PREVALENCE OF SCHISTOSOMIASIS AMONG RICE FARMING COMMUNITIES OF NIGER STATE, NIGERIA.

BY

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A thesis submitted to the Postgraduate School, Ahmadu Bello University, in partial fulfillment of the requirements for the award of the degree of Master of Science (M.Sc.) in Microbiology

March, 1996

DECLARATION

I hereby declare that the work reported in this thesis was carried out by me under the careful supervission of Dr. M. Galadima, Dr. (Mrs) L. E. Odama and Dr. I . H. Nock of Ahmadu Bello University, Zaria.

No part of this work was reproduced from any previous work or had been presented for an award of higher degree. The works of other workers cited were dully acknowledged.

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CERTIFICATION

This thesis entittled ``**Prevalence of schistosomiasis among rice- farming Communities in Niger state, Nigeria**``. by Mr. Opaluwa . S. Ahmadu meets the regulations governing the award of the Degree of Master of Science of Ahmadu Bello University, and is approved for its literary contribution.

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DEDICATION.

This thesis is dedicated to all bilharziasis patients in Nigeria and beyond.

ACKNOWLEDGEMENT

Iam extremely grateful to my supervisors Dr. Musa Galadima, Dr. (Mrs) L.E. Odama and Dr. I.H. Nock whose grant I used for this work. Dr. Musa Galadima took the pain to read and make necessary corrections, ensured that I was not starved of funds needed to carry out this work and assisted both financially and morally.

Iam indebted to Dr. (Mrs) L.E. Odama for her interest and constructive criticism that made the work possible. Iam also indebted to Dr. I.H. Nock for his contribution towards making the work a success.

Iam grateful to Dr. (Mrs) L.J. Ogbadu whose concern and assistance saw me through this work succesfully. Iam also grateful to Mr. Yakubu of the Department of Microbiology, who provided me with some of the materials required for the work.

To my brothers, Mall. Umoru Sanda Opaluwa, Abdullahi Opaluwa, Hussaini opaluwa, Musa Opaluwa and Hassan Opaluwa, Iam much grateful for their love, patience and understanding enjoyed in the course of study. I especially wish to thank Mall. Umoru Sanda Opaluwa who stood behind me at my most difficult period.

My special thanks and appreciation go to the following collegues, Mr. Osue .O. Hudu, Ndukwe Mberi, Mrs Umah Mohammed and Dr. Adamu Nuhu who assisted both morally and financially in the course of study.

I wish to thank the Commissioner of Health, Niger State, Dr. S.K. Shaba, the Local Government Chairmen and Primary School Heads I visited while carrying out this work.

My special thanks go to the Chairman of Bosso L.G.A, Mr. Daniel Tarachi and the Deputy Chairman of Shiroro L.G.A. Mr. Pius Wakili for their assistance in the field.

Iam indebted to Dr. V.C. Ogbogu of Department of Veterinary Parasitology, A.B.U. Zaria who helped in the snail vector identification. Iam also indebted to Mall. Musa M.D. of the department of Biological Sciences who identified the weed associated with transmission.

My special thanks and appreciation go to Mall. Mohammed M. Amana and Mall. Isah Edogbanya Saliu of United Nigerian Textiles plc (Computer Operations Department) who took the pain to type this thesis.

Iam very grateful to Mr. Abel Ogwu of U.B.A. Headquarters, Lagos, Mr. Bello Okai of CHELTECH, Zaria and Mr. Tunde S. Adeyemi of Department of International Studies, A.B.U. Zaria whose support I enjoyed in the course of my study. Iam also very grateful to Mall. Abdulrasheed Giwa, Mr. Samuel Garba, Mall. Saidu Galadima and Miss Esther Azeh who were of immense support during sample collection in the field. I especially wish to thank Mall. Abdulrasheed Giwa who took me round to most of the communities in the study Area.

I wish to thank Miss Funmilola Samuel (Nelly), Charity Makolo, Puna Ripiye, Janet Makum and Patience Oyibo for the care and understanding shown in the course of study. I especially wish to thank Miss Charity Makolo for her encouragement and support towards making this work a success.

