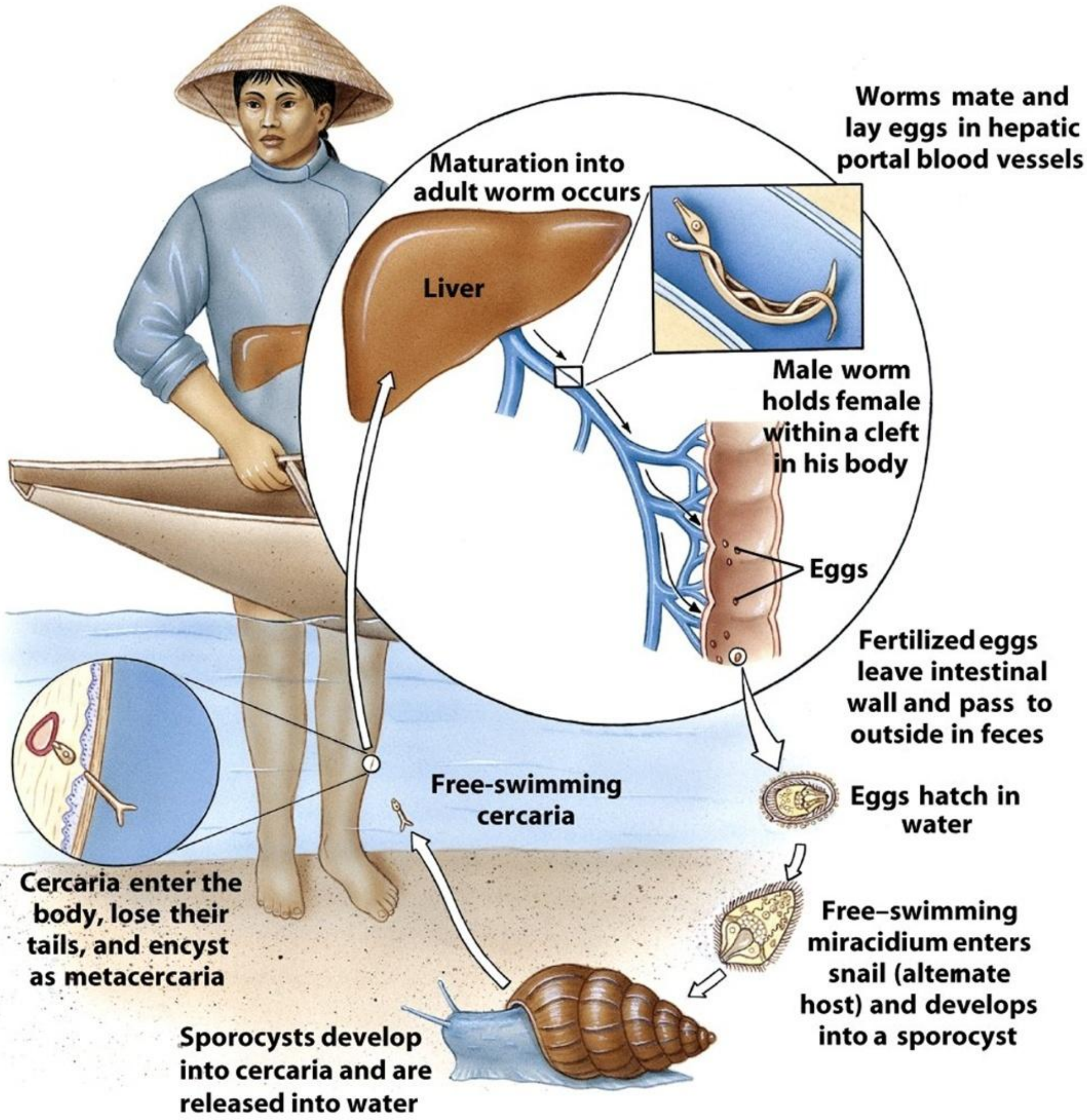


**Figure 2.3**: Life cycle of *schistosoma* species. Source: schistosome_main.jpg

Secretion of mucous substance to adhere miracidium to snail tissues (c) Elongation of anterior papilla which acts as drill (d) Release of the contents of the penetration glands which is lytic. Not all miracidia develop into mother sporocysts. Those that develop are the ones in the foot, which develop into daughter sporocysts and then migrate to the snail's digestive gland (hepatopancreas), and in the interlobular connective tissue produce furcocercariae. These migrate through the epithelium of the mantle collar and emerge.

The cercariae of the schistosomes that infect humans look alike except for some minor differences for their diagnosis (Doehring *et al.,* 1985). They are positively phototropic and will therefore congregate towards the water surface where possibilities for contact with humans or animals are maximal. Upon contact with human skin, they adhere and apply their oral sucker. They respond to chemical signals, particularly medium chair fatty acids, as a signal for skin invasion. By means of both enzymes and vigorous movement the skin is penetrated. Their bodies and tails are covered with minute spines. The ventral sucker is well developed and a head organ that serves as anterior sucker. Ventral to this is a small oral opening which leads into a capillary oesophagus that ends in bi-lobed pocket, the anlagen. There is a small cluster of genital cells posterior to the ventral sucker and two pairs flame cells- the posterior pair are at the proximal part of tail. A pair of collecting ducts (tubules) join and open into a median bladder (a median posterior collecting tubule which extends to the tail and splits), opening at the ends of each furcaby a pore. Thereafter, they shed their tail and are transformed to schistosomula, the next larval stage. The intermediate snail host is essential for the completion of the life cycle.

#### 2.4.1.1 *Bulinus*

*Bulinus* is a freshwater pulmonate snail genus that acts as the intermediate host of *Schistosoma haematobium* for its larval development and multiplication. The genus has four species groups such as *B. africanus*, *B. forskalii*, *B. reticulatus* and the *B. truncatus/tropicus* complex. Though morphological divergence is limited within species groups, but there is considerable molecular divergence (Stothard, 2007). The *B. africanus* group species are known, or suspected, to act as intermediate snail hosts for *Schistosoma haematobium*, a trematode parasite that causes urinary schistosomiasis.

#### 2.4.1.2 *Biomphalaria*

Freshwater snails of the genus *Biomphalaria* are intermediate snail host for the transmission of the medically important trematode parasite, *Schistosoma mansoni*, the causative agent of the human tropical disease schistosomiasis. *Biomphalaria* snails are hermaphrodites, capable of self-fertilization. Due to their natural dispersal ability they are capable of quickly colonizing new locations and somehow climate change could help schistosomiasis spread into currently unaffected areas. *Schistosoma mansoni* is most likely to invade new areas mainly because of the adaptability and invasiveness of its intermediate host, *Biomphalaria* snails (Majoros *et al*., 2008).Its widespread distribution is permitted by the board geographic range of susceptible species of the freshwater snail, genus *Biomphalaria*, that serve as intermediate host for its larval stages which follows, el Kholy *et al*., (1989) findings, that its occurrence is directly linked to the presence of these transmitters’ snails.

### 2.5 Possible Anthropogenic and Risk Factors

The major cause of schistosomiasis is the dumping of human waste into water bodies..

Schistosomiasis particularly affects agricultural and fishing populations. Women doing domestic chores and washing clothes in infested water are also at risk. Inadequate hygiene and play habits in infested water bodies make children especially, vulnerable to infection. The poor level of awareness about the possible cause of the disease is a serious issue as researchers noted (Chidozie and Daniyan, 2008). Records have it that both abiotic and biotic factors contribute to the schistosomiasis transmission cycle and invariably affect its prevalence (Satayathum *et al*., 2006). The abiotic factors include climatic factors such as temperature and rainfall (Zhou *et al*., 2008). The factors however can affect the prevalence of schistosomiasis indirectly as they affect the breeding and development of the intermediate snail hosts (Thieltges *et al*., 2008).More so, biotic factors that can affect the prevalence of schistosomiasis include host sex and age as a result of behavioural, hormonal or genetic factors (Brooker, 2007). Parasite transmission and the consequent risk of human infection are strongly linked to specific geographic locations, because the parasite goes through several developmental stages that must occur in fresh water, including a period of growth within particular species of intermediate snail hosts. Even after infection ends, disease still persists (Koukounari *et al.,* 2006).

**2.6 Schistosomiasis**

Schistosomiasis, also known as bilharziasis or snail fever, is primarily a tropical parasitic disease caused by the larvae of trematode known as schistosomes. The first document written on schistosomiasis is the Ebers papyri dating back to 3000BC. The Ebers and subsequently the Edwin Smith (1550BC) papyri (intestinal worms) contain cvan accurate description of a (blood urine) disease with a ‘worm’ pinpointed as its causative agent. This was confirmed many centuries later when schistosomal ova were recovered from the bladders of Egyptian mummies dating 2000-1000BC (Cox, 2003). Interestingly, ova also were found in contemporary mummies from China which suggest the undocumented existence of the disease in Asia since ancient times (WHO, 1993). In 1950 BC, Egyptian pharaohs wrote of urinary bladder disturbances that were probably *Schistosoma haematobium*. What the hieroglyph used to denote the disease was a dripping penis (Abdel Wahab, 1979). Further progress were recorded from the work of a German pathologist named Theodeor M. Bilharz, who first discovered the parasite in 1951 while working at Kasr EI-Eini Hospital in Cairo and describe schistosomiasis in 1852 (Jordan and Webbe, 1993). First dubbed as “Bilharzia” after the discoverer, then schistosomiasis became the official name for the disease (Tan and Ahana, 2007).

