

**PREVALENCE AND ASSOCIATED RISK FACTORS
OF SCHISTOSOMIASIS OF AMONG SCHOOL
CHILDREN IN LOGO LOCAL GOVERNMENT
AREA OF BENUE STATE, NIGERIA**

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MAY, 2015

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NIGERIA**

MAY, 2015

DECLARATION

I hereby declare that the work in this thesis entitled “PREVALENCE AND ASSOCIATED RISK FACTORS OF SCHISTOSOMIASIS AMONG SCHOOL CHILDREN IN LOGO LOCAL GOVERNMENT AREA OF BENUE STATE, NIGERIA” was carried out by me in the Department of Biological Sciences. 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 institution.

Chris Umaka’a Iorgema

.....

28 May, 2015

CERTIFICATION

This thesis entitled “PREVALENCE AND ASSOCIATED RISK FACTORS OF SCHISTOSOMIASIS AMONG SCHOOL CHILDREN IN LOGO LOCAL GOVERNMENT AREA OF BENUE STATE, NIGERIA,” by CHRIS UMAKA’A IORGEMA, meets the regulations governing the award of the degree of Master of Science in Zoology of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This project work is dedicated to the memory of my late father, Iorgema Shor.

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ABSTRACT

This study was carried out to determine the prevalence and associated risk factors of schistosomiasis among school children in Logo Local Government Area of Benue State, between May 2013 and June 2013. A total of 397 urine and stool samples were examined for eggs of *Schistosoma haematobium* and *Schistosoma mansoni* respectively. The prevalence for urinary schistosomiasis was 43.6%, while none (0%) was reported for intestinal schistosomiasis. Aluor LGEA Primary School recorded the highest prevalence of urinary schistosomiasis in the 10 primary schools that were sampled. The differences observed among the primary schools was not statistically significant ($P > 0.05$). Differences were observed with respect to gender as males were more infected (51.3%) than females (33.1%), but the difference was statistically significant ($P < 0.05$). Results from the study also revealed that urinary schistosomiasis and other risk factors associated with streams in the study area showed that living close to stream influenced the prevalence of urinary schistosomiasis. Children who lived close to streams were more infected than those who do not live close to streams ($P < 0.05$, OR = 5.33, 95% CI = 2.44-11.63). Pupils who had contact with water that was contaminated with urine and faeces were infected more than those who did not have contact with water that was contaminated with urine and faeces, ($P < 0.05$, OR = 4.81, 95% CI = 2.36-9.78). Results from the present study show that pupils who had contact with infested water were more likely to have urinary schistosomiasis than those who do not have contact with infested water ($P < 0.05$, OR = 6.81, 95% CI = 3.00-15.46). Although there was an association between pupils who touched or caught snails in case of searching for edible ones significantly more infected than those who did not touched or caught the edible snails ($P < 0.05$, OR = 4.89, 95% CI = 3.09-7.76).

Results from the present study show that urinary schistosomiasis is endemic among children in Logo Local Government Area of Benue State where there is poor knowledge on the source of the disease, its etiology as well as the poverty in the study area. This calls for adequate education on the predisposing factors that can influence the spread of schistosomiasis as well as adequate enlightenment on personal hygiene so as to curtail the spread of the disease.

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CHAPTER ONE

INTRODUCTION

1.0 Background

Schistosomiasis also known as bilharziasis, is to the pathological conditions resulting from infection by digenetic trematodes of the genus *Schistosoma*. Schistosomiasis causes chronic ill health and is the major health risk in the rural areas of central China and Egypt and continues to rank high in other developing countries (WHO, 2004). Schistosomiasis is common in tropical countries in Africa, the Caribbean, South America, and Southeast Asia and in the Middle East (Gryseels *et al.*, 2006). There are two forms of schistosomiasis namely urinary and intestinal schistosomiasis. The urinary schistosomiasis is characterized by the presence of blood in the urine, while intestinal schistosomiasis is characterized by blood in stool (WHO, 2004; Wiwamitkit, 2005). Human schistosomiasis are caused by five species of the schistosomes: *Schistosoma mansoni* is found in parts of South America and the Caribbean, Africa and the Middle East and causes intestinal schistosomiasis; *S. haematobium* is found in Africa and the Middle East and causes urinary schistosomiasis; *S. japonicum* in the Far East causes intestinal schistosomiasis; *S. intercalatum* causes urinary schistosomiasis while *S. mekongi* causes intestinal schistosomiasis and are found locally in Southeast Asia and Central West Africa (WHO, 2004; Wiwamitkit, 2005).

The intermediate snail host for *S. mansoni* is *Biomphalaria* species, *Bulinus* species for *S. haematobium* and *S. intercalatum*, *Onchomelania* species for *S. japonicum* and *Tricula* species for *S. mekongi* (Gryseels *et al.*, 2006).

Reservoir hosts for the parasites include humans, cats, dogs, cattle, horses, water buffalo, pigs and rodents (Gryseels *et al.*, 2006). However, humans serve as their usual reservoirs (Feldmeier and Poggensee, 1993). The transmission of schistosomiasis takes place only where the fresh water snail intermediate hosts are present and where there is contact between humans and infested water. Those at high risk of infection are people involved in fishing activities, farming, bathing, paddling of canoes, swimming and possibly handling of infected snail host in the case of collecting edible ones (WHO, 2004).

Schistosoma haematobium, the causative agent of urinary schistosomiasis, is associated with damaging the bladder and kidneys resulting to painful urination, abdominal pain as well as passage of blood in the urine. *Schistosoma mansoni* is responsible for and causes intestinal schistosomiasis, damages the intestines and liver, resulting in abdominal pain, fever and rectal bleeding. Schistosomiasis results in anaemia, stunted growth and development in children, chronic debility and sometimes, premature death.

Among human parasitic diseases, schistosomiasis ranks second to malaria in terms of socio-economic and public health importance in tropical and sub-tropical areas (WHO, 2004). Schistosomiasis is endemic in 74-76 developing countries, infecting more than 200 million people, half of whom live in Africa

(WHO, 2004). They live in rural agricultural and peri-urban areas, and placing more than 600 million at risk (WHO, 2004). This disease is also endemic in Nigeria (Luka *et al.*, 2001; Okpala *et al.*, 2004; Ibidapo *et al.*, 2005; Mbata *et al.*; 2008; Gyuse *et al.*, 2010; Kanwai *et al.*, 2011).

1.1 Statement of the Research Problem

In Logo Local Government Area of Benue State, there is lack of adequate knowledge on the risk factors associated with transmission of schistosomiasis. Apart from hospital records that are not comprehensive, there has been no comprehensive study to our knowledge on the prevalence and risk factors associated with schistosomiasis among school children in Logo Local Government Area of Benue State. Therefore the prevalence status as well as the relationship of the risk factors and the infection is desirable.

1.2 Justification

The outcome of this research will provide baseline data on the prevalence and the risk factors that facilitate the transmission of schistosomiasis in the study area towards understanding the dynamics of transmission and possible intervention.

1.3 Aim

This research is aimed at determining the prevalence and associated risk factors of schistosomiasis among primary school children in Logo Government Area of Benue State.

1.4 Objectives

- i. To determine the prevalence of urinary and intestinal schistosomiasis among school children in Logo Local Government Area of Benue State.
- ii. To determine the prevalence of schistosomiasis in relation to sex and age of pupils.
- iii. To determine the risk factors associated with the prevalence of the disease.

1.5 Hypotheses

- i. Schistosomiasis is not prevalent among school children in Logo Local Government Area of Benue State.
- ii. The prevalence of schistosomiasis is not related to sex and age groups of school pupils.
- iii. The prevalence of schistosomiasis is not influenced by risk factors.

CHAPTER TWO

LITERATURE REVIEW

2.1 History of schistosomiasis

Schistosomiasis has been recognized since the time of the Egyptian Pharaohs (WHO, 2004). In man, it is a chronic and debilitating disease caused by flukes known as schistosomes (Noble and Glem, 1982). Schistosomiasis is one of the most common parasitic infections in the world (Gracio *et al.*, 1992). It is an ancient disease of man; eggs have been recovered from Egyptian and Chinese mummies several thousand years old (Nunn and Tapp, 2000). However, scientific studies of the disease did not start until the middle of the 19th century with independent reports first by Fuji in 1847, who described the early, acute Katayama syndrome and then Bilharz in 1852, who found distome trematodes in the urogenital blood vessels during post mortem examinations of Egyptian corpses (Sturrock, 2001). Over 60 years later, just before the first world war, Japanese workers finally incriminated amphibious prosobranch snails of the genus *Onchomelina* as the intermediate host of the oriental schistosome, *Schistosoma japonicum* (Miyairi and Suzuki, 1914), while Leiper (1915) showed that aquatic, pulmonate snails of the genera *Bulinus* and *Biomphalaria* transmits *Schistosoma haematobium* and *Schistosoma mansoni*, respectively.