Iam extremely grateful to my Mother, Mrs Abiba Opaluwa whose love and prayer made it possible for me to reach this stage.

ABSTRACT

A parasitological survey of schistosomiasis in 8 - rice farming communities in Niger State, Nigeria, was undertaken. A combination of the Alteration and reagent strip technique were used for the urine samples and the modified Quick-Kato technique for the stool samples was employed. Children up to 21 years of age were involved. Seventy - two (9%) of the 835 subjects examined had urinary schistosomiasis. This comprised 51 (6%) males and 21 (3%) females. 31 (4%) had intestinal schistosomiasis of which 23 (5%) were males and 8(2%) were females. Of the 5(1%) of the subjects who had both infections, 2(1%) showed S. mansoni ova in mixed infection in the urine. 490(59%) of the subjects haboured one or more intestinal parasites besides S. mansoni while 7(1%) had myiasis. Males were more infected than females but intensity was generally higher in females than males. The peak of infection was found in the age group 11-15 years while the highest intensity was found in the age group 6-10 years for S. haematobium and 11-15 years for S. mansoni. At age group of peak intensity of S. haematobium, the mean egg load 10ml of urine for females was 82 eggs while that for males was 47 eggs. Similarly, at age group of peak intensity of S. mansoni. the mean egg load/ gram of faeces was 290 eggs for females and 217 eggs for males. Though proteinuria correlated positively with level of infection for positve cases, haematuria had a higher predictive value and was thus considered overall better indicator. The weed. Oncomelina bractcosa and Banana plants growing along the irrigation cannals provided the ecological cover for the three snail types (Bulinus truncalus. Biomphalaria pfeifieri and Lvmnaea truncatus) found associated with transmission while bathing, laundry, bad hygiene, agricultural practices and fetching of water for domestic activities constituted the major risk factors responsible for human contact.

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CHAPTER ONE

GENERAL INTRODUCTION

Schistosomiasis also known as Bilharzia or Bilharziasis was named after a German pathologist, Theodore Bilharz, who first discovered the parasites in Egypt in 1851. The infection is widespread with relatively low mortality rate, but very high morbidity rate causing severe debility in millions of people. The infection is often associated with water development projects, such as dams and irrigation schemes, where the snail intermediate hosts of the parasite breed. Human activities such as swimming, washing, fishing and farming bring people into contact with the ineffective form of the parasite (W.H.O. 1991).

Schistosomiasis is the most important of all water impounding diseases and is second to malaria in its socio - economic and public health implications (Roger, 1986). The global prevalence of the disease is estimated at 200 million, with an estimated mortality rate of 200,000 per year. 600 million people are considered at risk and about 76 countries are affected world - wide (W.H.O. 1991).

The causative agents of schistosomiasis are trematode flatworms (flukes) of the genus Schistosoma, transmitted from infected snails. Schistosoma mansoni is found in Africa and Latin America; S. haematobium in Africa and Middle East; S . japonicum in South East Asia and parts of Western pacific while S . intercalatum is found in small foci in Africa, and S . mekongi in the Mekong River Basin of South East Asia (W.H.O: 1991).

Of the three main species affecting man, two namely Schistosoma mansoni (causing intestinal schistosomiasis) and Schistosoma haematobium (causing the urinary form) are endemic in Nigeria due to irrigation (Betterton, 1974; Pugh et al ; 1980).

The presence and degree of disease transmission in a community depends on among others the degree of exposure of human populations to the vectors or pathogens. Other than agriculture, other human water contact activities that bring about increase in transmission include Fishing, Laundering, Swimming , domestic and religious practices (Webbe, 1981).

Adult male and female schistosomes live together in blood vessels of different organs; they release egg some of which are passed out in the urine (S . haematobium) or stools (S . mansoni; S . japonicum), but some eggs become lodged in the tissues where they induce inflammatory reactions leading to the pathology of the disease. In urinary schistosomiasis (due to S . haematobium), damage to the urinary tract is revealed by blood in the urine. Urination becomes painful and there is progressive damage to the bladder, ureters, and then to the kidneys. Bladder cancer is quite common in advanced cases (W.H.O ; 1991).

