THE EPIDEMIOLOGY OF SCHISTOSOMIASIS IN LERE LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA.

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DECLARATION

I hereby declare that this thesis is a record of my research work. It has never been presented by me or anybody in any previous application for a higher degree.

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10-3-93

DATE

CERTIFICATION

The thesis entitled "THE EPIDEMIOLOGY OF SCHISTOSOMIASIS IN LERE LOCAL GOVERNMENT AREA, KADUNA STATE" meets the regulations governing the award of the degree of MASTER OF VETERINARY PUBLIC HEALTH AND PREVENTIVE MEDICINE of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

To my beloved Husband

and

Daughters (Rahila and Queen Esther)

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I wish to express my profound gratitude to Dr. I. Ajogi, Prof. J.U. Umoh and Late Dr. V.C. Ogbogu for supervising suggestions, criticism and assistance offered throughout this work.

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ABSTRACT

An epidemiological survey of schistosomiasis was carried out among school children between the ages of 7-20 years in twelve primary schools selected randomly within Lere Local Government area of Kaduna State, Nigeria, between November 1994 and April 1996.

Questionnaires were issued to obtain information from each pupil. The modified quick-Kato technique was used in the laboratory analysis of the stool samples. Of the 1159 pupils comprising 635 males and 524 females whose stool samples were examined, the overall prevalence of Schistosoma mansoni was 11.3%. The intensity of the disease was light (1-26 eggs per gramme of faeces). The disease was encountered in both males (13.5%) and females (8.8%). The disease in females decrease with age while in males it increased with age. There were statistically significant ($P<0.05$) differences between the prevalence of males and females and the different age groups

The sedimentation method was used in the laboratory analysis of the urine samples. The overall prevalence of Schistosoma haematobium was 12.3%. The disease occured in males (15.9%) and in females (6.9%). The overall prevalence was higher in males than in females. The highest prevalence in males and females was in the age group of 13 years and above. There were statistically significant ($P<0.O5$) differences between the prevalence of the disease in males and females and

among the different age groups. The prevalence rate of the disease varied greatly among the different schools. There was no statistical significant difference between the prevalence of schistosoma mansoni and Schistosoma haematobium in the study area.

The overall intensity of S. haematobium was 17 geometric mean egg count per 10 mls of urine. There was an association between the S. haematobium infection and haematurda (0R=7.6). There was an association between schistosomiasis (due to S.mansoni and S. haematobium) the sources of water and man-water contact activities, (fishing and swimming), history of bloody stool also showed a strong association with S. mansoni infection.

Other intestinal parasites encountered in the faecal samples were hookworm, (34.3%); Entamoeba coli, (6.6%); Taenia, (1.7%); Enterobins vermicularis, (1.5%); Ascaris, (0.9%); Entamoeba histolytica, (0.3%); Trichuris trichura, 0.04%).

Four species of snails namely Lymnaea natalensis Bulinus globosus, Bulinus forskali and Biomphalaria pfeifferi were encountered in the water bodies during the survey of the snail fauna. In Maigamo and Kudaru streams, Lymnaea natalensis, Buiinus globosus and Bismphalaria pfeifferi were detected. In Yarkasuwa, Bulinus globosus, Bulinus forskali and Biomphalaria pfeifferi species and in Saminaka, Lere and Mariri, Bulinus globosus, Bulinus forskali.

Biomphalaria pfeifferi and Lymnaea natalensis species were encountered. Bulinus globosus and Lymnaea natalensis were the predominant species encountered. The adult worms of S. mansoni and S. haematobium were recovered from the mice that were infected with cercaria of the Bulinus globosus, Bulinus forskali and Biomphalaria pfeifferi.

Based on this study, it is recommended that control measure should be instituted in primary schools in the area, and the transmission cycle of the disease should be broken by the application of molluscicides in all the water bodies in the area.

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CHAPTER ONE

1.0 INTRODUCTION

1.1. The problem

Schistosomiasis is a snail-borne infection of man and animals caused by flukes of the family schistosomatidae. These flukes are parasitic in the blood vessels of the hosts where they occupy either the alimentary canal or the bladder. The disease occur mostly in the tropical and subtropical regions of the world and it is often associated with water development projects such as dams and irrigation schemes where the snail intermediate host breeds and people often swim, wash and drink such water (Choudhry, 1975).

The Global prevalence of the disease is estimated at 200-300 million, estimated number of people considered at risk is 500-600 million, estimated mortality rate of the disease is less than 200,000 per year and about 76 countries are affected. (Robert et al 1976)

There are over 15 species, of schistosomes that are recognized, 5 of which are important parasites of man. Schistosoma haematobium, Schistosoma mansoni, and Schistosoma japonicum are the most widely distributed species of schistosomes which infect man. Some species which are parasitic in other mammalian and avian hosts have been found to infect man often causing cutaneous pruritus. Schistosoma intercalatum and Schistosoma mattheei are associated with human infections and pathology. Schistosoma bovis, Schistosoma

margrebowier, Schistosoma rodhaini, Schistosoma spindale and Schistosoma incognitum have been found in man without showing any evidence of significant pathology (Edington and Gilles, 1969).

The adult worms inhabit the veins of the portal system, the mesenteric and pelvic veins. The main pathologic lesions occur in the urinogenital and digestive organs. The adult female worms lay eggs which are passed out from the human body with urine or faeces, hence finding the eggs of the parasite in the urine or faeces affords a simple way for diagnosis.

The life cycle of schistosomes is essentially similar. The larval stage of Schistosomes develop in the snail host, and the different series of schistosome show a high level of specificity. (Wurapa et al 1989). The geographical distribution of schistosomiasis in man in any locality depends on the distribution of the appropriate snail hosts and the opportunities for infection of both the snail and man; schistosoma haematobium and Schistosoma mansoni which are widely distributed in Africa and transmitted by snails of the genus Bulinus and Biomphalaria while Schistosoma japonicum which is found in South-east Asia and part of the Western pacific regions is transmitted by Oncomelania species (Robert et al 1976).

Unlike other tropical diseases, the prevalence of which are reducing, that of schistosomiasis is on the rise as a result of the emphasis on agricultural development which has

led to the introduction of new irrigation schemes in form of dams, canals and drains which provide a conducive habitat and breeding sites for the snails intermediate hosts (Hira 1972; Noamesi & Morcos 1974; Pugh et al 1979; and Bassey 1988). The disease is commonly associated with the rural communities. However, due to population movement it is becoming a growing problem in the urban communities.

Children have been found to be most frequently affected; hence epidemiological studies carried out among school children often provide or give an estimate on the prevalence of the disease in a given area because children are proned to wonder around and expose themselves to infection in natural waters (Pugh et al. 1979).

The disease is widespread with a relatively low mortality rate but high morbidity rate. The severity of the disease is well marked in hyperendemic areas, where the affected persons pose a socio-economic problem to both the government and the immediate community; farming strength of the population is considerably reduced, crop output falls below sustenance level thus hunger, malnutrition and disease set in (Cowper 1963). The prevalence of the disease vary considerably from place to place in relation to transmission pattern and the extent of exposure of the human population (Thomas 1966; Pugh et al 1979; Istifanus et al 1988).

The disease has been found to be endemic in Nigeria. Urinary schistosomiasis, caused by Schistosoma haematobium and intestinal schistosomiasis caused by schistosoma mansoni are widely distributed, but S. mansoni infection rate is generally lower than that of S. haematobium in the country (Cowper 1963; Pugh et al 1979; Aniagbo & Nwaorgu 1988; and Bello et al 1992).

1.2 Justification

If Nigerians present effort to boost the nations agricultural economy must succeed, special attention must be given to the water development projects, where the snail intermediate hosts of the parasite breeds. In Lere Local government area of Kaduna State, earth dams are being dug to conserve water for watering crops in the farms and other domestic uses. Information on the disease is scarce and little or no attention is paid to schistosomiasis. This present study aims at investigating the epidemiology of the diseases in the three districts of Lere Local Government Area of Kaduna State.

1.3 Objectives

The objectives of this study are to:

1. Determine the prevalence and intensity of the disease among school children in Lere Local Government Area of Kaduna State, Nigeria.

2. Determine the pattern of infection in the area over a five-year period using available hospital records.
3. Identify the potential snail intermediate hosts in the area.
4. Create awareness of the disease on the entire population in the area
5. Suggest possible preventive measures against the disease in the area.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 History of the disease

Schistosomiasis was named Bilharziasis after the German Pathologist, Theodor Bihar: who first discovered the parasite in Cairo, Egypt in 1815. He first discovered the causative agent of urinary Schistosomiasis; Schistosoma haematobium. The Egyptians first gave the disease the name "aaa" and prescribed remedies for it (Almotaz 1982). Later Schistosome mansoni was identified by Leiper in Cairo as a causative agent of intestinal schistosomiasis. Similarly, the disease was discovered in Japan by Yoshinao Fajii in 1847 (Almotaz 1982). The adult parasite was discovered in 1904, while the snail invertebrate host was discovered in 1913. Sir Patrick Manson in 1905, discovered that intestinal and Vesicular (urinary bladder) schistosomiasis are distinct diseases, caused by distinct species of worms and he gave the first account of laterally spined egg in America. (Gerald et al 1981).

Gonzalez Martinez first discovered the diseases to be endemic in the new world in 1907, Ruffer demonstrated the presence of S.haematobium ova in the kidney of an Egyptian mummy belonging to the twentieth dynasty (1220-1000 BC), Sambon Proposed the name of Schistosoma mansoni for the species producing eggs with a subterminal spine (Gerald et al 1981). The role of the snail intermediate host was defined in

1913 by Miyairi. The ministry of Health in Egypt was the first to include a section for snail control in organization. Consequently the first attempt to eradicate snails was successfully implemented in Dakhala Oasis by the section in 1925 (Almotaz, 1982).

The first trial of mass treatment with antimonials was also implemented in Egypt. These historical facts are responsible for the strong association of Schistosomiasis with Egypt, although the disease is wide spread in many countries (Almotaz, 1982).

2.2 The schistosome

The human Schistosome and most of the other species in mammals belong to the genus Schistosoma in the family Schistosomatidae. There are about 15 different species of schistosome that infect man and other animals. Three out of the species are of vast medical significance to man: Schistosoma haematobium, Schistosoma mansoni and Schistosoma japonicum. The first species causes urinary schistosomiasis in man while the last two cause intestinal schistosomiasis (Edington and Gilles, 1969; Chandler and Read, 1961). Each of the species require a snail intermediate host. Schistosoma intercalatum and Schistosoma mekongi have localised distribution. Other species such as schistosoma matteei, Schistosoma bovis, Schistosoma curassoni, Schistosoma spindale and Schistosoma incognitum which naturally infect animals can

occasionally infect man without evidence of pathology (chandler & Read 1961).

The species of schistosome have different degrees or extent of infection in the host. They exhibit numerous morphological and physiological dissimilarities which include size, shape of the egg, tuberculation, intermediate host, specified and preferred intravascular habitat in the human host (Laughlin 1986)

2.2.1 Life cycle of schistosomes

During the typical life cycle of schistosome, the worm utilizes two hosts, one being the definitive host mammals and the other, the molluscan intermediate host (Adams et al 1966).