2.2 Aetiology of the Disease

Schistosomiasis is a disease caused by digenetic trematodes that belong to the family schistosomatoidae (Monday, 2012). The three principal agents are *Schistosoma mansoni* and *Schistosoma japonicum* which are responsible for intestinal schistosomiasis and *Schistosoma haematobium*, the aetiologic agent of urinary schistosomiasis (Monday, 2012). Other species that infect man are *Schistosoma intercalatum*, *Schistosoma mattheei* and *Schistosoma mekongi* and various mammalian and avian schistosomes that do not complete their life cycles in the human host but may cause cercarial dermatitis or “swimmers itch” (Webbe, 1981). Other schistosomes of veterinary importance includes *Schistosoma sprinadalis*, *Schistosoma bovis*, *Schistosoma mathei*, *Schistosoma hippopotami* and *Schistosoma rohghaini*, some of these have been reported in man (Noble and Glem, 1982).

2.3 Life Cycle of the Schistosomes

The basic life cycle is complex entailing an alternation of generations with the sexual generation of adult schistosomes in the definitive vertebrate host and an asexual multiplication stage in a molluscan host (Webbe, 1981). All *Schistosoma* infections follow direct contact with fresh water that harbors free-swimming larval forms of the parasite known as cercariae (Allen *et al.*, 2002). Cercariae utilize an elastase proteolytic enzyme produced in the head region to penetrate the skin of humans or, in the case of *S. japonicum*, humans and other mammalian hosts (such as buffaloes, pigs, sheep and dogs) that act as reservoirs for infection

(Mcmanus and Loukas, 2008). The cercariae shed their bifurcated tails, and the resulting schistosomula enter the capillaries and lymphatic vessels and route to the lungs (Waine and Mcmanus, 1997). After several days, the worms migrate to the portal venous system, where they mature and unite. Pairs of worms then migrate to the superior mesenteric veins (in the case of *S. japonicum*), the inferior mesenteric and superior hemorrhoidal veins (in the case of *S. mansoni*), or the vesicle plexus and veins draining the ureters (in the case of *S. haematobium*) (Allen *et al.*, 2002). Egg production commences four to six weeks after infection and continues for the life of the worm usually three to five years. Eggs pass from the lumen of blood vessels into adjacent tissues, and many then pass through the intestinal or bladder mucosa and are shed in the faeces (in the case of *S. Mansoni* and *S. japonicum*) or urine (in the case of *S. haematobium*) (Jordan *et al.*, 1993). The life cycle is completed when the eggs hatch, releasing miracidia that, in turn, infect specific freshwater snails (*S. mansoni* infects *Biomphalaria* species, *S. haematobium* infects *Bulinus* species, *S. intercalatum* infects *Bulinus* species, *S. mekongi* infects *Neotricula* species and *S. Japonicum* infects *Oncomelania* species) (Allen *et al.*, 2002). After two generations — primary and then daughter sporocysts — within the snail, cercariae are released.

Schistosomiasis transmission arises from agricultural practices and water resources manipulation, particularly if there is poor sanitation and substantial water contact (Gryseels *et al.*, 2006). Environmental changes linked to water resource development, population growth, migration and disease have facilitated the recent spread of schistosomiasis to areas where it was not endemic (Gryseels *et al.*, 2006). The transmission of schistosomiasis takes place only in the place where freshwater snails are present and where there is contact between the population and snail/cercarie infested water (Okpala *et al.*, 2004). This is so because in areas where level of sanitation is poor, urine and/or faeces containing schistosome eggs often contaminate water (Rollinson, 2009). The eggs found in these water bodies (which could serve as a source of drinking or bathing) hatch into larvae that infect the snail hosts as the infection is transmitted by snails found in cercariae infested freshwater streams (Monday, 2012). Schistosomiasis acquired by man through activities associated with freshwater such as washing, bathing, fishing, farming, paddling of canoes, recreation and possibly handling of infected snail host in the case of collecting edible ones (WHO, 1985). Other socio-epidemiological factors responsible for transmission of the disease includes; distance from transmission site, migration, emergence of new foci, socio-economic status, water supply patterns and level of faecal contamination of water source (Bareto, 1991).

Intermediate host species of schistosomes vary across countries. For example in studies conducted in rural communities in Bahia in Brazil, *Biomphalaria glabrata*, *B. straminae*, and *B. tenagophila* are the main intermediate snail hosts

of *Schistosoma mansoni* (Mafiana *et al.*, 2003). In Egypt, the principal agents of transmission are *Biomphalaria alexandrina* and *Bulinus truncatus* (which are present in irrigation and drainage canals) (Mafiana *et al.*, 2003). In Nigeria, *Schistosoma haematobium* which is more prevalent is transmitted by *Bulinus* species (Ugbomoiko, 2000) just like in Zanzibar where the transmission of *S. haematobium* is only associated with water bodies harbouring *Bulinus globosus* (Stothard *et al.*, 2002). In Senegal also, *Bulinus globosus*, *B. umblicatus*, *B. truncatus* and *B. senegalensis* may act as intermediate hosts for *S. haematobium* (Rollison *et al.*, 2001). The range and habitats of the intermediate snail hosts, *Bulinus* spp and *Biomphalaria* spp do not always overlap, with *Bulinus* being generally more successful in temporary habitats and more tolerant of higher temperatures (Rollinson, 2009). Where suitable conditions exist, the snails may be found together in the same or adjacent habitats and this may lead to mixed infections of *S. haematobium* (urinary) and (intestinal) in the human population, with consequences for disease pathology (Rollinson, 2009). Another recognized aspect is that *S. haematobium* is exquisitely adapted to enhance transmission from people to snails by the marked rhythm of egg excretion which tends to peak before mid-day (Rollinson, 2009). Interesting to note also is that *S. haematobium* infection by reducing bladder elasticity, may increase the need to urinate (Rudge *et al.*, 2008). If this is further accentuated when an infected person is in contact with cool water, then the pathology caused by the schistosome may play a role in enhancing transmission (Rudge *et al.*, 2008).

2.5 Epidemiology and Distribution

Schistosomiasis affects 240 million persons worldwide, mostly in sub-Saharan Africa while an estimated 779 million people (more than 10% of the world population) are at the risk of infection (Steinmann *et al.*, 2006).

The disease has a widespread distribution in Africa and the Middle East (*S. haematobium* and *S. mansoni*) and in the Western hemisphere (Brazil, Venezuela, Surinam, and certain Caribbean islands) for *S. mansoni* (Webbe, 1981).

In the Far East, China, the Philippines, and Indonesia are endemic areas of *S. japonicum*, and limited foci have also been recorded in the Mekong and now in Malaysia (*S. mekongi* and *S. japonicum* respectively) (Webbe, 1981). The distribution of the different species depends mainly on the ecology of the snail hosts (Gryseels *et al.*, 2006). That is to say that the intermediate host relationships differ for each species, and the distribution of the main snail genera *Bulinus*, *Biomphalaria* and *Oncomelania* reflect the distribution of the parasites and the diseases that they cause (Rollinson, 2009). So the term schistosomiasis includes diseases which are clinically and biologically quite distinct (Rollinson, 2009).

Schistosomiasis is predominantly an infection of rural and agricultural communities, with some periurban distribution in many countries (Webbe, 1981). Schistosomiasis is characterised by focal epidemiology and over dispersed population distribution, with higher infection rates in children than in adults (Gryseels *et al.*, 2006). Snail populations, cercarial density, and patterns of human water contact show strong temporal and spatial variations, resulting in a

focal distribution of the infection within countries, regions, and villages (Gryseels and Nkulikyinka, 1988).

Typically, rates and intensities of infection increase from an early age to a peak around age 8–15 years and decrease again in adults (Gryseels *et al.*, 2006).

Within populations and age-groups, schistosomes are over dispersed; a small number of individuals carry most of the parasites (Gryseels and De Vlas, 1996).

These features have been attributed both to water-contact patterns and to innate and acquired immunity (Gryseels *et al.*, 2006).

Sex-related patterns vary in relation to behavioural, professional, cultural, and religious factors (Jordan *et al.*, 1993). Though a rural focal disease typically associated with poor rice farmers and fishermen in the tropics, it is increasingly been reported among Europeans with a history of travel to endemic areas in Africa and Asia (Monday, 2012). In sub-Saharan Africa, there is compelling evidence for an association between the occurrence of human schistosomiasis and several socio-cultural factors (Ofozie *et al.*, 1998).

The distribution of schistosomiasis is greatly modified by the creation of irrigation systems, man-made lakes, and other types of water development projects required for food production and generation of hydroelectric power (Iarotski and Davis, 1981).

Schistosomiasis in Africa is caused predominantly by infection with *Schistosoma haematobium* or *S. mansoni*, which cause urinary and intestinal schistosomiasis, respectively (Kabatereine *et al.*, 2002).

Within sub-Saharan Africa, Nigeria is the country with the most cases of human schistosomiasis — about 29 million in 2008 (Hotez and Kamath, 2009). Schistosomiasis is widely distributed in Nigeria (Oladejo and Ofoezie, 2006). It is hyperendemic in many states of the north and southwest with moderate to low endemicity in the southeast (Ofoezie 2002; Oladejo and Ofoezie, 2006). *Schistosoma haematobium* occurs in nearly all endemic foci while *S. mansoni* is predominantly found in the north and some parts of the southwest (Oladejo and Ofoezie, 2006).