Intestinal schistosomiasis (due to S . mansoni, S . japonicum or S . mekongi) is slower in development. There is progressive enlargement of the liver and spleen as well as damage to the intestine, due to fibrotic lesions around the schistosome eggs lodged in these tissues and hypertension of the abdominal blood vessels leads to blood in the stools and can be fatal (W.H.O; 1991).

In Nigeria, there have been several isolated reports on the prevalence of S . haematobium and relatively very few on S . mansoni since Ramsay, (1935) surveyed a cross section of the former Northern Nigeria mainly among School children, Prisoners, Hospital Patients and Soldiers.

Prevalence of schistosomiasis in Nigeria was reviewed (Cowper, 1963; 1971) and infection rate for some areas in the Northern States (Katsina, Kano, Sokoto, Kaduna and Argungu) was as high as 95%.

Public health implications of schistosomiasis was highlighted in the former Western States (Okpala, 1961a). Prevalence rate in Epe was 91% among school children (Ramsay, 1935) while the overall infection rate in Lagos was 76% (Okpala, 1961b). The infection rate varied from 54% to 100% in Abeokuta and Ibadan schools (Blair, 1956; Akinkugbe 1962; Ogbe, et al, 1990). In Kwara State, the inflection rate at Wawa, Pategi and Share varied from 3% to 87% (Cowper, 1963; 1971; Awogun, 1990).

In Bauchi State, the overall prevalence of S . haematobium and S . mansoni were 17% and 6% respectively. Males were significantly more infected than Females (Istifanus, et al, 1990).

Niger State is well endowed with fertile land and good water distribution pattern that favours rice cultivation through irrigation.

Irrigation continues to be the principal means by which humans modify their environment to increase food supplies. Developments in irrigation technology and agronomy have increased the potential productivity and profitability of agriculture considerably. Unfortunately, irrigation schemes in the tropical and subtropical regions create ecological environments favourable to vector- borne diseases such as schistosomiasis (Bergguist et al; 1988; El - Hawy et al; 1993).

Rice farming, just like other occupation, requires a lot of manpower for maximum yield. This manpower is being lost as a result of high morbidity rate due to this disease. The disease not only affects production of rice, but has denied us enough of vital proteins from fish, as fishing and other water- related occupationist stand the risk of being infected.

Wright, (1972) puts the annual loss due to schistosomiasis from complete and partial disability to be US $445, 886, 945 in Africa, US $.755, 480 in Mauritus, US $16, 527, 275 in South - West Asia, US $118, 143, 675 in South - East Asia, and US $60, 496, 755 for th Americas.

The total estimated annual world loss amounts to US $641, 790,130 but this sum does not include the cost of public health programmes, medical care, or compensation for illness.

School children within the age group of 11 - 15 years have been known to have high prevalence (Istifanus, et al, 1990). This age group commonly swim in infected ponds, river and streams where they acquire infection. Children infected with this parasite are not active and appear dull in the class room, implying poor performance (Kimura, et al ;1992). As a result, this disease could contribute to the falling standard of education in developing countries (Ekanem, et al; 1994).

Considering the huge economic loss due to schistosomiasis, further spread and transmission of the disease should be checked. Nation - wide epidemiological survey will reveal the true status and lead to appropriate planning for concerted nation - wide control.

Niger State is one of the biggest rice - producing states in Nigeria and it will be desirable to evaluate the prevalence and possible impact of schistisomiasis in the state. It is in the light of this, that, this study aims to:

(I) Determine the prevalence of the disease in the rice - farming communities of the state.

(ii) Identify snail vector types and vegetation associated with transmission.

(iii) Examine significance of proteinuria and haematuria in relation to egg load.

(iv) Identify agricultural practices employed by farmers and recommend appropriate control measures.