### 2.7 Pathology and Clinical Sign/Symptoms of Schistosomiasis

Many individuals do not experience symptoms. If present, it usually takes four to six weeks for symptoms to appear (Edington and Gills, 1976). The first symptom of the disease may be a general ill feeling. Within twelve hours of infection, an individual may complain of a tingling sensation or light rash, commonly referred to as "swimmer's itch," due to irritation at the point of entrance. The rash that may develop can mimic scabies and other types of rashes. Other symptoms can occur two to ten weeks later and can include fever, aching, cough, diarrhoea, or gland enlargement. These symptoms can also be related to avian schistosomiasis, which does not cause any further symptoms in humans (Horak, et al., 2015).

Eggs that do not pass through the wall of the intestine are circulated in the blood. Initially the eggs may produce a fever known as Katayama fever (Leshem et al., 2008), but symptoms may be hard to recognize. Eggs trapped in the liver cause an immune response that damages the liver over time and cause further severe complications. Eggs lodged in the intestine wall can cause a reaction leading to intestine blockage and blood loss. For decades experts considered most cases “asymptomatic”. Recently however, Charles Kings and some other researchers have revaluated the toil inflicted by schistosomiasis and found a far higher loss of well-being than previously believed when measured in disability-adjusted life years. In the early stages of infection, symptoms include cough, headache, loss of appetite, aches and pains, and difficulty in breathing usually followed initial skin irritation. Nausea is common in more advanced infection, accompanied by haematuria and in some cases renal obstruction.

*Schistosoma haematobium* infections usually come with haematuria, leukocyturia, urinary tract complaints, tender abdomen and supra-pubic tenderness whose outcome include chronic iron deficiency anaemia, scarring, deformity of the ureters and bladder, and chronic bacterial super infection. These could lead to severe damage of urinary tract organs, and ultimately to renal failure. Schistosomiasis generally is insidious, it begins harmlessly but the end can be fatal if no attention is given to it at the onset. The Symptoms and signs are summarized as follows:

Schistosome dermatitis: This is pruritic popular rash that develops where the cercariae penetrate the skin in previously sensitized people (Warren, 1976). Acute schistosomiasis: Acute schistosomiasis (katayama fever) occurs with onset of egg-laying, typically 2 to 4 weeks after heavy exposure. Symptoms include fever, chills, cough, nausea, abdominal pain, malaise, myalgia, urticarial rashes, and marked eosinophilia, resembling serum sickness (Batmos *et al*., 2006).

Chronic schistosomiasis: Chronic schistosomiasis is a risk factor for nontyphi *Salmonella* infection and promotes development of squamous cell bladder cancer. It results mostly from host response to eggs retained in tissues. Early on, intestinal mucosal ulcerations caused by *S. mansoni* may bleed and result in bloody diarrhoea. As lesions progress, focal fibrosis, strictures, fistulas, and papillomatous growths may develop (Cheesbrough, 2006). With *S. haematobium*, ulcerations in the bladder wall may cause dysuria, haematuria, and urinary frequency. Over time, chronic cystitis develops. Strictures may lead to hydroureter and hydronephrosis. Papillomatous masses in the bladder are common, and squamous cell carcinoma may develop. Blood loss from both genitor-urinary and genitor-intestinal tracts frequently results in anaemia, hence resulting to co-infection (*Gelfand et al.,* 1967).

Secondary bacterial infection of the genitor- urinary tract is common and persistent. Schistosomiasis can affect the genitals especially in females, but it affects men too. It can extend into several complications in females like female genital schistosomiasis (FGS)-where the cervix, endometrium and fallopian tubes can be affected. *Salmonella septicaemia* may occur with *Schistosoma mansoni. Schistosoma haematobium* can cause genital disease in both men and women, resulting in numerous symptoms including infertility. Abdominal and pelvic irritations are evident, leading to dyspareunia, leucorrhoea, cervicitis, dysmenorrhea, endomertritis, simple contact or post-coital bleeding or bleeding during examination and salpingitis. FGS can secondarily cause other complications like sudden abortions, ectopic pregnancy and infertility in females of child-bearing age. FGS can be caused by other species of *Schistosoma,* but *S. haematobium* is the main cause. FGS are not restrained to parasitic ill-health, it can increase the risk of contraction of HIV, most especially in regions endemic with the dual infections (Brindley and Hotez, 2013). In the men, evidences of genital schistosomiasis have presented in the form of epididymitis which is stimulatory for tuberculosis, funiculitis, painful micturition, prostatitis, laziness, fistulization and haemospermia (WHO 2016). About one-third of women infected with *Schistosoma haematobium* develop genital disease; where vulvae and perinea involvement appear in forms of hypertrophy, ulcers, fistula, and warts. These could be mistaken for other forms of genital infections. Characteristically, the cervical wall of the female on examination may have sandy patches, abnormally branched or circular blood vessels, papules and contact bleeding (Allen et al., 2002).

Granulomatous reactions to eggs of *Schistosoma mansoni* in the liver usually do not compromise liver function but may cause fibrosis and cirrhosis, (Cheever,1997) which can lead to portal hypertension and subsequent hematemesis due to esophageal varices. Eggs in the lungs may produce granulomas and obliterative arteritis, which may cause pulmonary hypertension and cor pulmonale. Eggs lodged in the spinal cord can cause traverse myelitis, and those in the CNS can cause seizures (Walker and Zunt, 2005).Urinary tract schistosomiasis is characterized by blood in the urine, pain or difficulty urinating, and frequent urination. The loss of blood can lead to iron deficiency anaemia. A large percentage of persons, especially children, who have moderately to heavily infection, experience urinary tract damage that can lead to blocking of the urinary tract and bladder cancer (Elbaz and Esmat, 2013).

In intestinal schistosomiasis, eggs become lodged in the intestinal wall and cause an immune system reaction called a granulomatous reaction. This immune response can lead to obstruction of the colon and blood loss. The infected individual may have what appears to be a potbelly. Eggs can also become lodged in the liver, leading to high blood pressure through the liver, enlarged spleen, the build-up of fluid in the abdomen (ascites), and potentially life-threatening dilations or swollen areas in the oesophagus or gastrointestinal tract that can tear and bleed profusely (oesophagealvarices). Rarely, the central nervous system may be affected (Walker and Zunt, 2005). Individuals with chronic active schistosomiasis may not complain of typical symptoms. Present usually 4-8 weeks after exposure to *S.mansoni* contact with infested water Fever, lethargy, malaise, and myalgia are the most common symptoms while less common symptoms are cough, headache, anorexia rash (urticarial or papular). Right upper quadrant pain and bloody diarrhoea may also occur with focal neurological deficits.

Chronic Intestinal Schistosomiasis disease onset is insidious- Patients with symptomatic chronic schistosomiasis may present months to years after primary exposure. Portal hypertension with splenomegaly oesophagealvarices, hypersplenism, ascitis, dyspepsia, flatulence, and pain are present in the left hypochondrium. Some scientists attribute this neglect of schistosomiasis to a long standing understanding of the underestimation of its harmful scale (King and Dangerfield-cha, 2008).

The World Health Organization purported that, along with risk to organ, all schistosomiasis victims also suffer subtle harm that can include "impaired cognitive performance, chronic fatigue, and unremitting pain" and contributes to increased school absenteeism, reduced worker's productivity, lower self-esteem, and social exclusion (WHO, 2006). This occurs in individuals with relatively light infections, long before organ damage becomes apparent because of the chronic inflammation from the presence of the eggs. In this light King and Madeline Dangerfield-cha (King *et al.*, 2005) of Columbia University, gave an example of anaemia, as one of the effects "most firmly associated with schistosomiasis in all its forms. They noted as well that light infection, is associated with stunted growth, poor cognitive development and under nutrition in infected children (Ezeamama *et al.*, 2005).

Schistosomiasis continues to be a global public health concern in the developing world (Von Lichtenberg, 2009). This is because it is a chronic insidious disease, which is poorly recognized at early stages, and becomes a threat to development by disabling Men and Women during their most productive years. Again, katayama syndrome is a systemic, serum-like illness that develops after a several weeks in some, but not most, individuals with new schistosomal infections. It may correspond to the first cycle of egg deposition, as associated with marked peripheral eosinophilia and circulating immune complexes. It is most common with *Schistosoma mansoni* infections and is most likely to occur in heavily infected individuals after primary infection. Symptoms usually resolve over several weeks but the syndrome can be fatal. Early treatment with cidal drugs may exacerbate this syndrome and necessitate concomitant glucocorticoid therapy (Lyke *et al*., 2006).