In Nigeria, urinary schistosomiasis is widespread in both rural and urban communities, with prevalence ranging between 2% and 90% and the vast majority of cases occurring among the poor and marginalized (Opara *et al.*, 2007). For example, the urinary schistosomiasis prevalence of 12.9% obtained among the selected school children within Minna metropolis, inspite of its urban status, suggests that Minna is an endemic area (Chidozie and Daniyan, 2008).

Schistosomiasis has also been reported among travelers (Visser *et al.*, 1995) as 3 outbreaks have been reported among white-water rafters on the Omo River in Ethiopia (Schwartz *et al.*, 2005). Approximately one fifth of persons with recreational exposure to water on the upper Nile River in Jinja District showed evidence of schistosome antibody seroconversion (Oliver *et al.*, 2010). Infection occurred among persons who reported swimming/wading only, kayaking/rafting only, and both activities, which refutes the belief that exposure to fast moving water presents a low risk for schistosomiasis (Oliver *et al.*, 2010). Exposure to schistosomes is likely to be highest in slow-moving water near riverbanks;

although the risk for infection attributable to fast-moving water exposure could possibly be because of increased duration of exposure (Cetron *et al.*, 1996). Ecologic factors favourable to the intermediate snail hosts and the concentration of susceptible human hosts living under sub-standard conditions have contributed to maintenance of the disease and expansion of the endemic area (Barreto, 1991).

Studies done on rural communities in Bahia in Brazil have shown that the number, distribution, and rate of infection of the intermediate host *Biomphalaria glabrata* and contact with domestic water were key determinants of human infection, prevalence and that snail populations responded to seasonal rainfall patterns, with an increase in reproduction during the period October through January and proportional decreases during months of drought (Marcal *et al.*, 1991). A study of contrasting communities with high and low prevalence rates of *S. mansoni* in Sao Paulo State revealed that high altitude, low population density, high standards of sanitation, and limited numbers of breeding sites for *B. tenagophila*, the principal intermediate host in the Sao Paulo area, contributed to low rates of infection (Kloetzel and Vergetti, 1988).

Studies have indicated that the length of the dry season is more important than the quantity of rainfall or duration of the wet season in influencing both snail host distribution and the relative sustainability of a site for life cycle development and transmission (Bavia *et al.*, 1999). This is because temperature and moisture are fundamental environmental factors that drive or limit the distribution and abundance of biologic systems (Andrewartha and Birch, 1954).

In general, snails inhabit shallow water with moderate light penetration, minimal turbidity, a mud substratum rich in organic matter, and submergent or emergent aquatic vegetation (Bavia *et al.*, 1999). *Biomphalaria pfeifferi* for example becomes the dominant intermediate host snail for inland transmission and prefers temporary water bodies (Prentice, 1972).

However, the epidemiology of schistosomiasis is not only dependent on availability of suitable water bodies but also on the suitability of both climatic and environmental conditions for the schistosomes (Rubaihayo *et al.*, 2008).

Knowledge of the factors contributing to the size and location of snail populations is pivotal to planning and implementing effective programs of suppression using molluscicides (Bavia *et al.*, 1999). Since the number of intermediate hosts, their concentration, and rate of infection may be functions of rainfall, vegetation, topography, soil type, and characteristics of water bodies, geographic information system (GIS) methods may be suitable for analysis of the spatial relationships of the environment, mollusk intermediate hosts, and schistosomiasis in specific regions and communities (Piere and Thomas, 1987).

The prevalence and intensity (parasite burden) of schistosomiasis in a population depends on the quantum of parasites, frequency and length of exposure to infected water, and host susceptibility (Bavia *et al.*, 1999). Current estimates suggest that in sub-Saharan Africa 112 million people are infected with *S. haematobium* and 54 million are infected with *S. mansoni* (Rollinson, 2009). Out of the three main human infecting species of schistosoma (*S. haematobium*, *S.*

mansoni, and *S. japonicum*. *S. haematobium* is a predominant species in Africa being endemic in about 53 countries in Africa and the Middle East (Ogbe, 1995). Urinary schistosomiasis, caused by *S. haematobium* is noted to be more prevalent in Nigeria than intestinal schistosomiasis due to the wider distribution of its snail host *Bulinus species* (Ugbomoiko, 2000). This is in addition to indiscriminate passing of urine containing *S. haematobium* eggs into water supplies containing the snail host (Southgate and Rollinson, 1987). Urinary schistosomiasis was reported by WHO in 1985 to be endemic in Nigeria. Although, there is no current estimate of the disease in the country; past estimates have put the infection at about 25 million people and 101 million at risk of infection respectively (Chitsulo *et al.*, 2000).

Records of prevalence and intensity of urinary schistosomiasis in areas of endemicity show an infection pattern which seems to peak in individuals in their first two decades of life and with varying rates (El-Harvey *et al.*, 2000). When compared with their adult counterpart, children with schistosomiasis notably harbor greater worm burden and are more intensely infected due to high transmission rates of the parasite and the frequency of exposure to infection sites (Ogbe, 1995). Individuals who are encountering the infection for the first time may exhibit severe infections irrespective of their age and sex. In countries with a long history of schistosomiasis, research studies have identified the risk factors for infection with *S. haematobium* as male gender and aged < 20 years, living in smaller rural communities exposure to canal waters are most infected as revealed

by reagent strip detected haematuria and proteinuria, and a history of burning micturition (Gabr *et al.*, 2000).

2.6 Pathology and Clinical manifestations

The percutaneous penetration of cercariae can provoke a temporary urticarial rash that sometimes persists for days as papulo pruriginous lesions, especially after primary infections in tourists and migrants (Bottieau *et al.*, 2006) A similar swimmers' itch is also frequently caused by cercariae of animal trematodes in temperate climate zones (Horak and Kolarova, 2005). Possibly, cercarial dermatitis often goes unrecognised in endemic areas (Appleton, 1984).

Acute schistosomiasis (Katayama fever) is a systemic hypersensitivity reaction against the migrating schistosomulae, occurring a few weeks to months after a primary infection (Bottieau *et al.*, 2006).

The disease starts suddenly with fever, fatigue, myalgia, malaise, non productive cough, eosinophilia, and patchy infiltrates on chest radiography (Gryseels *et al.*, 2006). Abdominal symptoms can develop later, caused by the migration and positioning of the mature worms (Gryseels *et al.*, 2006). Most patients recover spontaneously after 2–10 weeks, but some develop persistent and more serious disease with weight loss, dysuria, diarrhoea, diffuse abdominal pain, toxemia, hepatosplenomegaly and widespread rash (Gryseels *et al.*, 2006).

Katayama fever due to *S. mansoni* or *S. haematobium* is rarely seen in chronically exposed populations, possibly owing to under diagnosis or in-utero

sensitization. It is common, however, in tourists, travellers, and other people accidentally exposed to transmission (Bottieau *et al.*, 2006).

In China, rebound epidemics have been reported in endemic communities exposed to floods (Ross *et al.*, 2001). The manifestations can be severe with persistent fever, organomegaly, and cachexia, which can evolve rapidly to hepatosplenic fibrosis and portal hypertension (Gryseels *et al.*, 2006). The main lesions in established and chronic infection are due not to the adult worms but to eggs that are trapped in the tissues during the perivesical or peri-intestinal migration or after embolisation in the liver, spleen, lungs, or cerebrospinal system (Cheever *et al.*, 2000). The eggs secrete proteolytic enzymes that provoke typical eosinophilic inflammatory and granulomatous reactions, which are progressively replaced by fibrotic deposits (Cheever *et al.*, 2000).

Three disease syndromes are associated with schistosome infection: dermatitis, which results from cercarial penetration of the skin and is due to hypersensitivity reactions of both the immediate and delayed types; Katayama fever or acute schistosomiasis, which occurs in intense initial infection and usually coincides with the onset of egg laying by the worms, being considered to be a form of serum sickness or immune complex disease; and chronic schistosomiasis, in which lesions in different organs are dependent on the main egg-laying sites of the adult worms (Webbe, 1981).

The major parasite factor responsible for the occurrence of chronic disease is the egg. The host granulomatous response to the eggs, which, at least in *S. mansoni* and *S. haematobium*, is a form of delayed hypersensitivity, plays an essential part

in the pathogenesis of the various schistosome syndromes (Webbe, 1981). The development of large granulomas around the eggs causes the destruction of tissue, which heals with consequent scarring, and the development of important pathological changes related to the intensity of infection, but also the intensity of host response (Webbe, 1981).

Schistosoma mansoni and *S. japonicum* are found in the portal and mesenteric vessels and disease mainly affects the gut and liver while, *S. haematobium* is found in the vesical plexus and disease affects the urinary tracts, genital tract, and lower bowel (Webbe, 1981). The lungs may be affected when large numbers of eggs reach the organ through collateral circulation, and the central nervous system, when worm pairs are in situ (Webbe, 1981). The eggs that are retained in the body are of interest to clinicians because they are the principal cause of disease in schistosomiasis (Strickland, 1994). Many ova are swept into the hepatic sinusoids of the liver where they provoke periportal fibrosis and, subsequently, portal hypertension while other ova are retained in the intestinal wall where they may lead to intestinal bleeding and protein loss, intestinal polyposis and other complications (Strickland, 1994). There is a direct correlation, at least in children, between the amount of disease and the intensity of infection as measured by number of ova excreted in the stool and urine (Strickland, 1994). Most patients with schistosomiasis have the chronic form of the infection, which is caused by a granulomatous response around these retained ova (Feldmeier *et al.*, 1995).