CHAPTER TWO

2.0 LITERATURE REVIEW.

2.1 LIFE CYCLE AND DEVELOPMENT.

The family schistosomatidae are diocious digenetic trematodes whose adults are found in the blood vascular system of vertebrates. Of the five genera within the family that are confined to mammals, only the genus Schistosoma contains species that are of medical and veterinary importance (Faust et al ;1963; Davey, 1958). Currently, eighteen species of Schistosoma have been recognized (Rollinson et al; 1987). Five species are considered important parasites in man:- Schistosoma haematobium . S . mansoni and S . japonicum are the most wide spread while the other two S. intercalatum and S . mekongi have localized distribution (W.H.O, 1991). Other species such as S . mattheei and S . bovis which naturally infect animals can occasionally infect man without evidence of significant pathophysiology (Laugling, 1986).

Schistosoma mansoni inhabits the inferior mesenteric veins of the colon and shed lateral spined ova that are excreted in faeces (Gelfand et al; 1953). Occasionally the parasites may be found in ectopic sites such as the kidney, probably carried there by the circulation prior to attaining maturity. These blood flukes rely on supply of carbohydrates and utilize glucose from the blood (Buedding, 1950).

The parasite has two phases in its life cycle: man and other vertebrates as definitive host and the snail (Biomphalaria species) as intermediate host. In man, the adult female produces ova which on contact with fresh water, hatch into free - swimming miracidia. Each miracidium must find the appropriate snail host (which is Biomphalaria pfeifferi in Nigeria).

penetrates it and develops into a primary or mother sporocyst, which later produces many secondary or daughter sporocysts (Davey, 1958). Each daughter sporocyst produces numerous forktailed cercarial that escape from the snail and swim about in water. Cercariae escape from infected snail 4 - 7 weeks after its invasion by the miracidium and must find a human host within 48 hours or die (Laugling , 1986). On finding a host it penetrates the skin, looses its tail and becomes a schistosomula (James et al ; 1976), and enters the blood circulation which carries it to the heart and then to the lungs. After some development in the lungs, the young worm goes to the liver to complete its growth. Fully grown schistosoma, the male caring the female in its groove, leave the liver to settle in the inferior mesenteric veins of the colon (Standen, 1949). The average period from cercarial penetration to egg production is 6 - 12 weeks.

Man becomes infected with Schistosoma haematobium by washing / wading in water which contain the ineffective form of the parasite called cercaria (W.H.O , 1991), which can penetrate the unbroken skin. The cercariae enters the blood and lymphatic and circulate until they reach the liver where they continue growing into mature flukes. After one to three months, the flukes begin to migrate out of the liver, and pass into the portal veins and those of the bladder.

The eggs are deposited in the capillaries and they can break through these, many entering the lumen of the bladder to be passed into the urine, (Davey, 1958). In contact with fresh water, the eggs hatch out the ciliated miracidium, which swim in the water in search of their snail host Bulinus globosus. In the snail the miracidia develop, multiply and produce sporocysts, which grow into the infective cercariae. These leave the snail and swim in water in search of definitive host (man) (Davey, 1958)

2.2 Morphology / Biology of the Parasite.

In both sexes of schistosomes, the mouth opens into an oesophagus which is surrounded by glandular cells. the oesophagus extends from the mouth to the ventral sucker, and shows two dilatation . At the anterior margin of the ventral sucker it bifurcates into two branches. In the male, these again unite in the posterior third of the body into a common trunk, which pursues a wavy course and terminates blindly posteriorly. The alimentary canal of a male S . mansoni resembles that of S . haematobium except that in S . haematobium, after primary bifurcation, the two limbs of the intestine re-unite in the anterior half of the body (Davey, 1958).

The lateral margins of the schistosomes are curved ventrally to present a cylindrical appearance (gynecophoric canal). Like all other distomes, it possesses two suckers, viz. a rather small oral sucker surrounding the mouth which is situated at the anterior extremity of the body, and a larger, pedunculated, ventral sucker, placed a little distance behind the oral sucker. The genital pore is situated behind, but close to the ventral sucker. The genital organs consist of four to nine testes placed close together, dorsally, just behind the ventral sucker. From each testis there arises a very short vas efferent. These unite into a common duct-the vas deferent, also extremely short, which dilates at once in a comparatively large globular, seminal vesicle, from which it runs to the genital pore. Copulatory organs are absent (Davey, 1958).