## 2.8 Control of Schistosomiasis

The control of the water-related diseases can be classified according to their target in a number of ways, some of which are mutually reinforcing. Three types of measures are distinguished:

- Measures aimed at the pathogens: immunization, prophylactic or curative drugs;
- measures aimed at reducing vector densities or vector lifespan: chemical, biological and environmental control
- measures to reduce human/vector or human/pathogen contact: health education and personal protection measures

### 2.8.1 Chemotherapy

This strategy for schistosomiasis control aims to prevent morbidity in later life through regular treatment with drug. It targets at elimination of the parasite from the definitive host. Praziquantel is currently the only recommended drug for infection and disease caused by the species of schistosome infecting humans the current drug of choice for treatment of schistosomiasis (Oniya *et al*., 2012). It is a safe single dose drug, which can be prescribed to all ages groups at a dose of 40mgkg body weight. Systematic cases are treated with praziquantel at all levels of the health care system. While chemotherapy with praziquantel is an important component of any schistosomiasis control programme, other operational components are essential to the control and elimination of schistosomiasis. Praziquantel could be combined with either oxamniquine or an artemisinin derivative (Keiser *et al.*, 2010).

### 2.8.2 Molluscicides

Another approach is to control snail populations, largely by the use of molluscicides. Molluscicide is a method of control targets at eliminating the intermediate snail host by using snail baits and snail pellets as pesticides (Bailey, 2002). The application of chemical molluscicides is still one of the most effective measures for schistosomiasis control. It is an optimal management approach to control intermediate host snail under acceptable thresholds based on the goal of the National Schistosomiasis Control Programmers. Different molluscicide treatment strategies have been deployed to maximize cost-effectiveness as compared to other control measures (Yang, 2012).

### 2.8.3 Sanitation, water supply and human involvement

This method of control targets at reducing the risk of the disease through the definitive host. A key control measure for all fluke infections is preventing egg-containing excreta from contaminating water sources. Where there is contaminated water, contact with such water should be avoided. Sensitizing the people to practice good hygiene, provide safe drinking water and water for domestic use (Sow *et al.,* 2008). Appropriately constructed sanitation infrastructure that ensures safe disposal of human excreta, and the promotion of personal and household practices such as hand-washing, bathing, and management of stored water in the home, all aimed at preserving cleanliness and health, is critical. Interventions have been shown to be highly effective in reducing the environmental exposure to, and transmission of, eggs and larvae for STH and schistosomes.Water supplies have a beneficial effect on a number of disease groups. An important role for any hygiene promotion is to enhance sanitation itself (Asaolu and Ofoezie, 2003).

### 2.8.4 Public Health Education

This method of control targets at preventive approaches initiated by private and corporate organizations. This is usually carried out by creation of awareness and campaigns for the people on the danger of the disease to human health. Such Initiatives are community wide treatment campaigns co-ordinate and organized at the national level (Wilkins, 1977). Building blocks for this integrated control were defined as health education, diagnosis and treatment, and more prominent primary health care system. To reduce the transmission of *S. haematobium* and *S. mansoni* in endemic communities, health education that is not only of high quality but also culturally sensitivity is needed (Garba, et al., 2009). The health education is to promote good hygiene and sanitation, especially among school-aged children and caregivers. It discourages practices such as bathing in streams and indiscriminate disposal of refuse that tend to increase risk of the infection. The ultimate goal is to decrease the number of eggs reaching and contaminating the environment, particularly freshwater bodies. Conclusively, Schistosomiasis is known for an intimate connection between Conflict and Neglected tropical diseases (NTD). The Transmission of schistosomiasis can take place in almost any type of habitat from large lakes or rivers to small seasonal ponds or streams (WHO, 2002). Socio-economic factor to a certain extend has caused children in Nigeria to be vulnerable to this infection. Some individuals are asymptomatic but can pass infection to others. Our operational definition is that schistosomiasis is a preventable, chronic inflammatory condition caused by present or previous infection with parasitic blood flukes of the *Schistosoma* species (Miguel *et al*., 2003).

## 2.9 Diagnosis of Schistosomiasis, parasitological and immunological

The detection of the *Schistosoma* eggs in stool or urine has remained the standard for the diagnosis of schistosomiasis. Stool examination are be performed when infection with *S. mansoni* is and urine examination are be performed if *S. haematobium* is suspected. The examination can be performed on a simple smear (1 to 2 mg of fecal material). Sedimentation and concentration methods using formalin solution have greatly aided detection of light infections. The recommended time for collection is between noon and 3 PM. For intensity of the infection, light infection has $<50$ eggs/10 ml urine while heavy infection has $\geq 50$ eggs/10 ml urine (Bishop et al., 2016).

Screening for urinary schistosomiasis has been conducted using various indirect diagnostic tests such as interview technique for unqualified haematuria, terminal haematuria and dysuria, visual examination of urine specimen for macrohaematuria, chemical reagent strip technique for microhaematuria and proteinuria, and immunological method using monoclonal antibody based (mab) dipstick assay. These methods have been found to be simple and reliable with their outcomes serving as useful indicators of schistosomal infection among children in endemic areas (Fatiregun, et al., 2005). Quantification is possible by using filtration through a Nucleopore® membrane of a standard volume of urine followed by egg counts on the membrane. Tissue biopsy (rectal biopsy for all species and biopsy of the bladder for *S. haematobium*) may demonstrate eggs when stool or urine examinations are negative (CDC24/7). In places like China, miracidium-hatching test followed by microscopic visualization of hatched miracidia has been used for diagnostic purpose. For field surveys and investigational purposes, the egg output can be quantified by using the Kato-Katz technique (20 to 50 mg of fecal material). Also, examination of biopsies from the bladder and rectal mucosa is employed (Leder, and Weller, 2011). Some markers have been helpful in the complete diagnosis of schistosomiasis to include eosinophilia, anaemia (but may be due to iron-deficiency, chronic disease, or macrocytosis), hypoalbuminemia, elevated urea/creatinine levels, hypergammaglobulinemia, and splenomegaly.

Though serological (antibody detection) have been developed, they are not so useful than in defining the regions of low intensity and poor detection of eggs in stool, urine or biopsies; this is because of prolonged positivity period in already cured patients. Antibody detection can be useful to indicate schistosome infection in patients who have traveled in schistosomiasis endemic areas and in whom eggs cannot be demonstrated in fecal or urine specimens. Test sensitivity and specificity vary widely among the many tests reported for the serologic diagnosis of schistosomiasis and are dependent on both the type of antigen preparations used (crude, purified, adult worm, egg, cercarial) and the test procedure.

## CHAPTER THREE

## 3.0 MATERIALS AND METHODS

### 3.1 Study Area

The study was conducted among dwellers in Zangon-Kataf L.G.A of Kaduna state. Zangon-Kataf L.G.A lies between longitude 8°05′00″E and 8°40′00″E and latitude 9°32′ 30″N and 10°10′00″N with a total land area of 2668km$^2$ (Figures 3.1 and 3.2). Vegetation is savannah type with tall and scattered trees, that is wooded vegetation, and tropical climate is dominated with mean annual temperature of (25°C-30°C) and annual mean rainfall of 1270-1500mm (Manza et al., 2015). The main activities of the population among others, is agriculture, with predominantly rice cultivation, vegetable growing and cultivation of millet. Two general hospitals are situated in Zangon-kataf local Government area, Zonkwa and Zango town, together with private hospitals and clinics in almost all the towns and villages.

### 3.2 Cross-Sectional Study

#### 3.2.1 Sample size

Sample size was determined using the sample size determination formula according to Naing *et al.*, (2006) stated as follows:

$$n = \frac{z^2pq}{d^2}$$

Where $n$ = the desired sample size; $z$= 1.96 which is a constant for data that assumes a normal distribution at 95% confidence interval; $p$= 50% on the average (Mtethiwa *et al*., 2015)( Bala *et al.*,), known prevalence of the disease in the population expressed as a proportion of 1; $d$=0.05, being the level at which significance difference is determined; and $q$= (1-$p$) = 0.5.