The inciting factors are soluble antigens released from the eggs (Ekpo *et al.*, 2010). The granuloma, changing somewhat as it matures, is composed of lymphocytes, eosinophils, macrophages, and multinucleated giant cells (Strickland, 1994).

Urinary schistosomiasis caused by *S. haematobium* has wide distribution across Africa and infection is associated with haematuria (blood in urine) and damage and significant pathology to the urino-genital system, which may lead to bladder cancers and renal failure later in life (Rollinson, 2009). During infection, the parasites deposit terminal spined eggs which clog the venous plexus, impeding blood flow (Ekpo *et al.*, 2010). This bursts the veins, allowing blood and eggs to enter the urinary bladder, resulting in the characteristic symptom of blood in urine or haematuria (Ekpo *et al.*, 2010).

In sub-Saharan Africa alone it is estimated that 70 million individuals experience haematuria, 32 million with difficulty in urinating (dysuria), 18 million with bladder-wall pathology, and 10million with major hydronephrosis from infection caused by *Schistosoma haematobium* (Ekpo *et al.*, 2010). Mortality rate due to non-functioning kidney (from *S. haematobium*) and haematemesis has been put at 150,000 per year (Van der Werf *et al.*, 2003).

Infection with *S. mansoni* on the other hand results in schistosome eggs migrating through the intestinal wall provoke mucosal granulomatous inflammation, pseudopolyposis, microulcerations, and superficial bleeding (King *et al.*, 1998). Most lesions are situated in the large bowel and rectum (Gryseels *et al.*, 2006). The most common symptoms and signs are chronic or intermittent

abdominal pain and discomfort, loss of appetite, and diarrhoea with or without blood (Gryseels, 1989). These features are difficult to ascribe unequivocally to schistosomiasis in people with several infections, as is common in endemic areas (Booth *et al.*, 1996). Population surveys found that infection with *S. mansoni* was estimated to cause diarrhoea in 0.78 million, blood in stools in 4.4 million and hepatomegaly in 8.5 million people and mortality rate due to haematemesis as a result of infection with the parasite at 130000 per year (Van der Werf *et al.*, 2003). Although, as the associations are not always clear, the authors pointed out that these may be underestimates specifically for *S. Mansoni* (VanderWerf *et al.*, 2003).

Schistosoma haematobium, the parasite that causes pathology in the urinary tract, was found in vaginal tissues as early as 1899 in Egypt (Madden, 1899). Since then involvement of female organs, from the vulva to the ovaries, has been observed by pathologists from almost every country where schistosomiasis is endemic (Feldmeier *et al.*, 1995). It is now recognized that up to 75% of the women excreting *S. haematobium* ova in the urine may have schistosome ova in the uterine cervix, vagina, or vulva (Helling-Giese *et al.*, 1996). Studies in *S. haematobium*-endemic areas have also shown that up to 23% of women may have involvement of the lower reproductive tract even without schistosome ova in the urine, (Bland and Gelfand, 1970) and it has been estimated that 9–13 million women have female genital schistosomiasis, although recent reports indicate that this figure is too low (Feldmeier *et al.*, 1995).

Post mortem studies of the reproductive tract, confirmed by histopathologic analysis of material from surgery, have shown that *S. haematobium* may be distributed in all the pelvic organs (Kjetland *et al.*, 2005). Clinically apparent vulval, vaginal and cervical schistosomiasis is a common gynecological finding in areas where infection with *Schistosoma haematobium* prevails (Friedberg *et al.*, 1991). Whereas there is convincing evidence that infections with *S. haematobium* cause genital lesions in 50 to 80% of girls and women parasitized by this species (Kjetland *et al.*, 1996, Leutscher *et al.*, 1997), the relevance of genital manifestations as a consequence of the infection with intestinal schistosomes is not precisely known. Previous reviews of the existing literature indicate that *S. japonicum* and *S. intercalatum* frequently induce genital lesions and rarely cause significant pathology in the affected women (Feldmeier *et al.*, 1998). As to *S. mansoni* the picture is less clear: in Africa the geographic distribution of *S. haematobium* and *S. mansoni* widely overlaps, and the differentiation in histological specimen between *S. haematobium* and *S. mansoni* is not easily achieved (Leutscher *et al.*, 1997). Nonetheless, there are several reports indicating that genital lesions in *S. mansoni* infection are not uncommon (Chen & Mott, 1989).

Ova are most commonly found in the cervix (30–100%), followed by the vagina (12–100%), ovaries (5–57%), fallopian tubes (3–36%), vulva (7–17%), and uterus (0–11%) (Gelfand *et al.*, 1971). Histopathologic studies have shown that *S. haematobium* ova in genital tissue may be surrounded by eosinophils, lymphocytes, epitheloid cells, macrophages, foreign body giant cells, and

multinucleate histiocytes (Williams, 1967). Gynaecologic *S. haematobium* has been associated with a range of lesions morphologically similar to the different sexually transmitted infections (STIs) and reproductive tract diseases, such as ulcers, papillomatous tumors, leukoplakia, malignancies, and polyps (Poggensee *et al.*, 2000). Microbial invasion being the basis of urinary tract infection could be seen in various clinical manifestations resulting into various disease conditions in both males and females (Adeyeba, and Ojeaga, 2002). These disease conditions include pyelonephritis which was shown to be non-age discriminatory as it affects both older person and infants with age range of 2 weeks to 18 years (Rushton and Majd, 1995).

The children at great risk for kidney damage are infants and young children of school age with febrile urinary tract infection in whom effective but are more often than not asymptomatic and frequently recurrent (Kunin, 1979).

2.7 Diagnosis

The microscopic examination of excreta remains the gold standard for the diagnosis of *S. mansoni* (Feldmeier and Poggensee, 1993). The eggs are easy to detect and identify by microscopy owing to their size and shape, their typical lateral or terminal spine, and the living miracidium (in fresh samples) with mobile cilia and pulsing excretory cells (Gryseels *et al.*, 2006).

Direct wet slides are not very sensitive; if no eggs are found, concentration methods should be used but even these can miss light infections (Engels *et al.*, 1996). Urine should be concentrated by sedimentation, centrifugation, or

filtration, and samples should be taken around noon or after physical exercise. (Engels *et al.*, 1996). To obtain a quantitative assessment of the intensity of infection, a fixed amount (generally 10 ml) of urine is forced over a paper or nitrocellulose filter, which can be examined and eggs counted directly under the microscope and intensity expressed as eggs per 10 ml (Gryseels *et al.*, 2006).

For the intestinal schistosomes, eggs are sought in the faeces and concentration methods, such as sedimentation in a glycerine solution or centrifugation in formalised ether are needed for detection of mild and light infections (Feldmeier and Poggensee, 1993).

In the field, the faecal thick smear or Kato-Katz method is commonly used, because it allows quantification of the infections by egg counts, usually expressed as per gram faeces (Feldmeier and Poggensee, 1993).

Rectal snips are very sensitive, even for *S. haematobium* infection (Feldmeier, 1993). Quantitative egg counts after standardised urine filtration or in calibrated faecal thick smears are especially useful for epidemiological surveys and control, since they correlate well with worm burdens and morbidity (Jordan *et al.*, 1993).

Individual egg counts should not be over interpreted as a measure of disease, however, because they vary substantially within and between stool and urine samples (De Vlas *et al.*, 1992).

Antibody-based assays are quite sensitive but cannot distinguish history of exposure from active infection they cannot also cross-react with other helminths and are not easily applicable under field conditions (Tsang and Wilkins, 1997).

They can also be useful for incidence studies in children and in low-transmission or post-control settings (Noya *et al.*, 2002).

Most routine techniques detect IgG, IgM, or IgE against soluble worm antigen or crude egg antigen by EIA, indirect haemagglutination, or immunofluorescence (Noya *et al.*, 2002). Seroconversion generally happens within 4–8 weeks of infection, but the interval can be as long as 22 weeks (Jones *et al.*, 1992). Most assays have positive results for at least 2 years after cure and in many cases much longer (Rabello *et al.*, 1997).

Somatic schistosome antigens, such as circulating anodic antigen and circulating cathodic antigen, can be detected and quantified with labelled monoclonal antibodies in serum or urine of infected individuals (Deelder *et al.*, 1994).

Antigen detection in serum is not very sensitive in light infections and therefore less useful for clinical applications (Van Lieshout *et al.*, 1997). However, as a specific, direct, and stable measure of worm burdens, it is a valuable research tool for epidemiological and therapeutic studies (Polman, 2000).