The adult worms live in the portal vessels and in the mesenteric veins.Schistosoma haematobium migrates when mated to the vesical plexus of the males carrying the females in their gynaecophoric canals. S. mansoni invades the veins draining the walls of the large intestine. While S. japonicum invades the branches of the superior mesenteric veins draining the mesentery and small intestine and eggs are laid in these sites. The eggs pass through the tissues and enter the bladder (S. haematobium), the large intestine (S. mansoni) and the small and large intestines (S. japonicum) and so are passed to the exterior in the urine and faeces. The eggs, if deposited in fresh water, give rise to miracidia which must penetrate a suitable snail host within 1 or 2 days. In the snail, vigorous

multiplication and cyclical development takes place to form cercariae four or more weeks after invasion. The fully developed cercariae emerges from the snail and enter the water. Man becomes infected while wading, bathing or drinking water infected by the cancariae which rapidly penetrate his intact skin or mucous membrane. If the cercariae did not penetrate any host, it will die within 48 - 72 hours. Its infectivity decreases about 5 hours after emergence.

The cercaria casts its forked tail in process of penetrating thereby becoming a schistosomule (young schistosome) and migrates by an indirect route possibly through the lungs and the diaphragm to the portal veins, where it becomes mature after about 3 weeks. Mating takes place in the portal vessels and the paired worms migrates to the sites where eggs are laid 4 - 6 weeks after initial cercariae skin penetration (Edington and Gilles, 1969; Laughlin, 1986).

2.2.2 Intermediate hosts of schistosomes

Snails of the family Planorbidae serve as intermediate hosts of S. mansoni and S. haematobium. S. mansoni is transmitted by snails of the genus Biomphalaria and S. haematobium by snails of the genus Bulinus (Chandiwana 1983; Soulsby, 1982).

Salinity, temperature, velocity of the water and the presence of aquatic vegetation supports the snail colonies of the various genera. Snail population in any water reservoir

starts to build up at the onset of new rains around May, they become abundant between July and September (Prasertphon, 1988).

In the afrotropical regions, S. haematobium is transmitted by snails of the group Bulinus africanus. In the mediterrranean areas and South West Africa by the Bulinus truncatus tropicus complex, and in Arabia and Mauritius by members of the Bulinus forskali group (Chandiwana, 1983). In West Africa, three of the snail groups are known to act as intermediate host for S. haematobium. Biomphalaria pfeifferi has been found to serve as intermediate hosts for S. mansoni in West Africa (Cowper, 1963; Amin et al, 1972; Bassey, 1988).

In Nigeria, snails of the genus Bulinus and Biomphalaria have been commonly found to be involved in the transmission of S. haematobium and S. mansoni. Okwuosa (1982) carried out a survey in Oyo, Ogun & Lagos states of Nigeria, and discovered 13- species of snails mainly; Bulinus (physopsis) globosus, Bulinus (Bulinus) rohifsi, B.(B) truncatus, Biomphalaria pfeifferi, B(B) forskali, Lymnaea natalensis, Ferrissia, eburnesis, physa waterloti, Gyranlus costulatus, Malanoides tuberculota, Potadoma moechii, Pita ovata and Lanistes tilaycus.

In a survey carried out in Tiga dam, Kano state, snails of the genus Lymnaea. Bulinus and Biomphalaria were discovered (Prasertphon, 1988). Similarly, in Kujama dam, Kaduna state, Lymnaea, Bulinus and Biomphalaria species were also discovered

but lymnaea was more prevalent (Prasertphon, 1988). In Soba and Igabi Local government areas of Kaduna state, Lymnaea natalensis, Bulinus globosus and Biomphalaria pfeifferi snails were discovered (Ityondo, 1991; Mbawah, 1992).

2.3 Epidemiology

Human waste in water containing intermediate hosts of the schistosoma worm is the single most important factor in schistosomiasis. The availability of suitable species of snail host will determine the endemicity of the particular species of schistosome.

Man's association with water, the relative efficiency of the mollusca intermediate host, animal hosts, and intensity of infection also serve as factors that are involved in epidemiology of the diseases. These factors are extremely variable. There is no constant pattern of transmission and the epidemiology varies from locality to locality. The economic and educational level of the population influence the transmission of the disease (Cowper 1963; Bozdech 1973). Males usually show the highest rates of infection and the most intense infection and hazardous age is the second decade of life. This reflects occupational and recreational differences. During the course of infection, protective immunity to super infection may be elicited either by repeated exposure to the cercariae or by the presence of the adults (Edington and Gilles, 1969).

Schistosoma mansoni is mostly encountered in Africa, Caribbean Islands, Latin America and the Eastern Mediterranean. S. haematobium is mostly encountered in Africa and the Eastern Mediterranean. S. japonicum occur in the South East Asia, Japan, China and Philippines, S. Intercalatum is found in Zaire, Rwanda, Burundi and the Cameroon Wright, 1972; (Wurapa et al, 1989).

A summary report on the distribution of schistosomiasis in Africa shows that urinary schistosomiasis is endemic in 38 countries of the African region of the world; Intestinal schistosomiasis is found in 38 countries and that caused by S. intercalatum is endemic in six countries - Cameroon, Central African republic, Congo, Gabon, Chad and Zaire (Wurapa, 1989; Engels et al, 1993). There has been reports on S. intercalatum in Nigeria, Mali, Saotome, Principe and Equatorial Guinea (Wurapa 1989) Algeria, Mauritania and Mauritius are affected by only S. haematobium and Burundi and Rwanda only by S. mansoni (Engels et al, 1993).

Schistosomiasis is hyperendemic in Egypt with a high mortality and morbidity recorded in the country. Recent epidemiological studies on schistosomiasis have been carried out in different parts of the world (Almotaz, 1982).

In the Gambia, the prevalence of Schistosomiasis infection have reached about 100% with the counts of over 1000 eggs in 10ml of noon urine (Thomas, 1966). In Lebanon, only S. haematobium was found to have a very high prevalence (Azar et

al, 1972); In Zambia, S.haematobium has also been found to have a wider distribution than S.mansoni (Hira, 1972), In Gabon, epidemiological studies showed a high prevalence of S. Intercalatum and a low prevalence of S.haematobium in Sudan, Primary school children examined were found to be passing out S. haematobium and S. mansoni ova in their urine and stool respectively (Amin et al, 1972).

2.3.1 Prevalence of Schistosomiasis in Nigeria

Schistosomiasis is endemic in Nigeria. Studies on the prevalence of schistosomiasis in Nigeria was initiated by Ramsey (1932, 1934 and 1935). In the defunct Northern Region where the infection is focal and acquired in seasonal pools. S. mansoni is almost as wide spread as S. haematobium but owing to the great difficulty of diagnosis, it is much less frequently recorded (Cowper, 1963).

Research work on schistosomiasis in Nigeria has shown that the disease has existed over a long period of time. Cowper (1963) discovered that S. haematobium is endemic throughout the Northern region and some areas are marked by heavy infection rates. In Katsina, Kano, Zaria, Kaduna, Birnin Kebbi and Argungu, infection rates of up to 95% have been recorded and 90% infection rates were recorded in Sokoto and Kankiya. Fairly high infection rates have been recorded in Plateau, Yola, Biu, Wulgo region of Lake Chad basin, Pategi and Bida. About 18% infection rate has also been recorded in

Maiduguri and Potiskum areas (Cowper 1963).

Studies on S. mansoni have shown that it is generally widspread and more localized in the North and western parts of the country.Pugh et al, 1979; Ogbe and Ogunsekan, 1988; Ozumba et al, 1989). Infection rate as high as 78% was recorded in Bacita-share Pategi area, (Cowper, 1963). Varying infection rates of 39% in Yola; 25% in Sokoto; 25% in the Plateau, and 14% in Katsina were also recorded (Adewunmi et al, 1991).

Retrospective studies of Hospital records in the North Eastern Nigeria between 1976 and 1984 showed that urinary schistosomiasis was the second most communicable disease in the region while intestinal schistosomiasis is the sixth.

Recent studies were carried out on urinary schistosomiasis in Amagunze Anambra state, and a prevalence of 18% was recorded. The disease was found to be higher in males than in females (Aniagbo and Nwaorgu 1988). In Ilorin, Kwara state, the prevalence of S. haematobium and S. mansoni was found to be 23% and 8% respectively (Awogun 1988). In Gumau district of Bauchi state, (17.9%) and (10.0%) of the individuals examined for schistosoma eggs had S. haematobium and S. mansoni infections respectively (Akogun 1990). In Abeokuta, Ogun state, prevalence studies on schistosomiasis carried out among school children showed 60.9%) S. haematobium infection (Ogbe and Ogunsekan, 1990). In irrigated areas in of Kano state, a high prevalence of S. mansoni (61%) but lower prevalence of S. haematobium was reported (Bassey, 1988).

2.3.2 Ecological factors in relation to transmission of Schistosomiasis.

The distribution of Schistosomiasis depends on the ecological factors, most important of which is the presence of the snail intermediate hosts in the water and the man-water contact activities (Chandler and Read, 1961). The Intermediate hosts are schistosoma species specific and have a specific geographical distribution. Rainfall patterns have been found to influence the snail population (Robert et al 1976). Changes induced by Dam construction and other irrigation schemes, human recreational habits, bathing, playing, urinating and defecation have been identified as factors that have contributed in the maintenance of the cycle of the disease (James, 1983).

Man-water contact studies in many parts of the country have shown that young males are the prime environmental contaminators. Pugh (1979), James (1983) and Istifanus et al, (1988) discovered that males aged 15-20 years were responsible for more than 77% of the transmission of urinary schistosomiasis in Malumfashi, Katsina state, Nigeria.

Studies carried out in Nigeria among people living near irrigation schemes have shown that the disease is prevalent in such areas. The completion of Kainji dam in 1970 caused a lake side prevalence of S. haematobium of up to 62% with the prevalence and intensity of the disease much higher around the Lake. Similarly, the construction of the South Chad irrigation

project in Borno state also resulted in the prevalence of urinary schistosomiasis as high as 66% around the lake side (Noamesi and Morcos, 1974).

2.3.3 Schistosomiasis as a zoonosis

For many decades, schistosomiasis was regarded as a human disease. The first record of non-human infection with a human schistosome was that of S. mansoni in Vervet from St. Kitts. Natural infections of S. mansoni have been reported in baboons from East Africa. S. haematobium infection has also been reported from baboons and vervets skye monkeys. S. japonicum infection has also been reported in monkeys.

Hill and Onabamiro (1960) reported a case of infection of a male and female domestic pig with S. haematobium in Ibadan. However, the possibility of wild or domestic reservoir of schistosome occurring in Nigeria has not yet been concluded (Cowper, 1963).

Human Zoonotic Schistosomiasis is divided into three: Schistosome dermatitis which occur when schistosome cercariae mostly parasites of birds and mammals penetrate the skin of human and causes dermatitis. Non-patent Visceral schistosomiasis which sets in when the schistosome invades the deeper tissues and produces a non-patent visceral infection in the lungs and liver, and the patent zoonotic schistosomiasis occurs when mammalian schistosome such as S bovis, S. matteei cause pathology in human (Edington & Gilles, 1969).

2.4 Pathology of Schistosomiasis

The reaction of the tissues to schistosome eggs lodged in it are the causes of the pathology of the disease. The disease caused by various Schistosome are similar in many respects but differ in details (Chandler & Read 1961, Souslby 1982). In areas endemic with schistosomiasis, people living under the same environmental conditions with comparable infection pattern have been found to show differences in the intensity of infection.