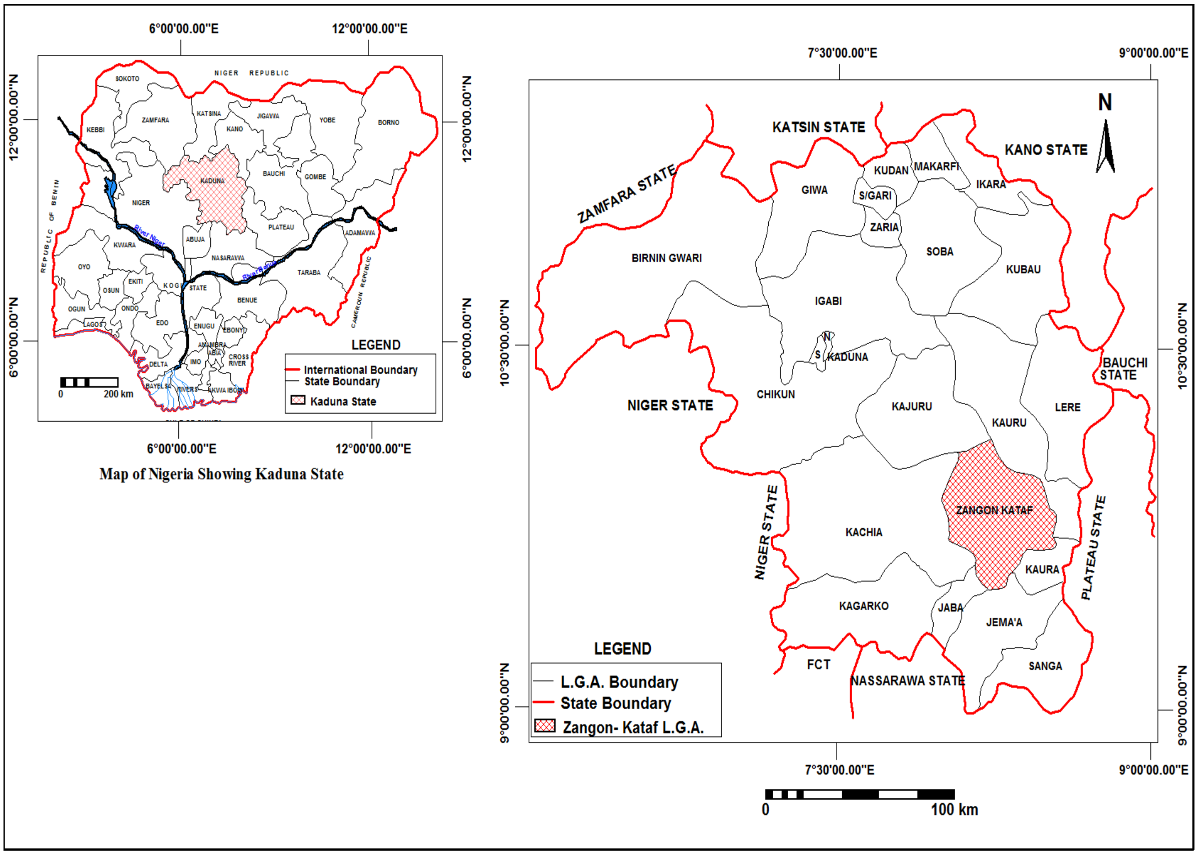


Fig. 3.1 Kaduna State, showing Zangon-Kataf LGA – Source: Modified from Administrative  Map of Nigeria.

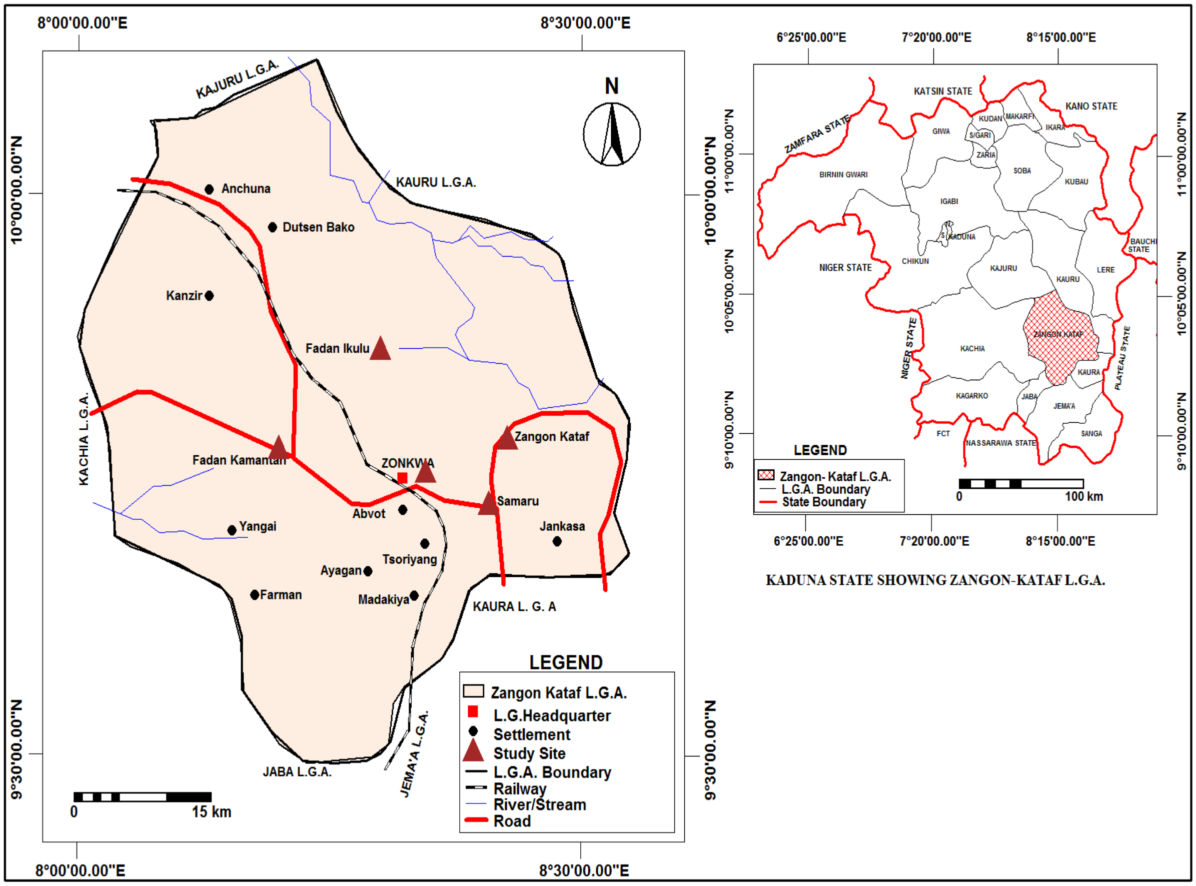


Fig. 3.2: **Zangon-Kataf L.G.A , Showing the Study Sites – Source: Modified from Administrative Map of Kaduna State.**

The values of the variables indicated above were substituted in the formula and the sample size was obtained as follows:

$$\boldsymbol{n} = \frac{\mathbf{1.96^2 \times 0.5 \times 0.5}}{\mathbf{0.05^2}} = \mathbf{384}$$

This was the minimum sample size that could be taken.

### 3.2.2 Collection of urine and stool samples

Consent for sample collection was obtained from each Village Head who issued a letter of introduction to permit collection of urine and stool samples from the people alongside the administering of questionnaire (Appendix 1). Labelled wide-mouthed sample bottles were given out to the selected individuals for the study. Labels corresponded to the number of the individual on the questionnaire and were instructed on how to obtain their urine and faecal samples without contamination. The questionnaires were administered to each individual recruited for the study through oral interview, to obtain information from them on the following: village, name, personal identification number, age, sex, occupation, water contact activities in existing water bodies, source of water for domestic use and type of toilet system used. The sample identification number and time of collection were noted on the stool and urine sample bottles for each individual recruited for the study. The population was sampled from house to house as individuals were given urine and stool sample bottles a day before and were collected the following morning preserved immediately with 5% formalin  and kept in a black polythene bag. They were transported to the Parasitology and Entomology laboratory of the department of Zoology, Ahmadu Bello University, Zaria for processing and examination, after matching the samples with the questionnaires.

### 3.2.3 Laboratory analysis of urine samples

Each urine sample was first physically examined for the presence of blood before it was analyzed. Urine sample were analyzed using simple sedimentation by centrifugation method as described by Cheesbrough (2006). Samples were allowed to settle for 30 minutes in the laboratory and the supernatant was reduced to about 10ml each. The samples were shaken thoroughly, transferred into centrifuge tubes and were centrifuged at 2000rpm for 5minutes. The supernatant was decanted and a drop of the sediment was pipetted and placed on a clean glass slide. A cover slip was placed over it and viewed at a magnification of ×400 under the microscope for *S. haematobium* eggs.

### 3.2.4 Laboratory analysis of stool samples

Formol-ether sedimentation technique was used to analyse the stool samples. In the analysis, 1g of stool sample was mixed with 5% formalin and normal saline, and sieved with gauze into centrifuge bottle to remove the debris. Few drops of diethyl ether were added to the filtrate, shaken vigorously and centrifuged at 2000rpm for 5minutes. The supernatant was then decanted to recover the sediment and a drop of the sediment was pipetted and placed on a clean glass slide. A cover slip was placed over the drop of sediment and viewed at a magnification of ×400 under microscope for *S. mansoni* eggs.

## 3.3 Collection of Intermediate Snail Hosts from Water Bodies

Water bodies (rivers and streams) in Zango, Zonkwa and Kamantan, were screened by using nets through the edges of all the water bodies for *Bulinus* and *Biomphalaria* species, the snail intermediate host for *S. haematobium* and *S. mansoni* respectively. This was carried out between the periods of Nov. 2013 to February 2014.

### 3.4 Retrospective Study

Patient's records from St Lois hospital and the general hospital, being the major hospitals in Zonkwa, the Zangon-Kataf Local Government headquarters were examined for stool and urine tests results that were carried out for patients from September 2004 to December 2010. The parasites encountered in such tests were recorded according to the sex of the patients and the month in which the test was carried out.

### 3.5 Statistical Analysis

Version 20 of the IBM SPSS for Windows software package was used for the data analysis. Odds Ratio analysis was used to determine associations between risk factors and prevalence. T-test was used to obtain the differences between any pair of variables that were independent.