In hospital settings, cystoscopy and endoscopy are used to visualise bladder lesions and oesophageal varices (Richter *et al.*, 1998). Laparoscopy and wedge biopsy can reveal the macroscopic and histological appearance of granulomatous inflammation or periportal fibrosis (Hayashi *et al.*, 2000). In hepatic schistosomiasis, contrast radiography can show portal-vein distension or gastro-oesophageal varices; CT, myelography, and MRI can be useful for detailed

imaging, especially for neuro schistosomiasis (Lambertucci *et al.*, 2000).

2.8. Immunology

There is longstanding epidemiological and clinical evidence that people living in endemic areas acquire some form of immune resistance after years of exposure (Butterworth, 1993). In terms of parasite population dynamics, host-related factors such as innate or acquired immunity are likely to have an important role in truncating the enormous reproduction potential of schistosomes (Gryseels, 1996).

The acquisition of effective immunity is difficult to prove, because the decrease in infection rates after adolescence can also be explained by reduced water contact (Gryseels *et al.*, 2006).

Comparative studies of reinfection after curative treatment have shown that children are far more susceptible than adults and that these differences cannot be explained by differing water-contact patterns (Gryseels *et al.*, 2006).

Observations in people and in animals suggest that acquired immunity is mediated by IgE against antigens of larvae and adult worms, which trigger eosinophils to release cytotoxins targeting schistosomulae (Butterworth, 1993).

The slow development of acquired immunity is thought to be due to blockage of the IgE receptors by excess antischistosome IgG4 and possibly other immunoglobulin isotypes in the first years of infection (Woolhouse and Hagan, 1999). Some researchers suggest a role of schistosome-specific IgA, such as anti-Sm28GST, in mediating protective immunity in people, or of the slow release of

somatic antigens of dying worms (Capron *et al.*, 2005). Most schistosomiasis-related pathology is induced by cellular immune responses and the granulomatous reactions around the eggs are orchestrated by CD4-positive T cells and involve eosinophils, monocytes, and lymphocytes (Cheever *et al.*, 2000).

In mice, a predominantly T-helper-1 reaction in the early stages of infection shifts to an egg-induced T-helper-2 biased profile, and imbalances between these responses lead to severe lesions (Pearce, 2005). Although these observations cannot readily be extrapolated, similar mechanisms could be at the basis of fibrotic pathology in human beings (Abath *et al.*, 2006). The possible interaction between schistosomiasis and HIV/AIDS is receiving increasing attention, given the role of immune responses in both diseases and the geographic overlap in distribution in Africa (Secor, 2005).

Low CD4-positive T-cell counts resulting from HIV infection might increase susceptibility to schistosome infection and influence egg excretion (Karanja *et al.*, 1997). HIV infection would not affect the efficacy of praziquantel, susceptibility to reinfection, the development of fibrosis, or the diagnosis and surveillance of schistosomiasis (Kallestrup *et al.*, 2005). Conversely, schistosomiasis does not interfere with HIV screening or viral-load testing and should not exacerbate the course of HIV infection, but it might contribute to immune reconstitution syndromes after antiretroviral treatment (Fernando and Miller, 2002). Schistosomiasis treatment can result in lower viral loads and

higher CD4-cellcounts (Kallestrup *et al.*, 2005). The clinical and epidemiological significance of all these observations is still unclear.

2.9 Prevention and Control

The aims and strategies of schistosomiasis control have shifted fundamentally over the past few decades, since the introduction of modern schistosomicides, particularly praziquantel (Gryseels *et al.*, 2006). As for other parasitic diseases, transmission control aiming at the intermediate host has been largely replaced by morbidity control through population-based chemotherapy (Fernando and Miller, 2002). This strategy allows quick gains, but careful long-term planning is needed to ensure sustainability and progression to the more demanding stages of infection and transmission control (Fernando and Miller, 2002). Snail control with molluscicides, toxic chemicals, is expensive and logistically complex (Gryseels *et al.*, 2006). Substantial human and material resources are needed for efficient application, as well as detailed epidemiological and malacological surveillance and this ensures that snail populations are greatly reduced but rarely eliminated, so regular and long-term retreatment is necessary (Gryseels *et al.*, 2006). The toxicity of molluscicides for other aquatic organisms, including fish, gives rise to ecological and economic concerns (Gryseels *et al.*, 2006).

Large-scale chemical snail control is still used in Egypt and China, but owing to the success of population-based chemotherapy, its cost-effectiveness is increasingly being questioned (Mafiana *et al.*, 2003).

Snail control can also be pursued by physical measures or biological competitors, but such methods are not easy to put into practice (Chigozie *et al.*, 2007). Schistosomiasis can in principle be eliminated by behavioural changes, sanitation, and safe water supply (Robert and Cirrillo 2002). Educational programmes can improve knowledge about the disease and healthcare seeking, but behaviour can be difficult to change without other options for water contact (Chigozie *et al.*, 2007).

The provision of safe water supplies and latrines is obviously useful, but for the prevention of schistosomiasis, safe contact sites are also needed (El Katsha, 2002). On the recommendation of WHO, population-based treatment with praziquantel is now the main component of most national control programmes (WHO, 2002).

The fundamental aim is to reduce morbidity by keeping down intensity of infection. Various strategies can be applied, including indiscriminate mass treatment, active case finding, and treatment of particular risk groups such as school-aged children (WHO, 2002). Wide-scale chemotherapy has greatly reduced the public-health impact of schistosomiasis in middle-income countries such as Egypt, China, Brazil, the Philippines, Puerto Rico, Tunisia, Morocco, and Saudi Arabia (WHO, 2002).

2.10 Treatment

Praziquantel, an acylated quinoline-pyrazine that is active against all schistosome species, is the most widely used (Gryseels *et al.*, 2006). It is mostly

marketed as 600 mg tablets, with a recommended standard regimen of 40 mg/kg bodyweight in a single dose (WHO, 2002).

The drug acts within 1 hour of ingestion by paralysing the worms and damaging the tegument (Gryseels *et al.*, 2006). Side-effects are mild and include nausea, vomiting, malaise, and abdominal pain (Stelma *et al.*, 1995).

In heavy infections, acute colic with bloody diarrhoea can occur shortly after treatment, probably provoked by massive worm shifts and antigen release (Stelma *et al.*, 1995). Praziquantel has very low toxicity in animals, and no important long-term safety difficulties have been documented in people so far (Dayan, 2003). It is judged safe for treatment of young children and pregnant women (WHO, 2002). Praziquantel has little or no effect on eggs and immature worms (Gryseels *et al.*, 2006). After a single dose of 40 mg/kg, 70–100% of patients cease to excrete eggs (Gryseels *et al.*, 2006). In most of those not cured, egg counts and antigen concentrations are reduced by more than 95% (Uttinger *et al.*, 2000).

Clinical, radiographic, and sonographic studies have shown the regression over weeks to months of intestinal and vesical lesions, reactive hepatomegaly, and even severe lesions of the upper urinary tract or mild liver fibrosis (Richter, 2003). This regimen is therefore recommended for most population-based treatment campaigns (Richter, 2003).

In populations with high initial egg counts exposed to rapid reinfection, cure rates can be much lower and as such in these cases, the dose can be increased to 60 mg/kg, if possible split in two and taken several hours apart to avoid side-

effects (Richter, 2003). 60 mg/kg or more in split doses is also advisable for individual case management or in people who have left the endemic area, to ensure complete cure (Davis, 1993). A repeat dose 6–12 weeks later can be useful to cure prepatent infections, particularly if eosinophilia, high antibody titres, or symptoms persist (Davis, 2003).

Katayama fever is primarily treated with corticosteroids to suppress the hypersensitivity reaction and with praziquantel to eliminate the already matured worms (Bottieau *et al.*, 2006). Since immature worms are not susceptible to praziquantel, treatment should be repeated 4–6 weeks after the first symptoms (Bottieau *et al.*, 2006). In oesophageal bleeding, β blockers, endoscopic sclerotherapy, splenectomy, or a portocaval shunt might be indicated (Olds and Dasarathy, 2000).

Oxamniquine acts only on *S mansoni* and is nowadays mainly used in Brazil (Fenwick *et al.*, 2003). It is as effective as praziquantel but can provoke more pronounced side-effects, most notably drowsiness, sleep induction, and epileptic seizures (Fenwick *et al.*, 2003). Artemisinin derivatives are effective against the immature stages of *S japonicum*, *S mansoni*, and possibly *S haematobium* (Xiao *et al.*, 2002). Their use in cure or prophylaxis for acute schistosomiasis, possibly in combination with praziquantel, is being investigated (Utzinger *et al.*, 2003).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

The study was carried out in Logo Local Government Area (LGA) of Benue State which is located between Latitude $7^{\circ} 30' \text{N}$ – $7^{\circ} 48' \text{N}$ and Longitude $9^{\circ} 06' \text{E}$ – $9^{\circ} 24' \text{E}$. The L.G.A lies in the north-eastern part of Benue State and shares boundaries with Ukum L.G.A. in the East; Guma L.G.A. in the Northeast; Buruku L.G.A. in the West and Katsina-Ala L.G.A. in the South (Figure 3.1). According to National Population Commission (2006), the Local Government has a population of about 169,063 people out of which 80% are peasant farmers. Logo Local Government Area has 10 council wards.