Several factors contribute to the intensity of the disease in man. These are: strain of the parasite, human race and blood type. (Edington & Gilles, 1969). Depending on the type of Schistosomiasis, the clinical manifestations of the disease involve liver, intestinal and urinary complications resulting from reactions to Schistosome eggs lodge in the tissues of infected persons (Soulsby, 1982).

2.4.1 Pathology of Schistosomiasis caused by Schistosoma mansoni

Intestinal Schistosomiasis is as a result of the infestation of the inferior mesenteric veins with Schistosoma mansoni. Pathology due to intestinal schistosome is divided into two phases: (a) acute and (b) chronic phases. (Edington & Gilles, 1969).

a) **The Acute phase.**

It encompases the period of toxic manifestations occurring during larval migration and early oviposition (Soulsby, 1982). This stage probably occurs more commonly than is recorded and is not easily recognized in persons living in endemic areas. Evans et al (1991) carried out a survey among a three-man Scuber diving team who were infected with the disease, two patients who had not lived in an endemic area came up with more severe infection while the third person who had lived in an endemic area for 10 years came up with mild infection due to acquired immunity initiated during the previous contacts with infected water.

The acute phase of the illness follows an exposure to heavily contaminated streams or bodies of water. This phase was observed in males from 12-16 years of age who got exposed to contaminated streams in Puerto Rico (Sotomayor et al 1965). The acute phase develops with patency of the female worms and the passage of large number of eggs through the intestinal mucosa (Chandiwana et al 1991). The syndrome starts 7-9 weeks after infection while the duration depends on the intensity of the infection. Itching and urticaria occur at the onset of the acute stage of the disease. This is followed by fever, abdominal pains, diarrhoea, general malaise, weakness, myalgia, headache, diaphoresis, anorexia, cough and weight loss (Lichtenberg, 1987). Intestinal lesions on the mucosa, particularly the posterior or small intestine is encountered,

eggs and classic granulomas are found in the submucosa, the eggs gradually disintegrates, causing infiltration with epithelioid cells, fibroblasts and fibrous tissues formation. (Edington & Gilles, 1969).

b) <u>The Chronic phase</u>.

The chronic - well tolerated intestinal form of Schistosomiasis is associated with the establishment and maintenance of a variety of immunoregulatory mechanisms (Goez et al 1991 and Gerald et al 1981). The distribution of the ova within the tissues supplied by the mesenteric colonic and portal circulation as well as response of the tissues to the local insult of the ova and its products is probably responsible for the clinical manifestations of the chronic phase called the hepatosplenic schistosomiasis (Edington & Gilles, 1969).

The main pathology of Schistosomiasis in the liver is Fibrosis, with the liver becoming enlarged, or slightly shrunken. The inner surface of the liver shows the characteristic clay pipestem fibrosis which causes the obstruction of the various portal blood supply and the rest of the body, deprived of a functioning liver becomes emaciated (Goez at al, 1991).

The obstruction of the portal venous circulation in the liver leads to a congestive splenomegaly which is the enlargement of the spleen. A few patients with marked

splenomegaly have retarded growth and retarded sexual maturation (Edington & Gilles, 1969; Gerald et al, 1981).

Pathology is more severely encountered in the large intestine than in the small intestine. The main lesions in the intestine include calonic polyposis, fibrosis and inflammation. The eggs of schistosome may get into the brain or spinal cord and creates granulamatous spaces occupying tumours. Schistosoma mansoni more frequently involves the spinal cord more than the brain (Edington & Gilles, 1969) Granulomatous pulmonary endarteritis sets in when the eggs lodge in the pulmonary arterioles of the lungs. A situation known as diffuse endothelial thickening, arteriolar hypertrophy and corpulmonate may develop as a result of pulmonary hypertension.

Appendicitis may be encountered if the eggs of S. mansoni gets lodged up in the appendix, but this situation is rare (Lichtenberg 1989). The effect of S. mansoni Schistosomiasis depends on the numerical strength of the worms and the sites of deposition and lodgement of the eggs.

Human race is one of the factors that contribute to the intensity of the infection in man. Clinical forms of S. mansoni with regards to racial groups was studied in Catolandia Bahia and it was discovered that the white race has a high risk (10.5%) than the black race (Tavares et al, 1990).

2.4.2 Pathology of Schistosomiasis caused by Schistosoma haematobium.

Urinary schistosomiasis is encountered in the urinary tracts. Damage to the urinary tract is revealed by blood in the urine and there is progressive damage to the bladder, ureters and kidneys (Woodruff, 1978).

The stage of established infection and oviposition is characterised by headache, muscular pains, anorexia, dysuria and terminal hematuria (Laughlin, 1986). The presence and severity of these symptoms depend on the number of ova in the urine. The urinary bladder is the earliest most severely and most constantly affected organ. Many lesions such as acute polypoid, fibrotic plagues, sandy patches, granulomas, ulcers, hyperaemia and calcification of the bladder wall are found in the bladder. Ectopic lesions observed in urinary schistosomiasis are liver granulomas, cutaneous deposition of eggs in the genital regions, papular lesions in the neck, chest and abdominal regions are responsible for the bladder filling defects (Lichtenberg, 1987).

Lesions directly due to the parasite are not commonly seen in the kidney, but occasionally ova are found in the renal submucosa tissues and renal pelvis. Lesions may be found in the prostrate and seminal vesicles in males. The epididymis and testes are rarely involved. The cervix is the most frequently involved organ in the female. Bladder carcinoma is associated with chronic urinary schistosomiasis. Other

complications associated with urinary schistosomiasis are pulmonary arteritis and appendicitis (Edington & Gilles, 1969; Robert et al, 1976).

Diagnosis of Schistosomiasis

Diagnosis of schistosomiasis is usually established by demonstrating the eggs in faecal or urine specimen microscopically.

Several techniques have been developed for the diagnosis of faecal matter. Faecal matter can be diagnosed with the cellophane or glass sandwich thick smear technique i.e the quick-kato technique as demonstrated by Katz et al (1972) which gives the value for the number of eggs per gram of faeces. The formal ether concentration technique is another very reliable method for the diagnosis of faecal matter (Chandler & Read, 1961). In case of light infection or when stool samples are difficult to obtain, rectal biopsy materials can be used for the diagnosis of intestinal schistosomiasis (Manson, 1966).

Urinary schistosomiasis can be diagnosed by finding the eggs in sedimented or centrifuged urine or miscropore urine filterates and microscopic examination (Chandler & Read, 1961; Manson, 1966).

Several immunological methods which can be used in the diagnosis of schistosomiasis include: (a) The intradermal test which is useful in diagnosing early infection but it is not

quantitative, (b) Complement fixation test which is a very reliable test especially in children and is quantitative and immunoflourescent test which is valuable for epidemiological surveys (Uga et al 1989).

Recent studies have shown that the enzyme linked immunosorbent assay (ELISA) is a very useful immunodiagnostic test for schistosomiasis. Immunodiagnosis is only useful in clinical situations but is of less value in epidemiological studies because the test has limited information about the intensity of the disease and the test also requires the services of highly trained technicians (Uga et al, 1989; Eltiro et al, 1992) .

2.6 Control of Schistosomiasis

The objective of schistosomiasis control is to achieve reduction of the disease. The control of the disease depends on a profound understanding of the epidemiology of the disease complex. The biology, ecology and distribution of the snail intermediate host, possible reservoir host and of the role of man in the transmission and maintenance of the disease. Thoug.. there have been important local successes in the control of schistosomiasis for example in China, Brazil and Tanzania. (Almotaz 1982) Globally, the infection has increased during the last decade. This, has been due partly to large scale irrigation projects which create new habitats for the snails and partly to migration which resulted both in population

increase in endemic areas and in the introduction of the parasite into uninfected area (Adewunmi, 1991)

Chemotherapy and the reduction of transmission are the two main tools in the control of schistosomiasis. Transmission can be reduced by provision of good water and sanitation, modification of the habitat, and public health enlightenment and snail control (Edington & Gilles, 1969; Gundersen et al, 1990).

Provision of good water helps to reduce the human water contact activities and contamination of water by infected individuals. The construction of latrines and its use when encouraged, reduces the incidence of faecal borne diseases and helps to improve the health and general standard of hygiene of the entire population in the society (Akogun, 1990). The provision of good water helps to break the life cycle of the parasite, hence reducing the rate of transmission of the disease and other water borne diseases in the society (Choudhry, 1975; Manson, 1966).

2.6.1 Modification of the habitat and public health Enlightenment

Construction of good drainage system, land reclamation and provision of good water helps as an effective means of breaking the transmission pattern of the parasite. In irrigated schemes, canal lining; a free drainage system, reduced reservoir and proper water scheduling help in

effective control of the disease (Fenwick et al, 1982; Akogun, 1990).

Educating the entire community on the public health importance of the disease, its transmission pattern its causes being poor hygiene through indiscriminate urination and defecation, the source of the disease being contaminated water, all help to promote effective health education in the society. The use of communication systems like radio, television and posters also help to enlighten the society about the importance of schistosomiasis and the role of human behaviour in the spread of the disease (Fenwick et al, 1972).

2.6.2 Snail control

This can be effective but requires a prolonged and sustained effort at control. Snail control may be achieved by the use of molluscicides, Biological control and environmental modification.

Molluscicides are crucial for the control of schistosomiasis. The need to use plant molluscicides has received increased interest as an inexpensive technology because of the high cost of synthetic compounds for snail control in the endemic areas of poor nations of the world (Adewunmi, 1991). Molusciciding is best done in the arid region where transmission is seasonal and confined to small habitats. It requires repeated long term application by highly trained personnel.

The common molluscicides used are Niclosamide, Tripenmorph, Sodium penthachlorophenate, Copper sulphate and Nicotinanilide (Mott, 1987). A number of molluscicides of plant origin have been used among which are phytolacca dodecandra (Endod) which is the most effective one and it is said to be non-target specific (Mott, 1987).

In Nigeria, a number of molluscicides of plant origin has been studied among which are Tetraplenta tetraptera, calliandra portoricensis, Balanites aegyptica (Adewunmi, et al 1990).

Biological control of snails is based on potential competitors, predators or parasites such as ducks, fish turtles, fungi and other parasites. Alteration of the habitat necessary for the establishment of snail colonisation helps in eradicating them and serve as a good tool for the control of snail population (Edington & Gilles, 1969).

2.7 Chemotherapy

Chemotherapy remains the most important measure for the control of schistosomiasis. It reduces the output of live eggs from infected individuals hence reducing transmission. Killing the worms in he treated individuals reduces the risk of morbidity and mortality due to the disease and also enable the patient to recover from the disease (Laughlin, 1986).

The modern safe antischistosomal drugs are oxamniquine, metrifonate, Niridazole, Hycanthone and Praziquantel.

Oxamniquine is very effective in the treatment of S.mansoni infection and is well tolerated, but its high cost and not being effective in S. haematobium and S. japonicum infectious has made it to be of great disadvantage (Gundersen et al, 1990).

Metrifonate is most effective in S. haematobium infections but is of little or no effect on S. mansoni and S. japonicum infection It has an advantage of low cost. Niridazole is effective in both S. haematobium, S. mansoni and S. japonicum infections but the drug is very costly and is less tolerated in populations. (Gundersen et al, 1990) Hycanthone is effective only in S. haematobium and S. mansoni infections and its of a moderate cost.