# CHAPTER FOUR

# 4.0 RESULTS

## 4.1 Cross-sectional Study

### 4.1.1 Gastrointestinal parasitic infections

The refusal of individuals to willingly give samples resulted in the collection of stool and urine samples from different sets of people. A total number of 366 stool and samples were collected and examined. Out of the 366 stool samples collected, 5(1.37%) were positive for *Schistosoma mansoni*, 3(0.82%) for *Ascaris lumbricoides* and 3(0.82%) for *Trichuris trichiura* (table 4.1). A higher prevalence of 6(2.46%) was recorded for males in this order, 3(1.23%) for *Ascaris lumbricoides* and 3(1.23%) for *Trichuris trichiura*, than in females with a lower prevalence of 5(4.07%) for *S. mansoni* (table 4.2). The sample population showed a higher prevalence in the younger age bracket of 11-20years, having 5(9.09%) for *S. mansoni,* with no positive sample for *S. mansoni* in other age brackets, except for *Ascaris lumbricoides* 3(3.57%) and *Trichuris trichiura 3*(3.57%*)* as shown in table 4.3. The highest prevalence of 5(3.29%) for *S.mansoni* was observed in respondents who had secondary level of education, with no positive sample in other level of education, except *Ascaris lumbricoides* 3(2.31%) and *Trichuris trichiura* 3(2.31%) (table 4.4). Of the categories of occupations considered in the study population, the highest prevalence of 11(3.01%) was recorded among students, in the division of 5(13.89%), 3(8.33%) and 3(8.33%) for *S. mansoni, Ascaris lumbricoides and Trichuris trichiura* respectively, with no positive samples for other occupational factors (table 4.5). The sources of water for domestic use had all the positive samples 11(3.01%) for persons that used well water in this order 5(1.61%), 3(1.75%), and 3(1.75%) *S. mansoni, Ascaris lumbricoides and Trichuris trichiura* (table 4.6). Water contact activities that predisposed persons to infection with schistosomes were fishing, swimming, washing and farming, in and around the water bodies that could harbor the intermediate snail hosts. Among

Table 4.1: Gastrointestinal parasitic infections prevalent among people in parts of Zangon-Kataf local government area of Kaduna state (n=366)

| Parasites | No. Infected | Prevalence (%) |
| --- | --- | --- |
| *Schistosoma mansoni* | 5 | 1.37 |
| *Ascaris lumbricoides* | 3 | 0.82 |
| *Trichuris trichiura* | 3 | 0.82 |
| Total | 11 | 3.01 |

Table 4.2: Prevalence of gastrointestinal parasites in parts of zongon-kataf Local Government Area according to sex (n=366)

| | Male (n=243) | | Female (n=123) | |
|---|---|---|---|---|
| Parasites | No infected (%) | | No infected (%) | |
| *S. mansoni* | 0 | (0.0) | 5 | (4.07) |
| *A. lumbricoides* | 3 | (1.23) | 0 | (0.0) |
| *Trichuris trichiuria* | 3 | (1.23) | 0 | (0.0) |
| Total | 6 | 2.46 | 5 | 4.07 |

Table 4.3: Prevalence of gastrointestinal parasites in parts of Zongon-Kataf Local Government Area according to age (n=366)

| Parasites | 1-10yrs (n=46) +ve(%) | 11-20yrs (n=55) +ve(%) | 21-30yrs (n=58) +ve(%) | 31-40yrs (n=43) +ve(%) | 41-50yrs (n=84) +ve(%) | 51-60yrs (n=50) +ve(%) | 60≥yrs (n=29) +ve(%) |
|---|---|---|---|---|---|---|---|
| *S. mansoni* | 0(0) | 5(9.09) | 0(0) | 0(0) | 0(0) | 0(0) | 0(0) |
| *A. lumbricoides* | 0(0) | 0(0) | 0(0) | 0(0) | 3(3.57) | 0(0) | 0(0) |
| *Trichuris trichiuria* | 0(0) | 0(0) | 0(0) | 0(0) | 3(3.57) | 0(0) | 0(0) |
| Total | 0 (0) | 5(9.09) | 0 (0) | 0 (0) | 6(7.14) | 0 (0) | 0 (0) |

Table 4.4: Prevalence of gastrointestinal parasites in parts of Zongon-Kataf Local Government Area according to Level of education (n=366)

| | Primary (n=130) | | Secondary (n=152) | | Tertiary (n=60) | | Illiterate (n=24) | |
|---|---|---|---|---|---|---|---|---|
| Parasites | No infected | % | No infected | % | No infected | % | No infected | % |
| *S. mansoni* | 0 | (0.0) | 5 | (3.29) | 0 | (0.0) | 0 | (0.0) |
| *A. lumbricoides* | 3 | (2.31) | 0 | (0.0) | 0 | (0.0) | 0 | (0.0) |
| *Trichuris trichiuria* | 3 | (2.31) | 0 | (0.0) | 0 | (0.0) | 0 | (0.0) |
| Total | 6 | (4.62) | 0 | (3.29) | 0 | (0.0) | 0 | (0.0) |

Table 4.5: Prevalence of gastrointestinal parasites in parts of Zongon-Kataf Local Government Area according to occupation (n=366)

| | Business (n=58) | Civil servant (n=48) | Farming (n=88) | Arm forces (n=36) | Students/ Pupils (n=36) |
|---|---|---|---|---|---|
| Parasites | +ve(%) | +ve(%) | +ve(%) | +ve(%) | +ve(%) |
| *S. mansoni* | 0(0) | 0(0) | 0(0) | 0(0) | 5(13.89) |
| *A. lumbricoides* | 0(0) | 0(0) | 0(0) | 0(0) | 3(8.33) |
| *Trichuris trichiuria* | 0(0) | 0(0) | 0(0) | 0(0) | 3(8.33) |
| Total | 0(0) | 0(0) | 0(0) | 0(0) | 11(30.56) |

Table 4.6: Prevalence of gastrointestinal parasites in parts of Zongon-Kataf Local Government Area according to source of water (n=366)

| | Borehole (n=48) | Reservior (n=5) | Tap (n=2) | Well (n=311) |
|---|---|---|---|---|
| Parasites | +ve(%) | +ve(%) | +ve(%) | +ve(%) |
| *S. mansoni* | 0(0) | 0(0) | 0(0) | 5(1.61) |
| *A. lumbricoides* | 0(0) | 0(0) | 0(0) | 3(0.96) |
| *Trichuris trichiuria* | 0(0) | 0(0) | 0(0) | 3(0.96) |
| Total | 0(0) | 0(0) | 0(0) | 11(3.53) |

these activities, the higher prevalence of 11(3.01%) was observed among those who practiced Farming which comprises of 5(2.3%), 3(1.38%) and 3(1.38%) prevalence for *S. mansoni, Ascaris lumbriciodes and Trichuris trichiura* respectively and the low and no positive sample was recorded among those who engageg in other practices of water contact activities (table4.7).

Tables 4.1- table 4.8 indicated that the result of stool samples was observed to have all positive samples in only one category of the factors. Therefore, association between gastrointestinal schistosomiasis and factors cannot be calculated.

For the type of toilet used, the higher prevalence of 11(3.01%) was observed among those who engaged in pit toilet defaecation in this order, 5(1.37%) for *S. mansoni*, 3(0.82%) for *Ascaris lumbricoides* and 3(0.82%) for *Trichuris trichiura* with no positive sample recorded among those who practiced other means of defaecation (table 4.8).

### 4.1.2 The prevalence and distribution of urinary schistosomiasis in part Zangon-Kataf LGA

Out of the 604 urine samples collected and examined the prevalence of 10(1.66%) was recorded for *Schistosoma haematobium*, (table 4.9). A higher prevalence of 7(2.15%) was recorded for males, than in females with a lower prevalence of 3(1.08%) for *S. haematobium* (table 4.10). The population studied showed a higher prevalence in the younger age bracket of 11-20years, having 5(3.22) positive samples for *S. haematobium*, with a lower prevalence 2(1.90) for *S. haematobium* in the age bracket of 21-30 as shown in table 4.11. The highest prevalence of 5(2.70%) for *S. haematobium,* was observed in respondents who had primary level of education, and the least prevalence was among those who had tertiary level of education with 3(4.11%) for *S. haematobium* (table 4.12). Of the categories of occupations considered in the study population, the highest prevalence of 7(8.75%) for *S. haematobium, was* recorded among students, with lower prevalence of 3(1.38%) for *S. haematobium* recorded among the farmers (table4.13). The sources of water for domestic use had all the

Table 4.7: Prevalence of gastrointestinal parasites in parts of Zongon-Kataf Local Government Area according to water contact activity (n=366)

| | Farming (n=171) | Fishing (n=31) | Swimming (n=22) | Washing (n=142) |
|---|---|---|---|---|
| Parasites | +ve(%) | +ve(%) | +ve(%) | +ve(%) |
| *S. mansoni* | 5(2.92) | 0(0) | 0(0) | 0(0) |
| *A. lumbricoides* | 3(1.75) | 0(0) | 0(0) | 0(0) |
| *Trichuris trichiuria* | 3(1.75) | 0(0) | 0(0) | 0(0) |
| Total | 11(6.42) | 0(0) | 0(0) | 0(0) |