The two distinct seasons in the area are the wet and dry seasons. The wet season begins from April to October and is characterized by heavy rains associated with flooding of banks of rivers, lakes, streams, ponds and ditches. The dry season begins from November to March, and is characterized by dry winds in December and January and high temperature in February and March.

The Local Government has one General Hospital, one Comprehensive Health Centre in each of the ten council wards, 43 Health Centres and eight Private Hospitals.

The area is transversed by streams and ponds which constitute the major source of water supply to the communities in the study area. Water contact activities like bathing swimming and washing are generally the norm. Agriculture, especially swamp rice cultivation, yams, soya beans, groundnut and fishing are the main stay of the economy of the inhabitants.

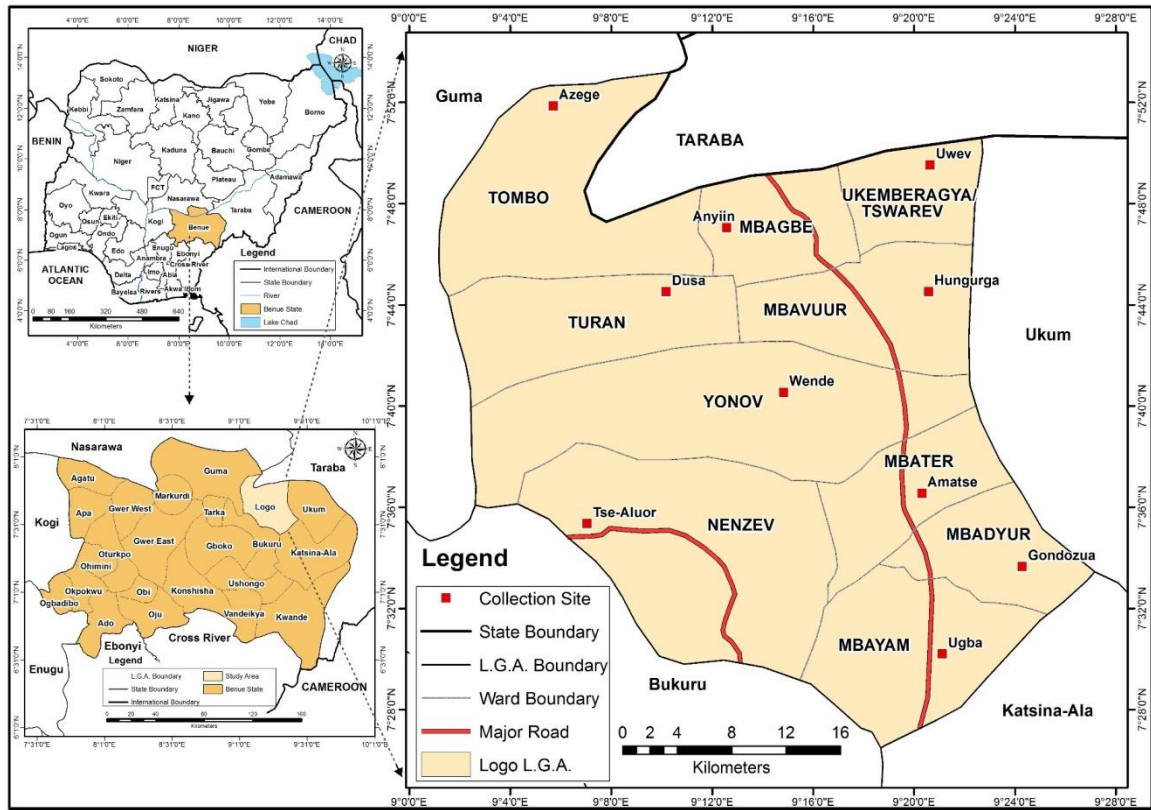


Figure 3.1: Map of Logo Local Government Showing Council Wards and Collection Sites

Source: Adapted and Modified from the Administrative Map of Benue State, 2014.

3.2 Ethical Considerations

Permission was sought and obtained from Logo Local Government Education Authority (Ref: LLGEA/EST/ED/FR/141/45/VI) (Appendix II) and Local

Government Health Department (Ref: LLG/HS/GEN/1/75) (Appendix III). The prospective schools that were used for the collection of samples and as well as the parents and children enlisted into the programme were well informed about the study and their consent was duly obtained. Only the children that were willing to participate were recruited.

3.3 Determination of Sample Size

Due to lack of data on the prevalence and risk factors of schistosomiasis among school children in Logo Local Government Area of Benue State, the 46.6% prevalence reported by Mbata *et al.* (2008) for urinary schistosomiasis in Ogbadibo Local Government Area of Benue State was used to determine the sample size using the formula of Sarmukaddam and Garad (2006).

$$N = Z^2 Pq / L^2$$

Where

N= Sample size

Z= Standard normal distribution at 95% confidence interval 1.96

P= Prevalence of 46.6% (0.466) (Mbata *et al.*, 2008).

$$q = 1 - P = 1 - 0.466 = 0.534$$

L= Allowable error which is given as 5% =0.05 substituting the values.

$$N = (1.96^2 \times 0.466 \times 0.534) / 0.05^2 = (3.842 \times 0.249) / 0.0025 = 383$$

However, 397 samples were collected.

3.4 Study Population

A stratified sample of 400 pupils comprising 228 males and 169 females within the age group of 5-19 years was selected from one primary school in each of the

ten council wards. The ten schools that were sampled are; Ugba LGEA Central Primary School, Tse-Aluor LGEA Primary School, Wende LGEA Primary School, Amatse RCM Primary School, Gondoza NKST Primary School, Azege NKST Primary School, Anyiin NKST Primary School, Uwev LGEA Primary School, Hungurga LGEA Primary School and Dusa LGEA Primary School. A systematic random sampling technique was employed in selecting the above mentioned schools.

3.5 Collection of Samples

Four hundred (400) pupils enrolled for this study, however, three girls were menstruating during the time of urine collection, therefore, they were excluded without any replacements. Stool and urine samples were collected from each of the 397 pupils enlisted in for the study.

Each pupil was given two sterile, dry screw capped, 10ml wide mouthed specimen bottles with the same identification number and was instructed on when and how to collect the samples. The samples obtained were preserved in 10% formalin while urine samples were preserved with 2mls of 0.1w/v boric acid (Nworie *et al.*, 2012).

3.5.1 Urine collection

Urine was collected between 10.00 am and 12.00 noon with an instruction to deposit mid-stream and terminal urine to coincide with maximum excretion period (Gryseels *et al.*, 2006).

3.5.2 Stool collection

Stool samples were collected between 7:00am and 10:00am for maximum number of eggs in stool (WHO, 2000).

Collected samples were transported in a cool box containing ice blocks to the Ugba Comprehensive Health Centre for microscopic examination.

3.6 Administration of Questionnaire

An interviewer-administered structured questionnaire was prepared using the modified method of Mafe *et al.* (2000). Information obtained included: sex, age, occupation of parents, source of water supply, water contact activities, closeness to streams, presence of blood in urine and contact with snails in order to determine the relationship of the above factors with urinary and intestinal schistosomiasis among primary school pupils in Logo Local Government Area of Benue State.

3.7 Laboratory Analysis of Samples

3.7.1 Urine sample analysis

Urine samples were examined by the use of centrifugation technique as described by Feldmeier and Poggensee (1993).

- 10ml of each urine sample was centrifuged at 1500rpm for five minutes.
- The supernatant was decanted.

- The sediment was examined for eggs of *S. haematobium*.
- Each slide was examined using x10 and x40 objectives for morphological confirmation. (Soulby (1982; Cheesbrough 2006).

3.7.2 Stool sample analysis

Formol-Ether concentration technique described by Neva and Brown (2004) was used to concentrate eggs of the parasites.

- Approximately 1g of faeces was added into 10ml of 10% formalin in a test tube and the mixture was stirred using an applicator stick until a cloudy suspension was obtained.
- The suspension was filtered into a centrifuge tube through gauze fitted to a funnel to remove particulate material.
- 3ml of diethyl ether was added to the suspension. The mouth of the centrifuge tube was stoppered and shaken vigorously for 30 seconds.
- The mixture was centrifuged at 2000 ×g for 2 minutes.
- An applicator stick was used to loosen the debris by passing the applicator stick between the inner walls of the tube and the debris.
- The supernatant was decanted and the tube placed in a rack to allow the fluid remaining on the sides of the tube to drain to the bottom of the tube.
- A Pasteur pipette was used to remove a few drops of the sediment which was then added to the Lugol's iodine on the slide for examination by microscopy.
- Morphological confirmation was done according to Cheesbrough (2006).

3.8 Data Analysis

Statistical analysis was performed using the Epi Info version 6.04. Chi-square (χ^2) test was used to determine whether there was a significant association between the prevalence of schistosomiasis with sex, age and other risk factors. Values were considered significant when P-value was <0.05 . Odds ratio and 95% confidence interval were used to determine the strength of association between the risk factors and the prevalence of schistosomiasis among school children in Logo Local Government Area of Benue State.