Female S . haematobium is delicately cylindrical, with a length measurement of about 20mm, and a diameter of 0.25mm. The genital organs, exclusive of the vitellaria, occupy the median longitudinal field. On oviposition, the eggs of S .haematobium are immature but when excreted , they have usually become fully embryonated. The fully mature egg of

S . haematobium is elongated, ovoidal , rounded at the anterior pole and provided posteriorly with a terminal spine. It measures 112 to 170 microns in length by 40 to 70 microns in breadth, is straw-coloured and relatively transparent (Faust et al; 1963).

The fully developed eggs of S . mansoni as recovered in the stool, are large, elongated - ovoidal objects, rounded at both ends and provided with conspicuous, lateral spine near one pole, extending at an obtuse angle from the shells long axis. They measure 114 to 175 microns by 45 to 68 microns (Gelfand et al; 1953).

The miracidium is highly organized. It bears an anterior boring papilla from which arises a primitive digestive sac lying between two small penetration glands. There are, in addition, two large unicellular penetration glands, a minute central nervous system, and a well - developed excretory system. The posterior half of the miracidium is occupied by a mass of germ cells. The sporocyst is an elongated thin-walled , sac - like body (Davey, 1958).

The cercaria has a body resembling the adult worm in that it possesses oral sucker and ventral suckers, a rudimentary gut and an excretory system. It differs from the adult worm in the absence or rudimentary condition of the sexual organs, in possessing large secretory glands which are used for emerging from the snail (Figueiredo et al; 1992). penetration and in encystment and in the presence of a prominent tail which may be simple or forked. The tail is cast off when the cercaria becomes a metaceria (James et al ; 1976)

The free - living cercaria swims about in water, drawn by the forked tail (Davey, 1958).

2.3 Transmission of shistosomiasis.

The adult worm pair, male and female, lives inside the mesenteric (S . mansoni, S . japonicum, S . intercalatum S . mekongi) or bladder venules (S . haematobium) in

humans where several hundred to several thousand eggs are produced each day (W.H.O. 1991). In order to hatch and infect the intermediate host. eggs need to be excreted . in faeces or urine. and reach snail inhabited water. S . mansoni eggs show preferential localization in stools with localization in urine being unusual except in heavy infections of S . haematobium (Ratard et al; 1991). After a sexual proliferation in the snail. large numbers of cercaria are released . When these penetrate the skin and enter the human body each cercariae develops into an adult worm via lung - stage schistosomulum larva. Bulinus snails are the vectors of S . haematobium while Biomphalaria snails are the vectors of S . mansoni (W.H.O.1990; Carvalho et al; 1992; Madsen. 1992).

Risk factors in schistosomiasis transmission include water contact through swimming, playing and fishing. fording and bad hygiene. In most places. recreational activities are the major reasons for schistosomiasis transmission (Marcal junior et al; 1993; Lima-e-Costa et al; 1991; Etard et al; 1992).

In a rice farm. pollution of the drain water and irrigation canal by micturition and defecation or use of water for ablution are the major risk factors (el - Hawy et al; 1993) and transmission takes place in these ``**water contact sites**`` that is. places where people come into contact with water.

Other than humans. animals do serve as reservoir host in the transmission of non human schistosomiasis which are the cause of schistosomal dermatitis in man. These animals include dogs. pigs. buffaloes and cows with dog being the main transmission source in some area. Pigs and buffaloes herd and fed in snail habitats are very significant in schistosomiasis transmission (Su et al; 1994). A role for bovine in schistosomiasis transmission has been suggested (Modena et al; 1993). Life cycle of S mansoni was maintained experimentally in the laboratory using the bovine - Biomphalaria glabrata - bovine model.

Wild rodents (Nectomys squamipes Akodon arviculoides and Holochilus braziliensis) have also been found to act as natural host of Schistosoma mansoni and they help in maintaining the transmission cycle (Rodriques e silva et al; 1992:Picot, 1992).