Praziquantel has been found to be the best drug which is effective against all three human schistosome. When administered orally the absence of any signs of resistance towards this drug has made TDR (Tropical Diseases Research Unit) and other research organisations not to make any attempt of development of another antischistosomal drugs (Frohberg, 1989).

Antischistosomal drugs may be administered by mass chemotherapy or targeted chemotherapy. Research is going on to produce successful vaccines to be used in conjunction with chemotherapy for long term control of schistosomiasis. (Kloetzel, 1990). The aim of vaccine development is to counteract morbidity resulting from granuloma formation around

the eggs deposited in the tissues. The vaccine will be directed against the larval stage of the parasite (Wurapa et al, 1989).

2.8 Socio-economic importance of Schistosomiasis

Schistosomiasis incurs great socio-economic losses to several communities affected by the disease. The degree of loss vary from one area to another depending on the intensity of the disease in the area which can vary within closely situated towns (Wright, 1972; Fenwick, et al 1972; Lichtenberg, 1987),

The consequences of schistosomiasis may be serious even though many infections are asymptomatic Economic development in areas where new dams and irrigation schemes are introduced often lead to an increase in the prevalence and severity of schistosomiasis which has an adverse effect on socio-economic progress. There is incapacitation and premature death leading to decreased productivity and economic loss (Wright, 1972; Parker, 1992).

CHAPTER THREE

3.0 MATERIALS AND METHODS

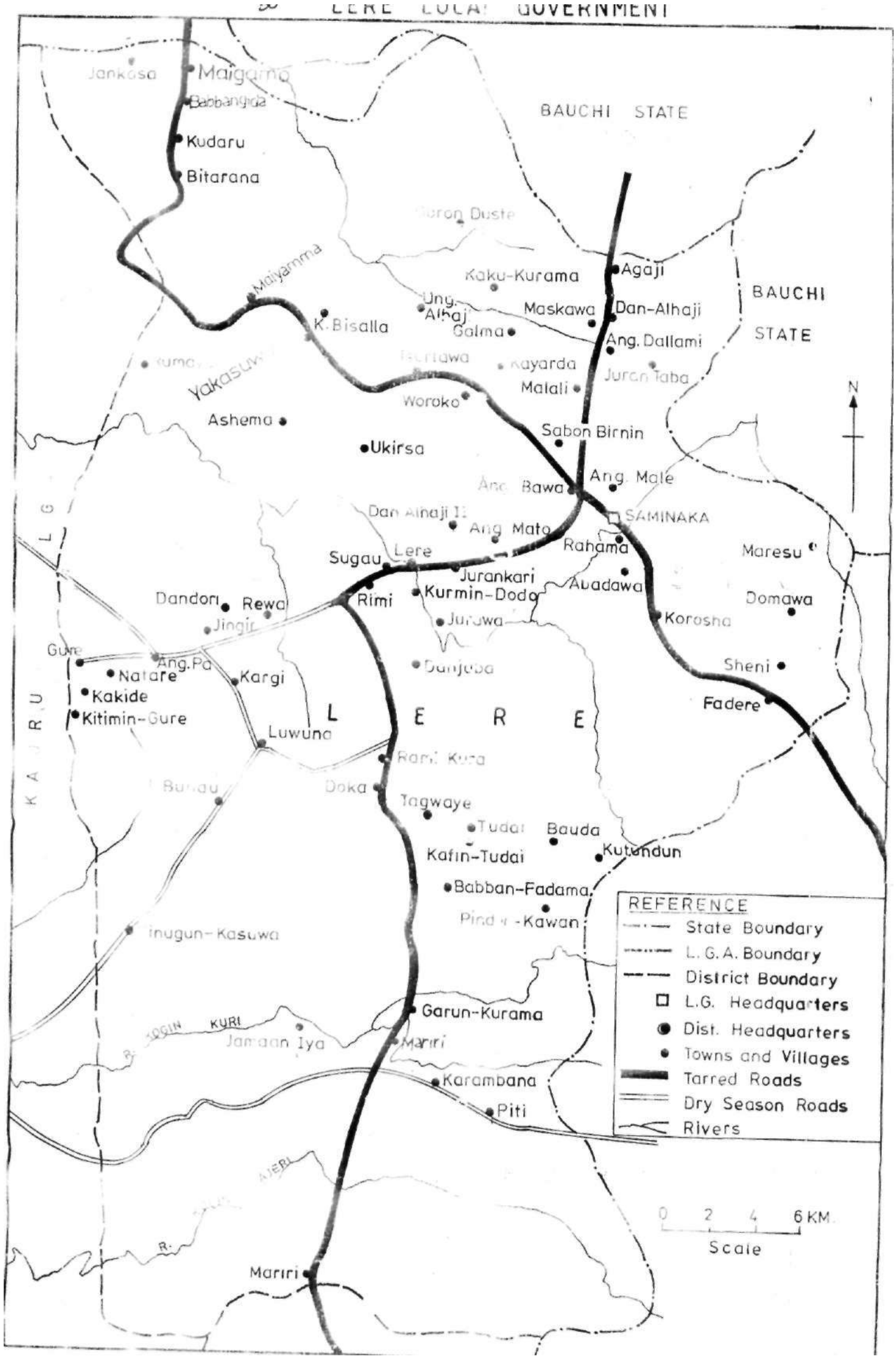
3.1 Study area

Lere is one of the Local Government Area in Kaduna State. It comprises three districts namely; Yarkasuwa, Saminaka and Garu districts (Fig.1).

The choice of Lere local government for this present study came about because no such work has been conducted in that area. The local government consists of different ethnic and cultural groups. The predominant tribes are the Kuramas about 90% of whom are christians, and the Hausa's who are predominantly muslims. Farming is the major occupation of the people of the area. The climate of the area is typical of the guinea savanna belt having two seasons, the rainy and dry seasons. The rainy season lasts between April and September and the dry season from October to March. During the dry season, when most wells in the villages usually dry up, the main sources of water for drinking and bathing are the earth dams and seasonal streams.

3.2 Study population

The study population comprised children of school age. Twelve primary schools, four per district were randomly selected from nine different villages within the three district of the local government. The Headmasters of the


LERE LOCAL GOVERNMENT
Jankasa
Maigarma
Babbangida
Kudaru
Bitarana
BAUCHI STATE
Maiyamma
K. Bisalla
Yakasuwa
Ashema
Ukirsa
Woroko
Kaku-Kurama
Ung. Alhaji
Galma
Maskawa
Agaji
Dan-Alhaji
Ang. Dallami
BAUCHI STATE
Kayarda
Malali
Sabon Birnin
Ang. Male
Ang. Bawa
SAMINAKA
Dan Alhaji II
Ang. Mato
Rahama
Maresu
Sugau
Lere
Jurankari
Kurmin-Dodo
Rimi
Abadawa
Domawa
Korosha
Dandori
Rewa
Jingir
Jurawa
Sheni
Fadere
Gure
Ang. Pa
Natare
Kakide
Kitimin-Gure
Kargi
Luwuna
L E R E
Tagwaye
Tudai
Bauda
Kafin-Tudai
Kutundun
Babban-Fadama
Garun-Kurama
Mariri
Karambana
Piti
Inugun-Kasuwa
Jamaan Iya
Mariri
KAURU
LGA
N
REFERENCE
State Boundary
L. G. A. Boundary
District Boundary
L.G. Headquarters
Dist. Headquarters
Towns and Villages
Tarred Roads
Dry Season Roads
Rivers
0 2 4 6 KM.
Scale

various schools were contacted and briefed on the purpose of the research and convenient dates were fixed for sample collection.

3.3 Collection of samples

Urine and stool samples were collected from primary school children between the ages of 7-20 years. The samples were collected between 10.00 am and 1.00 pm when most of the pupils were in attendance, in each of the schools. Prior to collection of the samples, all the pupils were assembled and briefed on the disease problem, its symptoms, how it is transmitted, and its socio-economic impact on man.

The samples were collected at random. In each class samples were collected from one tenth of the pupils. This was done by writing "Yes on 10 sheets of papers and "No" on the remaining papers, the 10 pupils that picked "Yes" in every class gave their stool and urine samples respectively. The samples were collected into clean specimen bottles containing about 5mls of 10% formalin which served as a preservative. The samples were then labelled and transported to the laboratory and stored in the refrigerator for analysis the following day. Questionnaires (Appendix I) were administered to all pupils from whom samples were collected.

3.4 Application of questionnaire

Each pupil who supplied specimen was interviewed using a structured questionnaire. Information was obtained on; name of the school, pupil(s) name, age, sex, fathers occupation. Housing sanitation which include type of toilet, sources of drinking and bathing water, outdoor activities the pupils engage themselves to, the history of bloody feaces and terminal haematuria.

The results that were obtained after the analysis of the samples were recorded in the questionnaires. The number of eggs of schistosoma mansoni per gram of faeces and Schistosoma haematobium per 10mls was also recorded Other parasites that were encountered in the samples were also recorded in the questionnaires. This information help to determine the level of awareness of the disease by the pupils, the intensity of the disease, and the level of exposure of the pupils to the disease by age and sex.

3.5 Laboratory analysis of samples

3.5.1 Urine samples

The urine samples were examined for S.haematobium eggs by using the sedimentation method. Each of the urine samples was stirred before use in order to keep all the items in the sample suspended. Five millilitres syringe was used to withdraw 5mls of the sample into centrifuge tube. An equal volume of distilled water was added to each of the sample to

ensure that all the waste matters in the samples were uniformly suspended, and centrifuged at 2,000 revolution per minute (rpm) for about 3 minutes. The upper part (supernant) was discarded and a drop of iodine was added to the sediment and examined under the light microscope for the presence of the eggs of S.haematobium. The number of eggs per 5 mls of the urine samples were counted in order to measure the intensity of the infection in each of the sample areas.

3.5.2 Stool sample

The Quick-Kato technique as described by Peters et al, (1980) was used in the detection of eggs of Schistosoma mansoni in the faecal matter. For each of the samples collected, one gram of the stool sample was sieved through a fine sieve into the petridish. A portion of the sieved sample was applied with a forcep to a hole through a flat sheet template resting on the glass slide, the hole of the template is 9.0mm in diameter, the stool cut on it is equivalent to 50 mg of stool sample. The template was removed and the faecal sample was pressed into the slides and a few drops of Ninhydrin was added to it. This served as a catalyst that reactivates the eggs to come up to the surface of the faecal matter and mounted on the microscope. The eggs were clearly seen and counted. The number of eggs were expressed as eggs/gram of faeces to measure the intensity of the infection in each of the samples examined.

3.6 Snail survey and experimental infection of mice

In order to identify the active site of transmission of the disease in the area, community ponds, dams and other water bodies around the study area were examined for the presence of the snails. A dip net was pushed through the weeds, leaves and other objects in the water in order to collect the snails. The snails were collected in winchester bottle containing water and was transported to the laboratory for identification. The snails were sorted according to genus. Each snail was then placed in a petridish containing distilled water and exposed to light to stimulate it to shed cercariae. Mice were exposed to cercariae by shaving their ventral side, and the mice were then placed in the petridish containing the cercariae and left for about one hour. They were later removed and placed in a cage kept in the animal house, and were fed for 11 weeks after which they were autopsied to recover the adult worms in their digestive tract.