CHAPTER FOUR

RESULTS

In this study, of the 397 children examined for urinary and intestinal schistosomiasis from ten (10) primary schools in Logo Local Government Area of Benue State, 173 (43.6%) had urinary schistosomiasis while none (0.0%) of the subjects examined had intestinal schistosomiasis.

Schistosoma haematobium eggs were recognized as golden yellowish ova and elliptical in shape with a terminal spine (Plate 4.1).

Table 4.1 shows that the highest prevalence of urinary schistosomiasis was obtained in Tse Aluor LGEA Primary School 24(55.0%). Followed by Amatse RCM Primary School 20(50.0%), Azege NKST Primary School and LGEA primary school, Uwev(47.5%), Hungurga LGEA Primary School and Wende LGEA Primary School(45.0%), Gondoza NKST Primary School 17(44.7%), Dusa LGEA Primary School 17(42.5%), Ugba Central Primary School(37.5%), Anyiin NKST Primary School 8(20.5%). Analysis of results shows that there was no significant difference among the primary schools that were studied ($P>0.05$).

Table 4.2 shows the prevalence of urinary schistosomiasis in relation to gender. Of the 228 male pupils examined, 117(51.3%) had urinary schistosomiasis against 56(33.1%) of the 169 females examined. The result obtained showed that there was a significant association between infection and sex of pupils ($P<0.05$).



PLATE I: Egg of *Schistosoma haematobium* viewed under $\times 40$ objective

Table 4.1: Prevalence of urinary schistosomiasis infection in 10 primary schools in Logo LGA of Benue state, Nigeria

School	Number examined	Number Infected	% infected
LGEA Central Pri. Sch.Ugba	40	15	37.5
LGEA Pri. Sch. Tse-Aluor	40	22	55.0
NKST Pri. Sch. Wende	40	18	45.0
RCM Pri. Sch. Amatse	40	20	50.0
NKST Pri. Sch. Gondoza	38	17	44.7
NKST Pri. Sch. Azege	40	19	47.5
NKST Pri. Sch. Anyiin	39	8	20.5
LGEA Pri. Sch. Uwev	40	19	47.5
LGEA Pri. Sch. Hungurga	40	18	45.0

LEEA Pri. Sch. Dusa	40	17	42.5
Total	397	173	43.6

$\chi^2 = 12.44$ df=9P>0.05 (statistically insignificant)

Table 4.2: Prevalence of urinary schistosomiasis in relation to gender

Gender	Number Examined	Number Positive	Prevalence (%)
Male	228	117	51.3
Female	169	56	33.1
Total	397	173	43.6

$\chi^2 = 13.05$ df=1 P<0.05 (statistically significant)

Figure 4.1 shows that pupils in the age group of 12-15 years had the highest prevalence of 64.2% followed by pupils in the age group 8-11 years that had the prevalence of 27.4%, while pupils of age 4-7 years had the least prevalence of 16.2%. Analysis of result showed that the age of the pupils influenced the prevalence of infection ($r = 0.080$).

Table 4.3 shows that pupils whose parents were fishermen were the most infected with 76.5% prevalence followed by children whose parents were farmers had 46.2%. Children whose parents were traders and civil servants did not have urinary schistosomiasis. The results of the study showed that there was a significant association between prevalence of infection and socio-economic status of the parents ($P < 0.05$).

Table 4.4 shows that one out of the two pupils (50.0%) whose regular source of water was pipe-borne had the highest prevalence of urinary schistosomiasis. This was followed by pupils who drink from the streams (48%), and pupils who drink water from ponds had prevalence of 46%. One of the three pupils whose source of water supply was well, have a prevalence of 33.3%. Users of bore-hole had the least prevalence of 7.5%. The difference obtained with respect to source of water supply was insignificant ($P > 0.05$).

Table 4.5 shows that 14(70.0%) of the 20 pupils who had contact with water through fishing activities were the most infected. one of 2 (50%) pupils who used

water for domestic purpose ranked second while 5 (45.5%) of the 11 pupils who had contact with water through farming had the least prevalence of infection. Of the 153 (49.2%) of 311 pupils who bath and swim in water ranked third in prevalence. The difference in prevalence in relation to water contact were not significant ($P>0.05$).

Table 4.6 shows that urinary schistosomiasis and other risk factors associated with streams in the study area showed that living close to stream influenced the prevalence of urinary schistosomiasis. Children who lived close to streams were more infected than those who did not live close to streams ($P<0.05$, OR = 5.33, 95% CI = 2.44-11.63).

Pupils who had contact with water that was contaminated with urine and faeces were infected more than those who did not have contact with water that was contaminated with urine and faeces, ($P<0.05$, OR = 4.81, 95% CI = 2.36-9.78).

Results from the present study showed that pupils who had contact with infested water were more likely to have urinary schistosomiasis than those who do not have contact with infested water ($P<0.05$, OR = 6.81, 95% CI = 3.00-15.46).

Although there was an association between pupils who touched or caught snails in case of searching for edible ones significantly more infected than those who did not touched or caught the snails ($P<0.05$, OR = 4.89, 95% CI = 3.09-7.76).

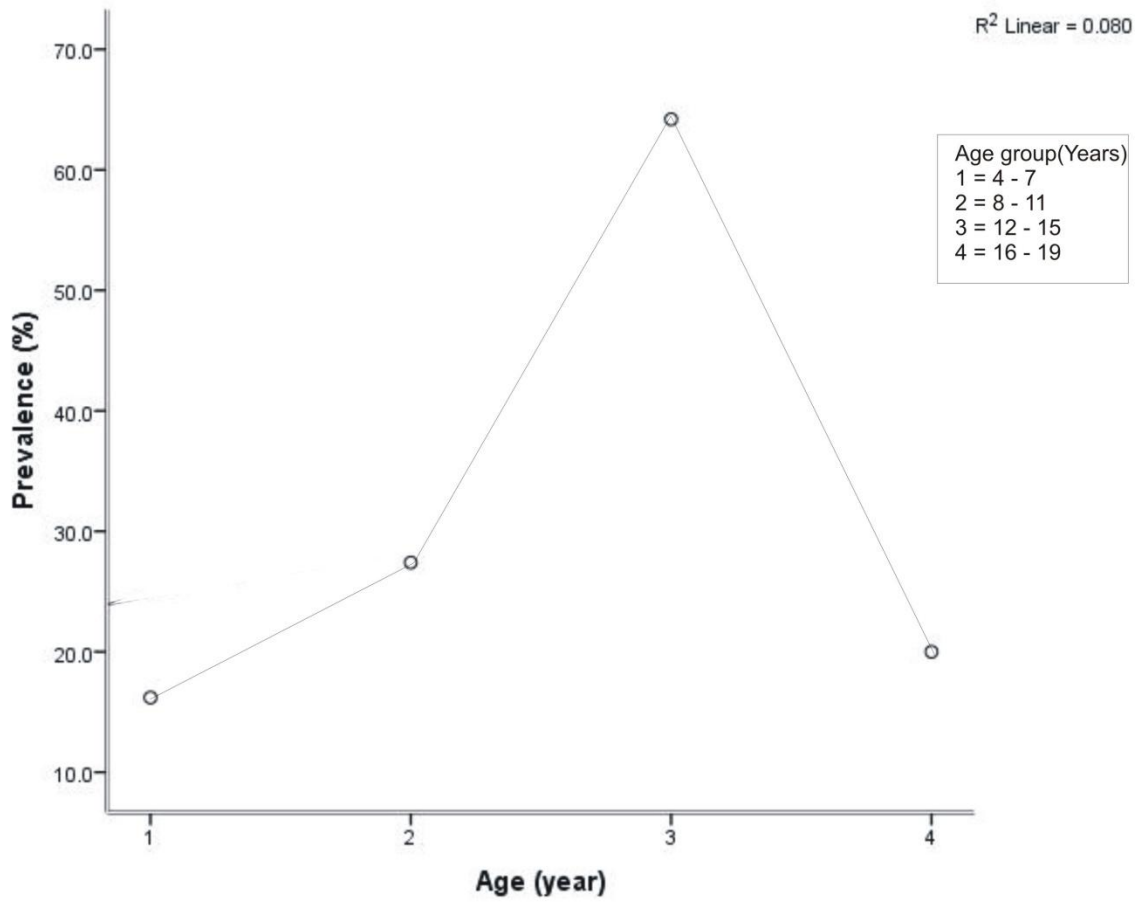


Figure 4.1: Age-related prevalence of urinary schistosomiasis among school children in Logo Local Government Area of Benue State.