Table 4:8 Prevalence of gastrointestinal parasites in parts of Zongon-Kataf Local Government Area according to type of toilet used (n=366)

| | Pit latrine(n=217) | | Open field (n=99) | | Water Closet (n=5) | |
|---|---|---|---|---|---|---|
| Parasites | No infected (%) | | No infected (%) | | No infected (%) | |
| *S. mansoni* | 5 | (2.30) | 0 | (0) | 0 | 0 |
| *A. lumbricoides* | 3 | (1.38) | 0 | (0) | 0 | 0 |
| *Trichuris trichiuria* | 3 | (1.38) | 0 | (0) | 0 | 0 |
| Total | 11 | (5.06) | 0 | (0) | 0 | 0 |

Table 4.9: Urinary parasitic infections prevalent among people in parts of Zangon-Kataf local government area of Kaduna state (n=604)

| Parasites | No. Infected | Prevalence (%) |
|---|---|---|
| *Schistosoma haematobium* | 10 | 1.66 |
| | 10 | 1.66 |

Table 4.10: Prevalence of urinary parasites in parts of Zongon-Kataf Local Government Area according to sex (n=604)

| | Male (n=325) | | Female (n=279) | |
|---|---|---|---|---|
| Parasites | No infected (%) | | No infected (%) | |
| *S. haematobium* | 7 | (2.15) | 3 | (1.08) |

Table 4.11: Prevalence of urinary parasites in parts of Zongon-Kataf Local Government Area according to age (n=604)

| **Parasites** | **1-10yrs (n=66)** | **11-20yrs (n=141)** | **21-30yrs (n=105)** | **31-40yrs (n=84)** | **41-50yrs (n=63)** | **51-60yrs (n=75)** | **60≥yrs (n=70)** |
|---|---|---|---|---|---|---|---|
| | +ve(%) | +ve(%) | +ve(%) | +ve(%) | +ve(%) | +ve(%) | +ve(%) |
| *S. haematobium* | 3(4.55) | 5(3.55) | 2(1.90) | 0(0) | 0(0) | 0(0) | 0(0) |

Table 4.12: Prevalence of urinary parasites in parts of Zongon-Kataf Local Government Area according to level of education (n=604)

| | Primary (n=185) | Secondary (n=297) | Tertiary (73) | Illiterate (49) |
|---|---|---|---|---|
| Parasites | No infected (%) | No infected (%) | No infected (%) | No infected (%) |
| *S. haematobium* | 5 (2.70) | 2 (0.67) | 3 (4.11) | 0 (0.0) |

positive samples 10(2.16) prevalence for *S. haematobium* for persons that used well water (table 4.14). Among water contact activities that is directly linked to water bodies and exposes persons to infection with schistosomes, the higher prevalence of 2(8.00%) for *S. haematobium,* was observed among those who practiced fishing and the lower prevalence of 5 (1.64) for *S. haematobium* among those who engage in farming (table 4.15). For the type of toilet used, open field recorded highest prevalence of 5(2.50) for *S. haematobium*, was observed among those who use pit toilet and open field defaecation (table 4.16)

### 4.1.3 Factors associated with urinary schistosomiasis

There was association between urinary schistosomiasis and some of the factors, which were indicated by their odds ratio values as follows: sex (2.025) (table 4.17); age bracket of 1-10(3.612) and 21-30 (2.0676) (table 4.18); primary level of education, (2.300), tertiary level of education (3.208) (table 4.19); open field defaecation (2.046) (table 4.21); fishing (6.207) and swimming (4.988)(table 4.22); with no association in all the factors in occupation (table 4.20). But the association was only significant in the water contact activities of fishing and swimming with Confidence Intervals of (1.247-30.882) and (1.249-19.924) (table 4.22) respectively.

## 4.2 Observation of Intermediate snail host

The intermediate snail host screened were found to be absent in the stagnant water bodies during the period of study in study area.

## 4.3 Retrospective Study

The hospital records revealed that patients gave either stool or urine sample according to the doctor's prescription and what their health situation may require. Hence, 1351 stool samples and 2001 urine samples (3352 patients) were obtained and examined for gastrointestinal and urinary parasites from the hospital records that were reviewed from September 2004 to December 2010. Out of 3352 patients, 1541 patients were males and 1811 patients were

Table 4.13: Prevalence of urinary parasites in parts of Zongon-Kataf Local Government Area according to occupation (n=604)

| | Business (n=141) | Civil servant (n=45) | Farming (n=217) | Arm forces (n=67) | Students (n=80) |
|---|---|---|---|---|---|
| Parasites | +ve(%) | +ve(%) | +ve(%) | +ve(%) | +ve(%) |
| *S. haematobium* | 0(0) | 0(0) | 3(1.38) | 0(0) | 7(8.75) |

Table 4.14: Prevalence of urinary parasites in parts of Zongon-Kataf Local Government Area according to source of water (n=604)

| | **Borehole (n=106)** | **Reservoir (n=19)** | **Tap (n=15)** | **Well (n=464)** |
|---|---|---|---|---|
| **Parasites** | +ve(%) | +ve(%) | +ve(%) | +ve(%) |
| ***S. haematobium*** | 0(0) | 0(0) | 0(0) | 10(2.16) |

Table 4.15: Prevalence of urinary parasites in parts of Zongon-Kataf Local Government Area according to type of toilet used (n=604)

| | **Pit latrine (n=300)** | | **Open field (n=200)** | | **Water Closet (n=104)** | |
|---|---|---|---|---|---|---|
| **Parasites** | No infected | % | No infected | % | No infected | % |
| ***S. haematobium*** | 5 | (1.67) | 5 | (2.50) | 0 | (0.00) |

Table 4.16: Prevalence of urinary parasites in parts of Zongon-Kataf Local Government Area according to water contact activities (n=604)

| | **Farming (n=305)** | **Fishing (n=25)** | **Swimming (n=224)** | **Washing (n=50)** |
|---|---|---|---|---|
| **Parasites** | +ve(%) | +ve(%) | +ve(%) | +ve(%) |
| ***S. haematobium*** | 5(1.64) | 2(8.00) | 3(1.34) | 0(0) |

Table 4.17: The distribution of urinary schistosomiasis by sex (n=604)

| Sex | No Examined | No Positive | Odds ratio | 95% CI |
|---|---|---|---|---|
| Male | 325 | 7(2.1) | 2.025 | 0.519-7.907 |
| Female | 279 | 3(1.0) | | |
| Total | 604 | 10(1.66) | | |

CI= Confidence Interval

Table 4.18: The distribution of urinary schistosomiasis by Age (n=604)

| Age(Years) | No Examined | No Positive | Odds ratio | 95% CI |
|---|---|---|---|---|
| 1-10 | 66 | 3 | 3.612 | 0.911-14.322 |
| 11-20 | 141 | 5 | 0.818 | 0.172-3.899 |
| 21-30 | 105 | 2 | 2.067 | 0.526-8.129 |
| 31≥ | 292 | 0 | NA | NA |
| Total | 604 | 10 | | |

NA: Not applicable; CI: Confidence Interval

Table 4.19: The distribution of urinary schistosomiasis by level of Education (n=604)

| Education | No Examined | No Positive | Odds ratio | 95% CI |
|---|---|---|---|---|
| Primary | 185 | 5 | 2.300 | 0.658-8.043 |
| Secondary | 297 | 2 | 0.253 | 0.053-1.203 |
| Tertiary | 73 | 3 | 3.208 | 0.811-12.692 |
| Illiterate | 49 | 0 | NA | NA |
| Total | 604 | 10 | | |

NA: Not applicable; CI: Confidence Interval

Table 4.20: The distribution of urinary schistosomiasis by occupation (n=604)

| Occupation | No Examined | No Positive | Odds ratio | 95% CI |
|---|---|---|---|---|
| Business | 141 | 0 | NA | NA |
| Civil servant | 45 | 0 | NA | NA |
| Farming | 271 | 3 | 0.528 | 0.135-2.063 |
| Armforces | 67 | 0 | NA | NA |
| Students/pupils | 80 | 7 | 0.818 | 0.172-3.899 |
| Total | 604 | 10 | | |

NA: Not applicable; CI: Confidence Interval

Table 4.21: The distribution of urinary schistosomiasis by type of toilet used (n=604)

| Type of toilet used | No Examined | No Positive | Odds ratio | 95% CI |
|---|---|---|---|---|
| Pit toilet | 300 | 5 | 0.980 | 0.290-3.538 |
| Open field | 200 | 5 | 2.046 | 0.585-7.152 |
| Water closet | 104 | 0 | NA | NA |

NA: Not applicable; CI: Confidence Interval

Table 4.22: The distribution of urinary schistosomiasis by water contact activity (n=604)

| Water contact activity | No Examined | No Positive | Odds ratio | 95% CI |
|---|---|---|---|---|
| Farming | 305 | 5 | 0.980 | 0.281-3.420 |
| Fishing | 25 | 2 | 6.207 | 1.247-30882 |
| Washing | 224 | 0 | NA | NA |
| Swimming | 50 | 3 | 4.988 | 1.249-19.924 |