3.7 Collection of hospital records

A five-year (1990 - 1994) record of schistosomiasis in the local government area was collected from Saminaka general hospital. It is the only general hospital in the area. It is located in the heart of Saminaka town. People from all the villages in the local government often come to the hospital for treatment.

There is a well equipped laboratory in the hospital, the records were collected through the assistance of the laboratory technologist. The record books provided the following informations; name, sex, age, the parasites recovered from the individuals and the occupation of the adults.

3.8 Statistical methods

The comparison of the prevalence between the examined pupils was carried out; The chisquare test was used to find whether there is an association between each factor and the disease in the different age groups. The student -t-test (unpaired-t-test) was used to find whether there were statistical significant differences between the prevalence of the disease in males and females, the odds ratio (OR) for each factor were also calculated to determine whether or not an association existed between the factor and schistosomiasis (Spiegen, 1988).

CHAPTER FOUR

4.0 RESULTS

4.1 Schistosoma haematobium survey

An epidemiological survey was carried out among school children between the ages of 7 and 20 years in Lere Local Government Area of Kaduna State, Nigeria.

The overall prevalence of Schistosoma haematobium was 142 out of the 1159 urine samples that were examined representing 12.3% of the sampled population. The 1159 pupils comprised 635 males and 524 females. The prevalence of S. haematobium varied in different villages and were 4.4% in Maigamo, 7.4% in Rahama Local Education Authority (LEA), 7.8% n Garu, 9.6% in Yarkasuwa, 11.5% in Saminaka central, 15.9% in Maiyamma, 20.6% in Babangida, 21.3% in Lere and 31.0% in Mariri (Table I, Fig 2).

TABLE I: **Prevalence and intensity of Schistosomiasis per school in Lere Local Government Area. NOVEMBER 1994 - JULY 1995.**

	SCHISTOSOMA MANSONI			SCHISTOSOMA HAEMATOBIUM		
SCHOOL/VILLAGE(S)	NUMBER EXAMINED	NUMBER INFECTED %	INTENSITY	NUMBER NFECTED %	INTENSITY	MIXED INF.
Maigamo LEA	136	13(9.5)	2	6(4.4)	13	1
Babbangida LEA	34	0	-	7(20.6)	25	0
Kudaru LEA	64	3(4.7)	2	9(14.1)	27	1
Maiyamma LEA	126	2(1.6)	1	20(15.9)	28	0
Yarkasuwa LEA	115	3(2.6)	5	11(9.6)	12	0
SAminaka B LEA	156	24(15.4)	11	18(11.5)	12	5
Saminaka Central LEA	85	21(21.7)	6	13(15.3)	22	4
Rahama Saminaka LEA	108	15(13.9)	13	8(7.4)	7	4
Lere LEA	122	26(21.3)	10	26(21.3)	18	7
Garu LEA	72	13(17.1)	7	6(7.8)	47	1
Mariri LEA	58	11(19.1)	6	18(31.0)	21	3
Total	1159	132(11.3)		142(12.3)		26

Prevalence of S. haematobium in males was 107 (16.9%) and in females 36(6.9%). The distribution of the disease by age among the males showed that, the highest prevalence rate of 19.6% was in the age group of 13 years and above. The age group of 10-12 ranked second with 15.9% being infected (Table II). Among the females, the highest prevalence rate of 8.0% was recorded in the age group of 7-9 years and 3.7% in the age group

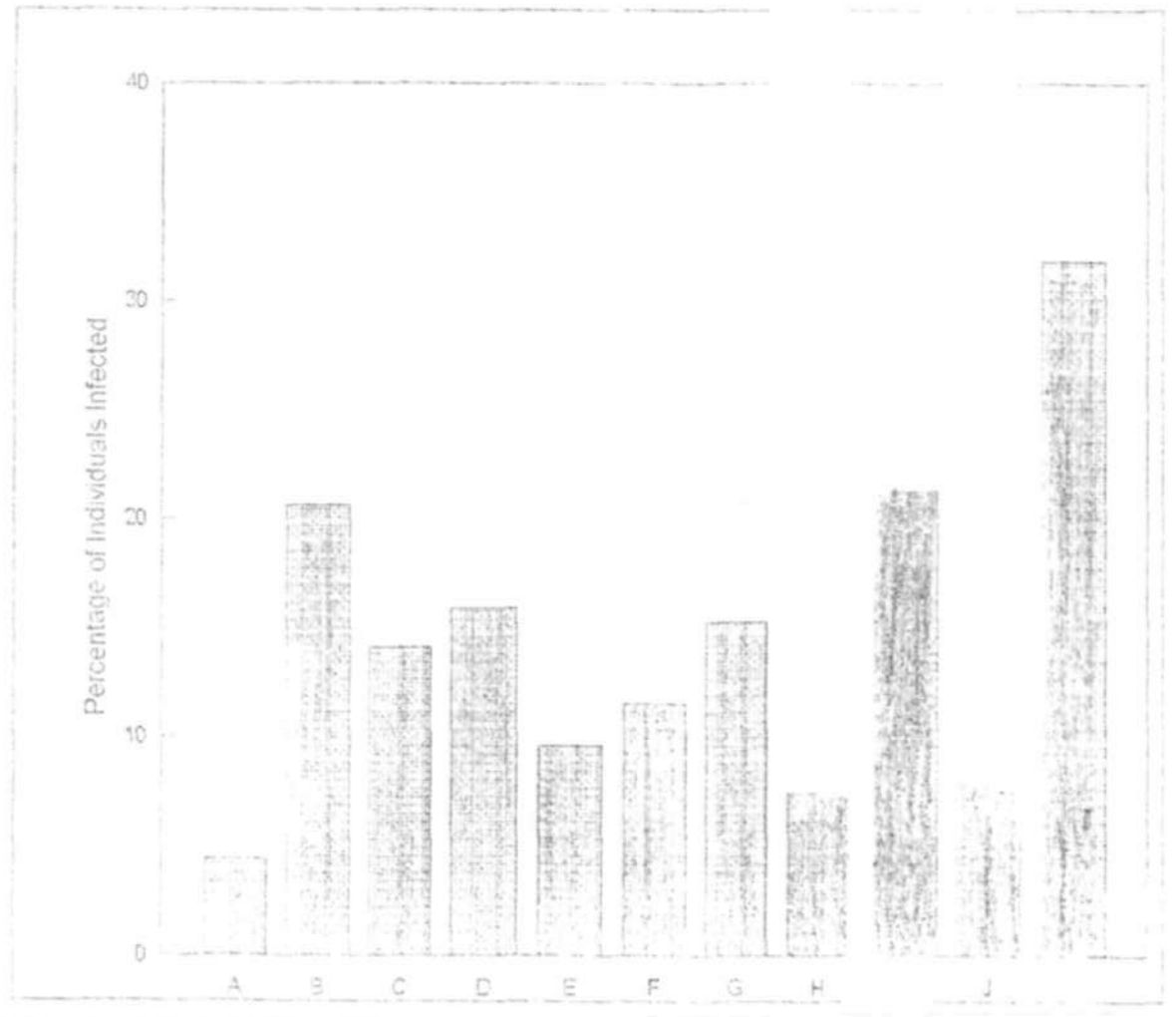


Figure 2: Distribution of Schistosoma haematobium infection in selected schools, Lere Local Government Area, [illegible]

of 13 years and above. Increase and decrease in prevalence in the two sexes took an opposite trend. While the disease increased with age in the males, it decreased with age in the females.

The overall intensity of Schistosoma haematobium in the primary schools showed that Garu had the highest level of intensity of infection of 47XG, Rahama had the least. The overall prevalence and intensity of S. haematobium was found to be higher than that of S. mansoni in the whole local government. The overall intensity of S. haematobium infection in the study population was 17 geometric means egg count per 10mls of urine. Individual egg count ranged from 1-181 eggs / 10mls of urine.

Statistical analysis using the unpaired t-test for the ungrouped data showed that there was no statistical significant difference between the egg output in both sexes and intensity did not necessarily increase with prevalence rates of schistosomiasis in the primary schools. The school with the highest prevalence did not record the highest intensity.

Analysis of the infected pupils with the infection showed that 92.3% of the pupils had light infection, 1-100 eggs) and 7.7% had moderate infection with (101 - 500 eggs) and none had heavey infection (over 500 eggs). Moderate egg output 6.3%) over the females (2.1%). The chi-square test showed that there was no significant difference between the prevalence rates in the different age groups ($P > 0.05$).

4.2 Schistosoma mansoni survey

Out of the total population of 1159 school children examined, S. mansoni eggs were detected in the stools of 132 pupils (11.3%). The intensity of the infection was light with 1-26 eggs/ gram of faeces. The

prevalence of S. mansoni varied in different villages and was 1.6% in Maiyamma, 2.6% in Yarkasuwa, 4.7% in Kudaru, 9.5% in Maigamo, 13.9% in Rahama LEA, 15.4% in Saminaka .B LEA, 17.1% in Garu, 19.1% in Mariri, 21.3% in Tere and 24.7% in Saminaka Central. No S.mansoni infection was recorded in Babbangida LEA (Table I).

The prevalence was higher in males than in the females. 86 males (13.5%) and 46 females (8.8%) had S.Mansoni eggs in their faeces. In males, the highest prevalence rate was in the age group 13 years and above where 18.2% of the pupils were infected. The age group 10-12 years ranked second with 14.5% being infected, the least was in the 7-9 years age group where 7.3% were infected (Table III, fig 3).

TABLE II: Age and sex distribution of S. haematobium infection in school children

	M A L E			F A M A L E		
Age group Years	Number Examined	Number Infected	Age specific Rate	Number Examined	Number Infected	Age specific rate
7 - 9	164	25	15.2	142	10	7.0
10 - 12	328	52	15.9	274	22	8.0
> 13	143	28	19.6	108	4	3.7
Total	635	105	50.7	524	36	18.7

TABLE III: Age and sex distribution of *Schistosoma mansoni* infection in school children

	M A L E			F E M A L E		
Age group Years	Number Examined	Number Infected	Age specific Rate	Number Examined	Number Infected	Age specific rate
7 - 9	164	12	7.3	142	7	0.9
10 - 12	328	48	14.5	274	24	3.8
> 13	143	26	18.2	108	15	13.9
Total	635	86	40.0	524	46	18.6