Table 4.3: Prevalence of urinary schistosomiasis infection in relation to socio-economic status of parents of pupils

Occupation of parent	Number Examined	Number Positive	Prevalence (%)
Farming	346	160	46.2
Fishing	17	13	76.5
Trading	17	0	0.0
Civil servant	17	0	0.0
Total	397	173	43.6

$\chi^2 = 34.74$ df= 3 P<0.05 (statistically significant)

Table 4.4: Prevalence of urinary Schistosomiasis in relation to source of water supply

Water supply source	Number Examined	Number Positive	Prevalence (%)
Stream	302	145	48.0
Bore-hole	40	3	7.5
Pond	50	23	46.0
Well water	3	1	33.3
Pipe-borne	2	1	50.0
Total	397	173	43.6

$\chi^2=23.87$ df=4P>0.05 (statistically insignificant)

Table 4.5:Prevalence of urinary schistosomiasis in relation to water contact activities

Water contact activity	Number Examined	Number Positive	Prevalence (%)
Fishing	20	14	70.0
Bathing	311	153	49.2
Farming	11	5	45.5
Domestic purpose	2	1	50.0
Total	397	173	43.6

$\chi^2=2.50$ df= 3P>0.05 (statistically insignificant)

Table 4.6: Prevalence of urinary schistosomiasis infection in relation to some risk factors

Risk Factor	Number Examined	Number Positive	Prevalence (%)	P-value	Odds Ratio	95% C. I.
Close to stream						
Yes	343	165	48.1	0.00	5.33	2.44-11.63
No	54	8	14.8			
Urine and/or faeces contaminate stream						
Yes	336	163	48.1	0.00	4.81	2.36-9.78
No	61	10	16.4			
Contact with water						
Yes	340	166	48.8	0.00	6.81	3.00-15.46
No	57	7	12.3			
Touch or catch edible snail						
Yes	244	140	57.4	0.00	4.89	3.09-7.76
No	153	33	21.6			

CHAPTER FIVE

DISCUSSION

From the results obtained, none (0%) of the 397 pupils examined had intestinal schistosomiasis. The zero prevalence obtained on intestinal schistosomiasis is surprising but may be due to the absence of *Biomphalaria* species (around the streams, ponds and other water bodies) which is the intermediate snail host for *S. mansoni*. A total of 173(43.6%) of 397 pupils examined for urinary schistosomiasis was positive implying that the disease is endemic in the study area. The result supports a number of previous reports which have consistently shown that urinary schistosomiasis is endemic in Nigeria and is on the increase particularly in the rural areas with school children at greater risk. The prevalence recorded in this study is higher than the 0.67% reported by Okpala *et al.* (2004) in pupils in Apata and Laranto areas of Jos, Plateau State, 12.3% by Luka *et al.* (2001), 12.9% by Chidozie and Danyian (2008) among pupils in some selected schools in Minna, Niger State. Biu *et al.* (2009) reported a prevalence of 24.3% in school pupils of Konduga Local Government Area, Borno State. Similarly, Musa *et al.* (2010) reported an overall prevalence of 14.5% among primary school pupils in Maidugari, Borno State and the 9.8% prevalence reported by Nworie *et al.* (2012) in pupils in Ebonyi State. However, the prevalence obtained in this study is lower than the 73.1% by Nmorsi *et al.* (2005) in a rural community of Edo State, the 71.8% reported by Mafiana *et al.* (2003)

in settlements around Oyan reservoir in Ogun State, and the 46.6% reported by Mbata *et al.* (2008) in Benue State.

The major factors that may be responsible for the endemicity of urinary schistosomiasis in these study areas are low literacy level, lack of basic amenities, indiscriminate passing of urine and faeces in water bodies and high water contact activities with the specific intermediate host infesting the ponds and streams, which were also noticeable in this study (which may be snail infested).

In the present study, the difference in infection between the males and females were not significant indicating that both sexes were equally at risk of contracting infection. This agrees with the previous findings of Okoli and Odaibo (1994), Chidozie and Daniyan (2008) and Nworie *et al.* (2012). Luka *et al.* (2001) however reported that males were more at risk than females. This may be on account of their involvement in outdoor activities such as fishing, farming, and swimming activities which predispose them to contact with cercariae in water.

There was a steady age-related rise in the prevalence of urinary schistosomiasis and a decrease in prevalence of the disease with an increase in age. This rise was from the ages 5-7 years and 8-11 years and peaked within 12-15 years before a steady decrease in prevalence with increase in age within 16-19 years. The observed increase in prevalence may be attributed to the lack of protective immunity in the pupils as well as their frequent contact with sources of infection

through play but as they grow older, there is an increase in their protective immunity and their frequent contact with sources of infection may be reduced. (Nnoruka, 2000; Okpala *et al.*, 2004; Kanwai *et al.*, 2011).

Higher prevalence of urinary schistosomiasis was observed among children whose parents were farmers and fishermen. This higher prevalence might be due to higher frequency of contact with infective agents. These categories of children therefore have greater exposure to infection as result of occupational duties.

There was no statistically significant association between prevalence of urinary schistosomiasis with source of water supply, however, the highest prevalence in pupils whose source of water supply were ponds and streams may be due contamination of these water bodies by humans due to swimming, bathing as well as washing of sewage into them.

The observed prevalence among pupils whose regular source of water supply may be due to the fact that most of the wells in the study area have low edges and are left uncovered thereby making it possible for sewage and run off to be washed into them. Similarly, it is surprising that those pupils whose regular source of water supply was bore-hole were also infected. This might be attributed to the fact that this category of pupils did not only depended on bore-hole for drinking, cooking and washing of clothes, they also engaged in other activities like fishing, farming and swimming which may expose them to

infection. This contradicts the findings of Nworie *et al.* (2012) who reported a zero (0%) prevalence among primary school children in Afikpo North Local Government Area of Ebonyi State in Nigeria. One out of the two children who drink from other water sources such as rain water or sachet water was also infected. This could be as a result of their dependence on other water sources for washing and cooking, engagement in activities like farming and fishing which can expose them to infection as well as drinking water from other sources such as streams, ponds and wells when necessary.

The results of this study show that there is a significant association between urinary schistosomiasis and other risk factors such as closeness to stream, contamination of streams with urine and faeces, contact with water as well as touching or catching of the snails for the purpose of eating. This might be attributed to the prevailing factors which include bathing in water bodies containing infected snail intermediate hosts, catching of these snails for eating as well as the indiscriminate defaecation and urination in open bushes and around the streams and ponds which serve as the transmission foci.

CHAPTER SIX

6.0 Conclusion

Results from the present study show that schistosomiasis occurs in school children in Logo Local Government Area of Benue State. Although there was no significant association between the disease and the risk factors, the overall prevalence of 43.6% obtained here clearly demonstrates that the disease is endemic in the area. This may be due to poor knowledge of the source of the disease and its etiology, as well as the prevailing poverty in the study area. The results also showed that the prevalence of urinary schistosomiasis was associated with age, gender and occupation of the pupils' parents.

The results of this study also show that closeness to stream, contamination of stream with urine or faeces, and touching or catching of snails were significant risk factors in modulating infection pattern. Generally, urinary schistosomiasis was widespread with little or no hindrance in contracting it.

6.1 Recommendations

Adequate knowledge on the predisposing factors that can influence the spread of schistosomiasis as well as enlightenment on personal hygiene should be embarked upon so as to help curtail the spread of the disease.

Water and sanitation schemes should be introduced to the communities to remedy the disease situation.

The health centres in the communities should be equipped with adequate staff, drugs and facilities for effective treatment and management of the disease.

Further studies should be carried out in the same study area to determine the ecology of the snail intermediate host, their population dynamics and infection with *Schistosoma cercariae*.

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APPENDIX I

QUESTIONNAIRE

**DEPARTMENT OF BIOLOGICAL SCIENCES, FACULTY OF
SCIENCES, AHMADU BELLO UNIVERSITY, ZARIA.**

Dear Respondent,

I wish to solicit for your support by answering appropriately the questions on the questionnaire. The bearer is a postgraduate student of the above named institution and is working on the topic titled “PREVALENCE AND RISK FACTORS OF SCHISTOSOMIASIS AMONG SCHOOL CHILDREN IN LOGO LOCAL GOVERNMENT AREA OF BENUE STATE”. The information you give will be treated with strict confidentiality.

Thank you for your co-operation.

Code _____

Sex: Female [] Male []

Age range 5-7 [] 8-11 [] 12-15 [] 16-19 []

Occupation of parents: Farming [] Fishing [] Trading [] Civil

Servant [] others _____

Do you live close to a stream? Yes [] No []

Do you see faeces around the stream? Yes [] No []

Do you have contact with stream the water? Yes [] No []

If yes, how often do you visit the stream? Daily [] Weekly [] Monthly []

Others_____

What do you do there? Fishing [] Farming [] Others_____

What is your source of drinking water? Bore hole [] Deep well []

Ponds []Streams [] others.....

What is your source of domestic water? Shallow well [] Ponds[] Streams []

Others.....

Have you seen snails in the stream? Yes [] No []

Do you touch or catch the snails Yes [] No []

Have you had haematuria? Yes [] No []

If yes, have you tried treating it? Yes [] No []

Where did you go for treatment? Hospital [] Traditional [] Others []

Was it effective? Yes [] No []

If no, did you try any other treatment? Yes [] No []

Do you have abdominal pain? Yes [] No []

APPENDIX II

Prevalence of urinary schistosomiasis infection in relation to Age

Age Group(Years)	Number Examined	Number Positive	Prevalence (%)
4-7	37	6	16.2
8-11	168	46	27.4
12-15	187	120	64.2
16-19	5	1	20.0
Total	397	173	43.6

$\chi^2=25.03$ df=3 P>0.05 (statistically insignificant)