NA: Not applicable; CI: Confidence Interval

females. Of the 1541 males examined, 233 (45.9%) and 270 (54.0%) of the 1811 females were infected with at least one gastrointestinal parasite. Of these, 313 cases had protozoan infections at 9.34% prevalence and 190 cases had helminth infection at 5.67% prevalence (table 4.23). Among those infected with protozoa, 138 cases at 4.12% prevalence were male and 195 cases at 5.22% prevalence were female. While those infected with helminth, 95 cases at 2.83% prevalence were both male and female. For *Schistosoma* species, 19 cases of *S. mansoni* infection and 4 cases of *S. haematobium* infection were recorded at 0.56%and 0.2% prevalence respectively, with 12 male and 7 female for *S. mansoni* and 1 female at 0.05% prevalence and 3 male at 0.15% prevalence for *S. haematobium* (Table 4.24). The highest number of cases (260) was of those who had *Entamoeba histolytica* at 7.76% prevalence, of which 115 cases were male 145 and cases were female at 3.43 % and 4.33% prevalence respectively. Female patients had the higher prevalence of 35(1.04), 145(4.33) and 30(0.98) for *Ascaris lumbricoides, Entamoeba histolytica, and E. coli* respectively while male patients had the higher prevalence of 3(0.09), 12(0.36), and 54(1.61) for *S. haematobium*, *S. mansoni* and Hookworm respectively (Table 4.16). The parasite with the list occurrence in the reviewed records was *Trichuris trichuira* species with 2 cases at 0.06% prevalence.

The years that had the higher prevalence of parasites of 126(3.76) and 121(3.61) in the cases of patients reviewed were 2005 and 2007 respectively while the lower prevalence of parasite of 37(1.10) occurred in 2008 (Table 4.25).

The cases of gastrointestinal protozoas and urinary infection were spread throughout the year, while in cases of gastrointestinal helminths only hookworm was spread throughout the year. The highest number of infected cases were 74 (2.21%) recorded in the months of March. The least number of infected cases occurred in February with prevalence of 20(0.60%). In protozoan infections, the parasite with the highest monthly infection (0.92 and 0.98) was *Entamoeba histolytica* for the months of March and April respectively.  While the least

Table 4.23: Retrospective Prevalence of gastrointestinal and urinary infection in patients attending major Hospitals in parts of Zangon-Kataf LGA from September 2004 to December 2010 (n=3352)

| Infections | No Positive | Prevalence |
|---|---|---|
| *S. haematobium* | 4 | 0.2 |
| *S. mansoni* | 19 | 1.41 |
| *Hookworm* | 105 | 7.77 |
| *Ascaris lumbricoides* | 60 | 4.44 |
| *Entamoeba histolytica* | 260 | 19.25 |
| *Balantidium coli* | 53 | 3.92 |
| *Trichuris trichiura* | 2 | 0.15 |
| *Total* | 503 | 37.14 |

Table 4.24 Retrospective Prevalence of gastrointestinal and urinary infection based on sex in patients attending major Hospitals in parts of Zangon-Kataf LGA from September 2004 to December 2010 (n=3352)

| PARASITE | Male | Prevalence % | Female | Prevalence % |
|---|---|---|---|---|
| No Examined | 1541 | | 1811 | |
| *S. haematobium* | 3 | 0.15 | 1 | 0.5 |
| *S. mansoni* | 12 | 0.89 | 7 | 0.52 |
| *Hookworm* | 54 | 3.99 | 51 | 3.77 |
| *Ascaris Lum* | 25 | 1.85 | 35 | 2.59 |
| *Entamoeba histolytica* | 115 | 8.51 | 145 | 10.73 |
| *Balantidium coli* | 23 | 1.70 | 30 | 2.22 |
| *Trichuris trichuira* | 1 | 0.07 | 1 | 0.07 |
| Total | 233 | 8.65 | 270 | 20.04 |

Table 4.25: Retrospective Prevalence of gastrointestinal and urinary infection based on year in patients attending major Hospitals in parts of Zangon-Kataf LGA from September 2004 to December 2010 (n=3352)

| | YEAR | | | | | | |
|---|---|---|---|---|---|---|---|
| PARASITE | 2004(%) | 2005(%) | 2006(%) | 2007(%) | 2008(%) | 2009(5) | 2010(%) |
| *S. haematobium* | 0 | 0 | 2(0.1) | 2(0.1) | 0 | 0 | 0 |
| *S. mansoni* | 1(0.07) | 1(0.07) | 0 | 8(0.59) | 2(0.15) | 0 | 7(0.52) |
| *Hookworm* | 8(0.59) | 27(2.0) | 4(0.30) | 16(1.18) | 3(0.22) | 14(1.04) | 33(2.44) |
| *Ascaris Lum* | 11(0.81) | 23(1.70) | 1(0.07) | 2(1.15) | 0 | 11(0.81) | 12(0.89) |
| *Entamoeba histolytica* | 17(1.26) | 58(4.29) | 39(2.89) | 82(6.07) | 29(2.15) | 21(1.55) | 14(1.04) |
| *Balantidium coli* | 10(0.74) | 17(1.26) | 7(0.52) | 9(0.67) | 3(0.22) | 3(0.22) | 4(0.30) |
| *Trichuris trichuira* | 0 | 0 | 0 | 2(0.15) | 0 | 0 | 0 |
| *Total* | 47(3.47) | 126(9.23) | 54(3.88) | 121(9.91) | 37(2.74) | 49(3.62) | 70(5.19) |

monthly infection was *Trichura trichiura* species in the month of March (table 4.26).

The monthly prevalence with cases of *S. haematobium* was highest in the month of May with prevalence of 2(0.1%), while other cases were in the months of February and March both with same prevalence of 1(0.05%) as shown in table 4.27. From the 7years reviewed, the cases of *S. haematobium* in 2006 and 2007 with the same prevalence of 2(0.1%) (table 4.28). The cases of urinary infection showed a higher prevalence of 3(0.15%) among male patients in comparison to female with 1(0.05%) prevalence (table 4.29).

Although there was association between sex and gastrointestinal parasites infections as well as between sex and protozoa infections but the association was only significant ($p < 0.05$) between sex and intestinal helminth infections (table 4:30).

Table 4.26: Retrospective Monthly Prevalence of gastrointestinal and urinary infection in patients attending major Hospitals in parts of Zangon-Kataf LGA from September 2004 to December 2010 (n=3352)

| | MONTHS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARASITE | Jan (%) | Feb (%) | Mar (%) | April (%) | May (%) | June (%) | July (%) | Aug (%) | Sept (%) | Oct (%) | Nov (%) | Dec (%) |
| *S. haematobium* | 0 | 1(0.05) | 1(0.05) | 0 | 2(0.09) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *S. mansoni* | 2(0.15) | 0 | 3 (0.22) | 5 (0.37) | 3 (0.22) | 0 | 3 (0.37) | 0 | 0 | 1 (0.07) | 0 | 2 (0.15) |
| *Hookworm* | 7 (0.52) | 2 (0.15) | 18 (1.33) | 13 (0.96) | 5 (0.37) | 11 (0.81) | 13 (0.96) | 5 (0.37) | 10 (0.74) | 12 (0.89) | 4 (0.3) | 5 (0.3) |
| *Ascaris Lum* | 2 (0.15) | 6 (0.44) | 17 (1.26) | 7 (0.52) | 4 (0.3) | 4 (0.3) | 5 (0.37) | 1 (0.07) | 0 | 4 (0.3) | 5 (0.37) | 5 (0.3) |
| *E. histolytica* | 20 (1.48) | 10 (0.74) | 31 (2.29) | 23 (1.07) | 33 (2.4) | 24 (1.78) | 13 (0.96) | 20 (1.48) | 29 (2.15) | 25 (1.85) | 6 (0.44) | 16 (1.1) |
| *B. coli* | 7 (0.52) | 2 (0.15) | 5 (0.37) | 5 (0.37) | 5 (0.37) | 4 (0.3) | 1 (0.07) | 3 (0.22) | 7 (0.52) | 5 (0.37) | 6 (0.44) | 3 (0.22) |
| *T. trichuira* | 1 (0.07) | 0 | 0 | 0 | 1 (0.07) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 39(1.89) | 23(1.53) | 75(5.52) | 53(2.29 ) | 53(3.82) | 43(3.19 ) | 35( | 29(2.12 ) | 46(3.41 ) | 37(3.48 ) | 21(1.41 ) | 31(2.09) |

Table 4.27: Retrospective Prevalence of urinary schistosomiasis based on year in patients attending major Hospitals in parts of Zangon-Kataf LGA from September 2004 to December 2010 (n=2001)

| | YEARS | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2004 (%) | 2005 (%) | 2006 (%) | 2007 (%) | 2008 (%) | 2009 (%) | 2010 (%) |
| No examined | 155 | 434 | 80 | 579 | 336 | 188 | 229 |
| No Positive | 0 | 0 | 2(0.09) | 2(0.09) | 0 | 0 | 0 |