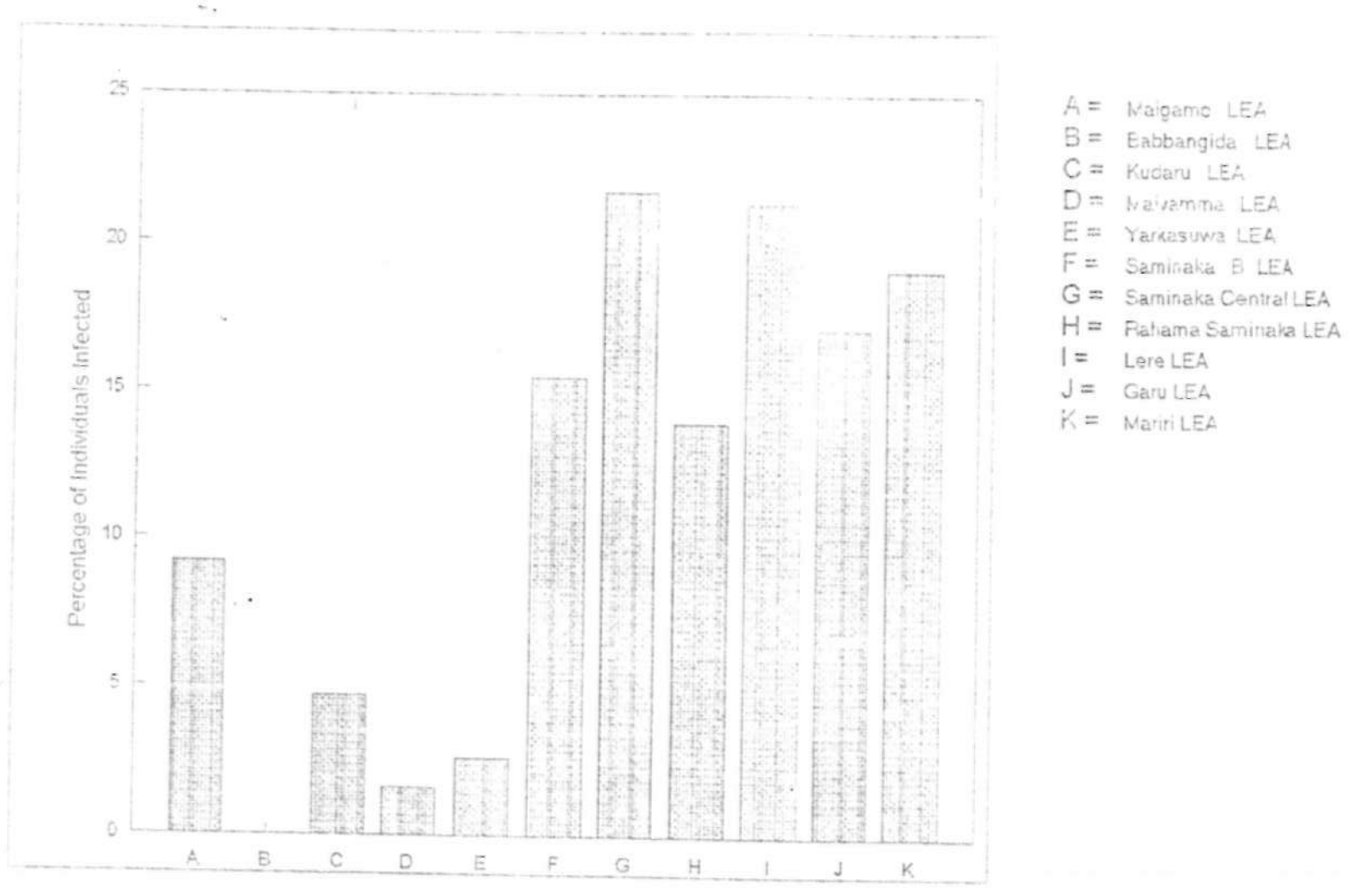


Figure 3: Distribution of Schistosoma mansoni infection in selected schools, Lere Local Government Area, Kaduna State.

In the females, the highest age specific rate of 13.9% was recorded in the 13 year and above age group and 3.8% in the 10-12 years age group. The least was in the 7-9 age group where 0.9% of the pupils were infected using the unpaired student -t-test in the ungrouped data, it was discovered that there was no statistically significant difference ($P>0.05$). between the prevalence rates in the males and the females and between the different age groups.

The prevalence of S.mansoni varied greatly in different schools within the same village. In Saminaka, three schools were examined and the prevalence rate in Rahama LEA 13.9%,LEA Saminaka B was 15.4%, and Saminaka central 24.7%. The intensity of infection due to S. Mansoni was 13 in LEA Rahama, 10 in Lere Primary School and 2 each in Kudaru and Maigamo LEA. 26 pupils (2.2%) had mixed infection of S. mansoni and S.haematobium (Table 1)

About 13.9% and 17.4% S. mansoni and S haematobium infections were recorded in LEA Rahama, 24.7% S. Mansoni and 15.3% S. haematobium in LEA Saminaka Central, 15.4% S. mansoni and 11.5% S. haematobium were recorded in Saminaka B and 21.3% each for S. mansoni and S. haematobium infections were recorded in Lere LEA respectively.

4.3 Survey of other intestinal parasites

Other intestinal parasite were encountered in the faecal samples of the pupils that were examined. Table V and Fig 4 show a summary of the number and percentage of other intestinal parasites that were examined.

Hookworm was encountered in 379 pupils which represented 34.3% of the total faecal samples examined, Entamoeba coli 76 (6.6%), Trichuris

trichiura among others was encountered in 1 (0.04%) of pupils. Taenia species 20 (1.7%), Enterobius vermicularis 18(1.6%), Ascaris species 10(0.9%), and Entamoeba histolytica 4 (0.3%). For hookworm and taenia species, further examination was not carried out to find out the type of species(Table 4, plate 1-8).

Table V shows the analysis of the prevalence of single and mixed infection of S. mansoni and other intestinal parasites. The results showed that 300 (25.9%) of the pupil had hookworm infection only, 75 (6.5%) S. mansoni only, 52 (4.5%) E. coli, 15 (1.3%) E. vermicularis only 13 (1.1%). taenia species 7 (0.6%) Ascaris and 1 (0.1%) each had E. histolytica and I. trichiura.

Mixed infection of S. mansoni with other intestinal parasites showed that a combination of S. mansoni and hookworm infection had the highest prevalence rate (Table V) No individual had a mixed infection of S. mansoni and Taenia Species, S mansoni and I. trichiura species.



PLATE I

Ova of Schistoma haematobium



PLATE II

Ova of Schistosoma mansoni

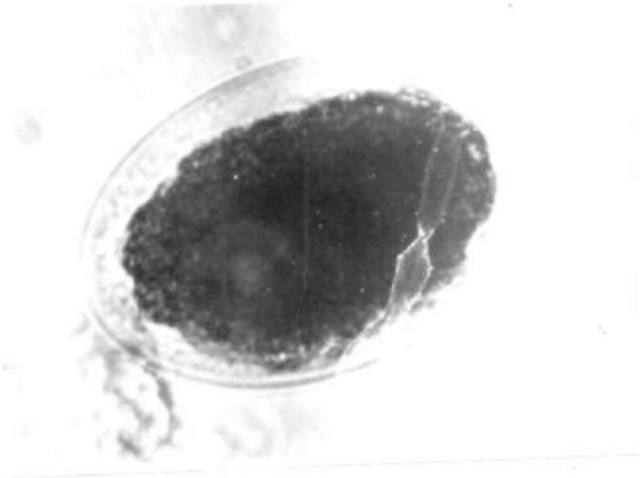


PLATE III

Ova of Hookworm

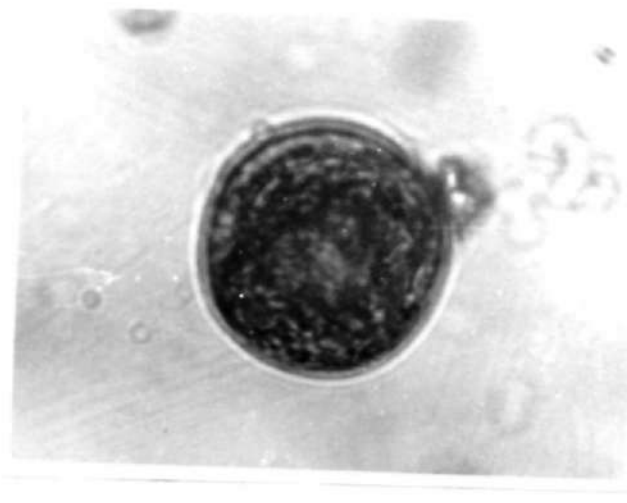


PLATE IV

Ova of Teania Spp.

TABLE IV: Relative Prevalence of *Schistosoma mansoni* and other intestinal parasites

Parasite (s)	Number infected	Percentage positive
Hookworm	397	34.3
Schistosoma mansoni	132	11.4
Entamoeba coli	76	6.6
Taenia species	20	1.7
Enterobius vermicularis	18	1.6
Ascaris	10	0.9
Entamoeba histolytica	4	0.3
Trichuris trichiura	1	0.4
Total	658	56.84

TABLE V: Prevalence rates of other intestinal parasites in relation to *S. mansoni* infection

Parasite (s)	Number infected	Percentage positive
Schistosoma mansoni		
eggs only	75	6.5
Hookworm only	300	25.9
Entamoeba coli cyst only	52	4.5
Taenia eggs	13	1.1
Ascaris egg	7	0.6
Entamoeba histolytica eggs	1	0.1
Enterobius vermicularis eggs	15	1.3
Trichuris trichiura eggs	1	0.1
S. mansoni + Hookworm	26	2.2
S. mansoni + E. coli	3	0.3
S. mansoni + Ascaris	1	0.1
S. mansoni + E. vermicularis	1	0.1
S. mansoni + E. histolytica	1	0.1

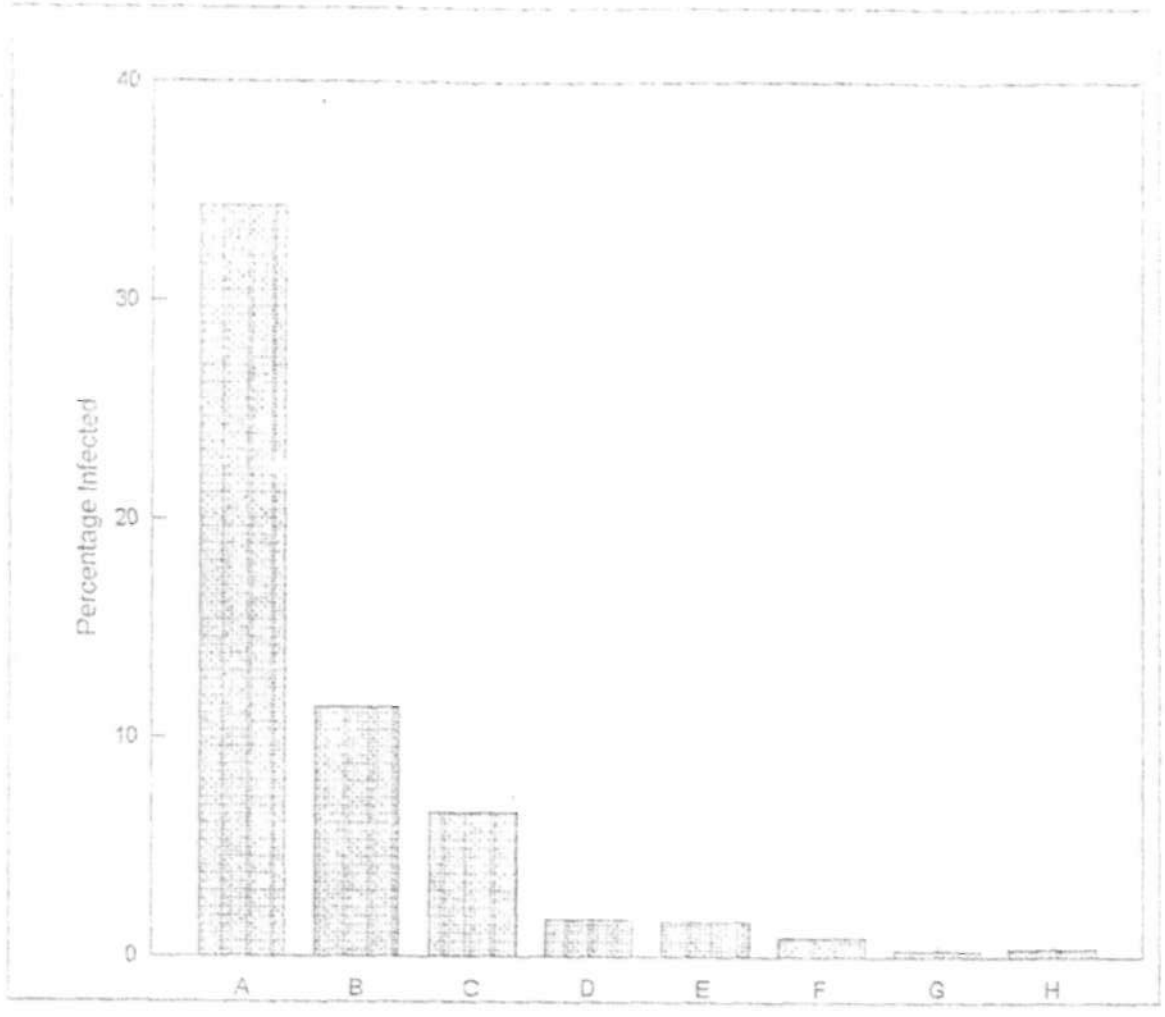


Figure 4: Relative Prevalence of Schistosoma mansoni and other intestinal parasites

4.4 Response from the questionnaires.

A summary of the responses of the pupils to the questionnaire and the results of statistical analysis to show the associations between the various epidemiological variables and the disease are presented in Table VI. The responses were categorised into the factor positive and the factor negative and the number of the pupils that have the disease and those that did not have the disease.

Odds ratio value greater than unity (1) which indicate there were associations between each of the factors and the prevalence of schistosomiasis were obtained. For the various water contact activities. Swimming had odds ratio value of 2.4, fishing the odds ratio value of 3.8 and fishing and swimming, odds ratio of 3.9.(Table 6)

Based on the type of toilet used by the pupils an odds ratio of 1.6 was discovered. The highest prevalence of the disease was discovered in children that do not have toilets but often go to the bush to empty their bowels ($P>0.05$). The result, shows that those pupils that use toilets were 1.6 times more likely to come down with the disease.

Responses on the sources of water supply showed that those that use stream water were 1.0 times more likely to come down with the disease. Those that use well water were 0.8 times more likely to come down with the disease while those that use tap water were 1.21 times more likely to come down with the disease.

TABLE VI: EFFECT OF SOME FACTORS ON THE PREVALENCE OF SCHISTOSOMA INFECTION IN LERE LOCAL GOVERNMENT OF KADUNA STATE.

Factors	Number Infected	Number not infected	Odds ratio value	95% CI
Toilet				
Use toilet	214	729	0.6	1.2-2.0
None	33	183		
Sources of Water				
Stream	7	25	1.0	0.1-1.0
Well	212	884	0.8	
Tap	39	115	1.21	
Water contact Activities				
i) Swimming				
Yes	132	256	2.4	1.2-1.7
No	138	388		
ii) fishing				
Yes	112	248	3.8	3.4-4.1
No	86	723		
iii) Fishing/ Swimming				
Yes	125	168	3.9	3.6-4.2
No	140	726		

Moreover, out of 188 pupils that indicated passing out stool with blood, only (6%) of them had S. mansoni eggs in their faeces at the time of examination. However, a higher percentage of the pupils that were infected with S mansoni were found to be passing out blood (OR 5.5) (Table 7)

Haematuria was manifested in 47.2% of the infected and 1.8% of the uninfected pupils. There was an association between history of terminal haematuria and Schistosoma haematobium infection (OR 7.6) The questionnaires were issued to the pupils in order to find out the level of awareness of the disease by the people in the area. From the responses, it was concluded that the disease was well known in the area.

TABLE VII: Relationship between bloody stool or Terminal haematurta on Schistosoma infection

Factors	Number infected	Number not infected	Odds ratio value	95% CI
History of bloody stool				
Yes	64	124	5.5	5.0-5.8
No	84	887		
Terminal haematuria				
Yes	72	69	7.6	7.2-7.9
No	123	895		

4.5 Snail survey and laboratory infection of mice

The species of snails recovered include Lymnaea natalensis. Bulinus globosus. Bulinus forskali. and Biomphalaria pfeifferi. Lymnaea and Bulinus species were the most prevalent species. Out of the 44 snails that were found, 30 (68.2%) of the snails were found to be shedding cercaria.

Four mice that were infected with cercaria of Bulinus globosus, Bulinus forskali and Biomphalaria Pfeifferi were autopsied after 12 weeks and adults worms of Schistosoma mansoni and Schistosoma haematobium were recovered from all the mice (PLATE VIII).

Table VIII shows a summary of the effect of snail population on the prevalence of Schistosomiasis in the study area. It was discovered that the snail density was high in Saminaka, Lere, Garu, Mariri and Kudaru, while in Maigamo, Babbangida, Yarkasuwa and Maiyamma, the snail density was low. Bulinus and Lymnaea species were the predominant snail species in the area. They were found in all the water bodies in the villages. Biomphalaria Pfeifferi was found in all except Maiyamma and Babbangida villages. The highest snail density was in Saminaka dam and Lere river and the infection rates in those villages as compared to others were higher. Most of the schools with Pupils with higher prevalence were found located either near the water bodies or a few metres away from them.

The rate of flow of water bodies also influences the prevalence of schistosomiasis. Villages with fast flowing streams like Maigamo and Kudaru had lower prevalence rates of the disease than villages with ponds, dams and slow flowing streams. Saminaka, Lere and Mariri had high prevalence because of the nature of the water bodies in the areas. Generally, most of the water bodies in the study area dry up easily and that is what exposes the entire population to infection.



Plate 8a Biomphalaria Pfeifferi
Intermediate host of
Schistosoma mansoni



Plate 8b Bulinus globosus
Intermediate host of
Schistosoma haematobium

TABLE VIII: Effect of Snail Population on the Prevalence of Schistosomiasis in Lere Local Government Area of Kaduna State

Village/Schl	Type of Water bodies	Snail Density	Predominant Snail species	Nearness of school to water	Prev. of S. mansoni (%)	Prev. S.heamatobium (%)
Maigamo LEA	Fast flowing stream and ponds	Low	Biomphalaria and Bulinus species	Near the stream	9.5	4.4
Babbangida	Ponds, fast flowing stream	Low	Bulinus species	Far from stream	0	20.6
Kudaru	Fast flowing stream ponds	high	Lymnaea, Bulinus, Biomphalaria	Far from the stream	4.7	14.1
Yarkasuwa	Ponds, stream	Low	Lymnaea, Bulinus Biomphalaria	Far from the stream	2.6	9.6
Maiyamma	Ponds	Low	Bulinus, Lymnaea	Far from the stream	1.6	15.9
LEA Saminaka Central	Dam, Ponds	High	Biomphalaria, Lymnaea Bulinus	Far from the dam	24.7	15.3
Rahama LEA	Dam, Ponds	High	Biomphalaria, Lymnaea Bulinus	Near the dam	13.9	7.4
Saminaka B LEA	Dam, Ponds	High	Bulinus, Biompha- Lymnaea laria	Near the dam	15.4	11.5
Lere LEA	River, Stream ponds	High	Biomphalaria, Bulinus Lymnaea	Near the river	21.3	21.3
Mariri LEA	Stream, Ponds	High	Lymnaea, Bulinus & Biomphalaria	Near the stream	19.1	31.0
Garu LEA	River, Stream	High	Lymnaea, Bulinus & Biomphalaria	Near the river	17.1	7.8

4.6 Analysis of hospital records

Using available hospital records, the status, level of awareness and the pattern of infection in the area over a five years (1990 - 1994) period were determined (Table IX & X). There was no proper documentation of the cases. The results obtained showed that only a few cases of the disease were being treated in the hospital. On a general note, fewer cases of S.haematobium were diagnosed than S. mansoni in the hospital. In 1990 and 1991, there were no cases of S.haematobium diagnosed in the hospital

TABLE IX: A five year(s) Hospital records of Schistosomiasis obtained from the Saminaka General Hospital (1990 - 1994).

Distribution of the Disease by Sex.

Years	Schistosoma mansoni Number of males infected	Number of females infected	Schistosoma haematobium Number of males infected	Number of females infected
1990	56	20	5	1
1991	41	17	-	-
1992	13	3	1	1
1993	42	15	-	-
1994	55	26	11	1
Total	207	81	17	3

TABLE X: Distribution of the disease by age

	Schistosoma mansoni						Schistosoma haematobium					
Age group(s)	1990	1991	1992	1993	1994	Total	1990	1991	1992	1993	1994	Total
1 - 10	10	12	5	11	25	57	-	-	1	1	2	4
11 - 20	31	27	5	19	19	95	-	-	1	3	7	11
21 - 30	26	15	3	25	29	97	-	-	-	2	3	5
31 - 40	6	3	1	2	6	17	-	-	-	-	-	-
41 - 50	1	-	-	-	?	2	-	-	-	-	-	-
51 - 60	2	1	2	-	-	5	-	-	-	-	-	-
Total	76	58	16	57	81	288	-	-	2	6	12	20

The distribution of S. mansoni by sex showed that more males than females were infected. A total of 207 males and 81 female were diagnosed for S.masoni infection over the period of 5 years, and 17 males and 3 females were diagnosed for S. haematobium over the same period.

The distribution of the disease by age showed that those in the 11-30 years age group were mostly affected. This shows a correlation between the past records for the disease in the area with the results of this present survey. The records also revealed that there were more cases of S. monsoni than S. haematobium diagnosed in the hospital and infection increased with age from 11-30 years and there after decreased in the older people.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Schistosoma mansoni and Schistosoma haematobium survey

This study recorded higher prevalence of Schistosoma haematobium than schistosoma mansoni. The prevalence of infection in the area was generally light or moderate. In some cases, this could be closely related to the presence and relative abundance of the snail intermediate hosts. The result agree with the works of Akogun (1990) carried out in Gumau district of Bauchi State, Awogun (1988) in Ilorin, Amali (1989) in Benue, Amin et al (1972) in Sudan and Hira (1972) in Zambia. In those studies also there were lower prevalence of S. mansoni than S. haematobium. In Babbangida, S. mansoni infection was not recorded but S. haematobium infection was very high. This is because the intermediate hosts of S. haematobium was abundant in that area.

The distribution of the disease in the different villages and individual schools were not uniform despite the similarities of the local topography and climatic conditions. In Maiyamma and Yarkasuwa, the prevalence of S. mansoni was very low, while in Saminaka, Lere, Garu and Mariri, the prevalence were very high. The variations may be due to the presence or absence of the habitats suitable for the survival and breeding of the intermediate hosts, and how often the pupils got in contact with the intermediate hosts. Higher prevalence were recorded in schools that were situated very close to the water bodies than those in other parts of the same village. Despite the fact that most of the people in Saminaka town use tap water, the disease prevalence in that area was found to be higher

than other villages. This may not be unconnected with the existence of a dam in the centre of the town and people being engaged in irrigation projects which is the most important human activity that is related to the severity of infection (Pugh et al, 1979). Children whose school (Saminaka central LEA) is a bit far from the dam were found to be highly infected. This might be attributed to the fact that children go to the dam for outdoor activities. Villages where low prevalence of the disease were observed, had streams which were either some distance away from the houses or were small and fast flowing which is not a conducive habitat for the snails. In some villages (Maigamo, Babbangida and Kudaru, the water bodies easily dry up during the dry season hence cannot support the transmission cycle of the diseases. The high prevalence of S. haematobium and S.mansoni recorded in Lere and Mariri primary schools may not be unconnected with the drying-up of wells during the dry season forcing the entire population to drink and bath with water from the ponds and streams around them. In Lere village, there is a big river where fishing and other outdoor activities are carried out. The river being slow flowing influences the snail population and increase the snail density. Hence, the river serves as a major transmission point which might have contributed to the high prevalence of the diseases in that area.