Table 4.28 Retrospective Monthly Prevalence of urinary schistosomiasis in patients attending major Hospitals in parts of Zangon-Kataf LGA from September 2004 to December 2010 (n=2001)

| | M | O | N | T | H | S | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan (%) | Feb (%) | Mar (%) | Apr (%) | May (%) | June (%) | July (%) | Aug (%) | Sept (%) | Oct (%) | Nov (%) | Dec (%) |
| No examined | 105 | 142 | 242 | 198 | 231 | 171 | 126 | 161 | 183 | 204 | 160 | 78 |
| No Positive | 0 | 1(0.05) | 1(0.05) | 0 | 2(0.9) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 4.29 Retrospective Prevalence of urinary infection based on sex in patients attending major Hospitals in parts of Zangon-Kataf LGA from September 2004 to December 2010 (n=2001)

| | SEX | |
|---|---|---|
| | Male (%) | Female (%) |
| No examined | 933 | 1068 |
| S. haematobium | 3(0.15) | 1(0.5) |

Table 4.30: The Retrospective study on the distribution of gastrointestinal and urinary parasitic infections and sex in patients attending major hospitals in parts of Zangon -kataf Local government area from September 2004 - December 2010 (n=3352)

| | Gender | No Examined | No positive | Odds ratio | CI |
|---|---|---|---|---|---|
| Protozoa | Male | 1541 | 230 | 1.011 | 0.593-1.119 |
| | Female | 1811 | 269 | | |
| Helminths | Male | 1541 | 230 | 0.815 | 0.779-1.164 |
| | Female | 1811 | 269 | | |
| Total | Male | 1541 | 230 | 0.933 | 0.747-1.164 |
| | Female | 1811 | 269 | | |

CI: Confidence Interval

# CHAPTER FIVE

## 5.0 DISCUSSION

The prevalence of *Schistosoma haematobium* and *Schistosoma mansoni* observed in the population studied have shown the infection to be non significant. The prevalence though low, registers the presence of the infection in the study area. The low 1.65% and 1.37 prevalence is supported by the non- availability of the snail intermediate hosts (*Bulinus* and *Biomphalaria* species) in the stagnant water bodies screened within the study area. This implies that there might be no active transmission of schistosomiasis in the study area and that the infected persons, may have acquired it from elsewhere outside the study area where active transmission was occurring (Jack *et al.*, 2015). Though the screening of the snail intermediate host was carried out in a short period of time, the absence of the snail intermediate hosts (Bulinus and Biophalaria species) in the water bodies in the study area might be due to the shortness of study period.

The absence of the snail intermediate hosts in the study area could be due to the absence of stagnant water bodies sufficient to support the breeding of the snail intermediate hosts during the period of the study. There was no dam in any of the rivers in the study area at the period of the study. This means that even if snails are introduced, breeding may not be sustained as the snails are flushed out of the rivers by the strong water currents that result from the heavy rainfall during rainy season. Since the physicochemical parameters of the water bodies were not studied, and no record of a previous study on this subject was encountered, it is difficult to attribute the absence of the snail intermediate host to unfavourable physicochemical conditions of the water bodies.

Igwe (2014) reported a prevalence of 26.6% for schistosomiasis in Kachia Local Government Area and Damen *et al*. (2006) reported a prevalence of 19% for schistosomiasis among students in Jema'a Local Government Area which are both Local Government Areas that share borders with Zangon-Kataf Local Government Area, the study area. This indicates that active transmission of schistosomiasis may be occurring in the surrounding Local Government Areas that might have been the source of infection for the few cases in Zangon-Kataf Local Government Area. Kachia Local Government Area is particularly noted for rice and irrigation farming which support snail breeding. Since irrigation farming was seldom practiced in the study area, therefore the large proportion of farmers recorded in this study was less infected with schistosomiasis. The small proportion of students within these age bracket11-20 agrees with the findings by Ogbeide *et al.*,(1994) and Nduka *et al.*,(1995) that ages of 13 and above tend to play outdoor water contact activities more, with a drop in load of infection on increasing age due to development of immunity (Edington *et al.*,(1976).who behave like visitors than resident, were more infected. The observed low prevalence among those that used well as source of water along with the low water contact activity for those who engaged in swimming and fishing in streams which did not support snail breeding lent credence to the result obtained in the study population.

The 7 years retrospective analysis of the hospital records carried out for both gastrointestinal and urinary schistosomiasis in the study area consisted of  helminths and protozoa infections. The low prevalence (0.56) and (0.2) of *S. mansoni* and *S. haematobium* infection respectively, observed in both males and females corroborated the prevalence obtained in the cross-sectional study. Also the low prevalence could have been from individuals that might have acquired the infection outside the study area and consulted the hospital in the study area when they became ill. Although there was limited information on the records kept of the individuals attended to in these hospitals, there was one case of a male infected with *S. mansoni* whose name and residential address was complete. The address was traced but it was discovered that he resided at Kaduna and only visited the permanent home residence during the Christmas period in December. He fell ill and was admitted in the hospital, after a few days he was discharged. He thereafter travelled back to Kaduna where he was employed. This case gave support to the supposition earlier made of the absence of active transmission of schistosomiasis in the study area.

Intestinal parasites other than *Schistosoma species* recorded in the retrospective study namely hookworm, *Ascaris lumbricoides, Entamoeba histolytica, Balantidium coli, Trichuris trichiura* are parasites commonly reported elsewhere in Nigeria (Okpala *et al.,* 2004; ). However, *B. coli* which is a normal parasite of pigs is zoonotic. The recorded prevalence of *B. coli* could be associated with piggery, a common practice in Southern Kaduna State made up of Kachia, Jabba, Jema'a and Zangon-Kataf Local Government Areas where piggery is widely practiced with a renowned pig market at Kafanchan, the Jema'a Local Government Area headquarters. In the course of the retrospective study, intestinal and urinary schistosomiasis results obtained showed relatively low prevalence (0.56%) with other intestinal parasites. These results are similar to the findings of (Okpala *et al*., 2004) who reported 0.67% in Jos and Goselle *et al*., (2010) reported 4.6% in Jos as well. The most common helminth parasite was hookworm. The presence of the Hookworm could be attributed to poor sanitation in the environment as infection is acquired when the filariform larva penetrates the skin that comes in contact with the contaminated soil. The highest prevalence in protozoa infection with *E. histolytica* is attributed to inadequate sanitation and poor personal hygiene which causes food and water contamination with faeces, flies or food handlers containing the parasite's infective cysts. For all the parasitic infections, there was no significant difference between males and females. Plausible reason for this observation could be the sustained vicious cycle of environmental contamination that harbours the infective stages of these parasites and the consequent exposure of both males and females to the same environment Nnoruka *et al.,* (*2000*) suggested that there is no consistent pattern attributable to sex differences with respect to infection in Nigeria and elaborated that status of infection is associated with water contact pattern.

# CHAPTER SIX

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

1. The prevalence of urinary schistosomiasis (1.65%, 0.2%) and intestinal schistosomiasis (1.36%, 0.56%) for cross-sectional and retrospective study respectively is hypoendemic in parts of Zangon-Kataf Local Government Area of Kaduna State.
2. The effect of anthropogenic risk factors such as age, sex, occupation water contact activity on the prevalence of schistosomiasis is not significant
3. Active transmission of schistosomiasis does not occur in the study area as *Bulinus* and *Biomphalaria* species which are the snail intermediate hosts of urinary and intestinal schistosomiasis do not occur in water bodies in the study area, hence infected person might of acquired the infection elsewhere.

### 6.2 RECOMMENDATIONS

1. Although the prevalence of urinary and gastrointestinal schistosomiasis is low, there is need to create health awareness program regularly in their various districts, so that the less privilege could learn basic hygiene to sustain health status of the communities for prevention of other parasitic infections.
2. The screening of all the water bodies in the study area for the intermediate snail hosts should be carried out over a longer period of time, so as to confirm or disprove their non-existence in the study area.

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## APPENDICES

**APPENDICE 1:** QUESTIONNAIRE ON PREVALENCE OF INTESTINAL AND URINARY SCHISTOSOMIASIS IN ZANGON-KATAF LOCAL GOVERNMENT AREA, KADUNA STATE.

1. Date of Collection: ........................................................................................................
2. Serial No: ........................................................................................................
3. Village: ........................................................................................................
4. Name of School: ........................................................................................................
5. Level of School: Primary( ) Secondary ( )
6. Class: ........................................................................................................
7. Health Educational Curriculum Activities on infections: Yes ( ) No ( )
8. Name of student: ........................................................................................................
9. Sex: Male ( ) Female ( )
10. Age (in years): ........................................................................................................
11. Parents Educational background: Tertiary ( ) Secondary ( ) Primary ( ) Illiterate ( )
12. Parents Occupation: Business ( ) Civil Servant ( ) Farming ( ) Armed Forces ( ) Others ( )
13. Sources of Water: Borehole ( ) Reservoir ( ) Tap ( ) Well ( )
14. Water contact activity: Farming ( ) Fishing ( ) Swimming ( ) Washing ( )
15. Type of toilet used: Pit latrine ( ) Open field( ) Water closet( )
16. Knowledge of Schistosomiasis: Yes ( ) No( )
17. Blood in Urine? Yes ( ) No ( )
18. Blood in Stool? Yes ( ) No ( )
19. Result of Urine Examination: ........................................................................................
20. Result of Stool Examination: ........................................................................................