In males, the prevalence rate was directly proportional to age while in females it was inversely proportional to age (Table II & III). These results are similar to those obtained in the work carried out by Amin et al (1972) in Gambia, Azar et al (1972), in Zambia, Bello et al (1992) in Kwara State, Nigeria and Ityondo (1991) in Soba Local Government area of Kaduna State. These findings may be attributed to the age dependent

increase or decrease in water contact activities of the different sexes and the cultural activities of the people in the area. The males are mostly engaged in outdoor activities like swimming, fishing and bathing in the streams or ponds but the females are known to help their parents in the home. Thus the water - contact activities by the females are reduced and this helps in reducing the prevalence of the disease among them.

There is a correlation between prevalence of the disease and intensity of infection as measured by heaviness of the egg output (Ramsey 1934; Cowper 1963; Pugh 1979). However, the results obtained in this study did not show a direct correlation, the pattern of infection showed that the egg output decreaased with age especially in the females. Villages (Lere and Mariri), where highest prevalence rates were recorded did not record the highest intensity despite the fact that large number of pupils were infected. In some villages (Garu, Babbangida, Kudaru and Maiyamma) where fewer people were found to be infected, the egg output by every infected individual was very high.

In general, the overall intensity of the disease was light with a small proportion of the individuals having moderate infection and none with heavy infection. Cowper (1963) reported that maximum excretion of eggs of schistosome occur after midday, but that period could not be utilized during this present work. This might have contributed to the low level of intensity of the infection. It is possible that some of the children that were recorded as uninfected had no eggs in their urine at the time of examination even though they were infected.

5.2 Survey of other intestinal parasites.

Other intestinal parasites that were recorded among school children in this present study have been reported in other several surveys. High prevalence of hookworm and tapeworm infections have been reported in Northern Nigeria (Ramsey, 1934; Gemade & Dipeolu, 1983; Ityondo, 1991; Istifanus, 1988; Mbawah, 1992). Hookworm species, Entamoeba coli, Taenia species, Ascaris, Trichuris trichiura species among others were recorded in the study area (Table IV).Some of the pupils were reported to have the habit of eating unwashed fruits with their dirty hands and some are fond of walking bare-footed and all these predisposed them to the endoparasite infection.(Nnochiri, 1975; Ndifon, 1991)

Hookworm had the highest prevalence of infection, (Table V), as compared to other infection, it is possible that the bloody stool passed out by some pupils may be due to hookworm infection not S. mansoni infection, in case of those that do not have S mansoni infection. Almost all the parasites were found to be in co-existence with S. mansoni. The highest was hookworm and S.mansoni infection. This could be due to the ability of the two parasites to live together in the same host, without harming each other. The lower prevalence of mixed infection that was recorded may be attributed to the fact that the parasite that invades the host first, its antigen is circulated round the body of the host which may hinder the survival or reduce the chances of invasion by other parasites (Chandler & Read, 1961).

5.3. Responses from the questionnaires

The statistical associations that were observed between water contact activities and the infection with Schistosoma mansoni and Schistosoma haematobium indicated that occupational (fishing) and recreational (swimming) activities tend to increase the prevalence of infection. These activities, when carried out in snail infested water, increase exposure to cercariae.

The sources of water for drinking, bathing and for household use also expose the subjects to the intermediate host. Those that often go to the stream to fetch water are more likely to come in contact with the snail intermediate host than those that use well and tap water. In this study, those that responded they use tap and well water were more likely to come up with the disease. This may be attributed to the fact that those villages that have tap water also have dams and rivers in the same locality where the children often go to swim in the water, and come in contact with the parasite.

Those that use toilets were 1.6 times more likely to be infected. This may be due to the fact that most pupils, despite the fact that they have toilets, they may not necessarily utilize it but rather go to the bush there by exposing themselves to the disease.

5.4 Snail survey

The prevalence of schistosomiasis in the study area is closely related to the presence and abundance of the snail species encountered in the study area. The predominant snail species encountered in the area were Bulinus globosus, Bulinus forskali and Lymnaea natalensis. This might be

due to the better adaptability of Bulinus species to local ecological factors (Cowper, 1963; Ndifon, 1982; Okwuosa, 1982; Prasertphon, 1988). The presence of the snails is an indication that ecological factors favourable for their survival are available in the study area. The snails were mostly found attached to the vegetation of the water bodies. The rate of flow of water bodies also influenced the prevalence of the disease.

In areas where Schistosomiasis is endemic, the population dynamics of the snails is said to have a direct effect on parasite transmission (Pugh et al, 1979). Schistosoma mansoni was discovered in many children in Saminaka town. This might be attributed to the water - contact activities in the area and abundance of Biomphalaria pfeifferi. The intermediate host of S. mansoni were mostly encountered in the Saminaka dam where most of the children go to swim and bath. The adult worms of S. haematobium and S. mansoni were recovered from the mice that were infected with the cercariae. This confirms that the snails were infected with S. mansoni and S. haematobium. In Babbangida, S. mansoni was not recorded and this is attributed to the low density of the Biomphalaria species in the area. However, S. haematobium infection was very high because Bulinus species were found in abundance in the area (Table VIII).

5.5 Relationship between results of hospital records and the results obtained from the survey.

The results of the present study was compared with that obtained from a five-year retrospective study using hospital records from the Saminaka General Hospital. Both studies have revealed an overall moderate prevalence of S mansoni in the area with the prevalence being higher in

males than in females. Despite the fact that the prevalence of S haematobium and S. mansoni were equal in the survey, the records from the hospital showed the distribution of S. haematobium to be patchy as compared to that of S.mansoni. This is contrary to the findings of other researchers which show that prevalence of S. haematobium is generally higher than that of S. mansoni in many parts of the world (Pugh et al, 1979; Zein, 1989; Ofoezie et al, 1991)

Man-water contact studies have shown that young males are the prime contaminators of our environment (Pugh et al, 1979). The result of this study which showed that the disease is mostly recorded between the ages of 11-30 years and that it decreases in the older people, may be attributable to the frequent water - contact activities of the young people. The hopsital records have given an indication that the people are aware of the disease and that it is not only found in children but also in older people who engage themselves in irrigation work especially during the dry season.

5.6 Summary and conclusion.

The epidemiological investigation of schistosomiasis in primary school children in Ilere Local Government has shown that the disease is endemic. The risk of infection was higher in children who have regular contact with the intermediate host in the streams and ponds.

The prevalence of S. haematobium and S. mansoni were equal. The prevalence rate of both parasites were higher in males than in females. The rate of infection in males increased with age while in females it decreased with age.

The intensity of the infection was light with a few individuals

having moderate level of infection. Other parasites were discovered in the faecal samples with hookworm predominating.

The predominant snail species in the area were Bulinus globosus, Bulinus forskali, Lymnaea natalensis and Biomphalaria pfeifferi. Analysis of the hospital records showed that the disease is endemic in the area with S.mansoni more often diagnosed than S. haematobium.

Thus, economic development, such as the construction of the Saminaka dam and the irrigation projects carried out in different parts of the area, has provided a suitable habitat for the survival of snails therefore enhancing the effective continuation of the transmission cycle which has led to the increase and severity of the infection.

Programmes, such as public health enlightenment and chemotherapy, should be intensified particularly among children of school age. This should be initiated by the Health Department of the Local Government Council. The emphasis should be on control of the disease through preventing contact with contaminated water and the use of moluscicides to kill snails thus reducing the snail population in the water bodies around the area. Unless this is done, the prevalence of the disease will continue to increase in the area.

Also, more wells and bore holes need to be constructed in the villages to reduce the frequency of going to the streams and ponds for water.

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APPENDIX I

QUESTIONNAIRE ON EPIDEMIOLOGY OF SCHISTOSOMIASIS IN LERE LOCAL GOVERNMENT AREA OF KADUNA STATE

SCHOOL.....
I Name.....
Individual No.....
Sex: M/F
Age in years.....
Village.....
Father's occupation...

II HOUSING SANITATION
Title: Water System
Latrin
None

Water Suppl
(a) Drinking — Well, Tap, Dam, Pond, Stream, Canal, Others
(b) Bathing — Well, Tap, Dam, Pond, Stream, Canal, Others

(c) For Housenold Services:
Well
Tap
Dam
Pond
Stream
Canal
Others

II OUT-DOOR ACTIVITIES

Swimming	
	Dam
	Lake
	Pond
	Stream
	Others

HISTORY OF BLOODY FAECES OR TERMINAL HEMAURIA

Stool	Urine
Yes No	Yes No

V. EXAMINATION OF STOOL
Collected:
Date.....
Hour.....
Examined:
Date.....
Hour.....
Stool Consistency:
Formed
Musny
Liquid
S. mansoni
Pos.....
Neg.....
Ova No./gm.....
S. hematobium
Pos.....
Neg.....
Ova/10ml.....

EXAMINATION OF URINE
Collected:
Date___
Hour____

Examined:
Date____
Hour____
Hematuria:
Milk
Moderate
severe

S. hematobiu
Sedimentation
Pos.....
Neg.....
Ova/No/10ml...
Filtration:
Pos.....
Neg.....
Ova/No./10ml..
RECORDED BY:
Date Signature
I-IV.....
V.....
VI.....

DIX II.

lation of the intensity of SCHISTOSOMA eggs in school children

ntensity can be defined as the number of eggs per person per programme
ool, or number of eggs per person per 10mls of urine.

culate intensity

ometric Means:

$$\sqrt[n]{X_1\ X_2\ \text{-----}\ X_n}$$

$$\frac{\text{Log } X^1 + \text{Log } X^2 + \text{-----} \text{ Log } X_n}{n}$$

log of the answer.

Maigamo LEA, 13 pupils were infected with Schistosoma Mansoni
following number of eggs were recorded in each of the pupils.

1, 2, 1, 1, 2,1, 1, 1, 2, 1 and 5.

ulate the itensity;

$$\sqrt[n]{X_1\ X_2\ \text{----}X_n} = \frac{\text{Log } X_1 + \text{Log } X_2 + \text{Log } X_3\ \text{----Dog } X_n}{n}$$

$$\frac{\text{Log 2+Log1+Log 2+Log 1+Log 1 +Log 2+Log 1+Log 2+Log 1+Log 2+Log 1+Log 5}}{13}$$

= 0

= 0.30

5 = 0.699

$$\frac{0+0+0.30+0+0+0.30+0+0.30+0+0.30+0+0.699}{13}$$

$$\frac{0+0.30+0.30+0.30+0.30+0.699}{13}$$

$$\frac{+\ 0.699}{3} = \frac{2.199}{13} = 0.1691$$

g of 6.1691 = 1.48

fore the intensity of Schistosoma mansoni infection in Maigamo