In Nigeria, there are four snail genera transmitting schistosomiasis. These are Bulinus, Lymnaea, Biomphalaria and Cleopatra (Prasertphon, 1990). The population of Bulinus truncatus monitored monthly for a period of one year correlated with weather variations. Snails were active throughout the year and particularly abundant at the end of spring and summer. Two snail generations were found to overlap (Khalla Youne et al; 1992).

The snail vectors of schistosomiasis show different degree of susceptibility to different parasite strains (Wolde Micheal, 1990) and genetic differences in infectivity of snail intermediate host - B . glabrata with strains of S . mansoni: from same geographic area and within a single isolated parasite population has also been reported (Richards, 1976).

In water contact sites, the pattern of snail infection varies with the type of habitats and the variation in season. Dry season transmission potential is high in running water habitats and low in stagnant water habitats. In wet season, the reverse seems to be the case (Okafor, 1990).

Schistosoma mansoni transmission occurred throughout the year while that of S . heamatobium occurred only in dry season (Adewumi et al;1990a).

Environmental factor like salinity plays an important role on the hatchability of the ova and the longevity and infectivity of the miracidia of schistosomes (Donelly et al; 1984). Complete inhibition of hatching of ova occurred in upper salinity while at lower salinity, hatchability was not significantly affected. Miracidial survival decreased progressively in salinities $\geq 7‰$. However, in salinities of 1.75‰ and 3.5‰, survival was significantly greater than in fresh water (≤ 0.05), although this did not appear to infer an increase in infectivity.

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2.4 Ecology of snail intermediate hosts.

Very few distinct relations have been established in snail ecology, and there is a general lack of accurate data. This is due to the euryok character of fresh water snails and their wide ecological tolerance, which results in less adaptation than most other marine or terrestrial organisms. The ecological requirements of snails are qualitatively similar but quantitatively different. Although snail intermediate hosts of S . japonicum are amphibious, their response to differences in physical, chemical, and biological factors in water are similar to those of acquatic molluscs. On land they favour moisture and shade (Webbe, 1982).

Bulinid and planorbid intermediate hosts of S . heamatobium and S . mansoni are found in many different habitats, including man - made lakes, irrigation and drainage channels, small water impoundment and rice fields . The amphibious oncomelanid species inhabit flood plains and habitats resulting from agricultural development drainage channels, road side ditches, rice-fields, and smaller irrigation channels and drains (Sturrock and Upatham, 1973).

Three generations of snail (parents generation, autumn generation and spring generation had been recognized (Khallayoune et al; 1992; Yousif et al; 1993).

Two phases of growth were distinguished in both autumn and spring generations, a faster phase followed by a slower one. The faster phase extends from January to May and from March to August in the autumn and spring generations respectively. The daily mortality rate of snails is highest in hot season (June - September) and lowest in the cold months (December - April) (Yousif et al; 1993).

The distribution of snail intermediate hosts may be influenced by geological factors such as topography. Steep stream gradient and in most cases marginal shallows supports high snail density (IRRI. 1988).

Rainfall cycles affect the life history of snails and determine seasonal fluctuations in their density. For example, in the bulinid, intense breeding has been reported following seasonal rainfall (IRRI. 1988).

Temperature is apparently the abiotic factor of greatest importance in determining the distribution of host snails in ponds and lakes. Low winter temperatures in temperate and subtropical zones reduces or stop breeding completely. When temperature increase, breeding resumes and snail populations reach maximum. There is no conclusive evidence for reproductive and population cycles, independent of cyclic fluctuation of environmental factors, but irregular population changes independent of seasonal factors may occur (Webbe, 1982).

Most habitats contain rich microflora which, together with decaying vegetable matter, provide the principal food of snails. Although snails may not prefer any particular species of microflora, the quantitative composition of the diet is probably important in conditioning the habitat. Snails thrive in habitats devoid of higher plant life but rich in green algae, blue green algae, and diatoms. No casual relationship with a particular species of algae or diatom has been established though some snails correlate positively with the presence of green algae but negatively with blue - green algae (Webbe, 1982).

2.5 Pathology of schistosomiasis.

The pathologic changes resulting from schistosome infection in a susceptible host are divided into three consecutive periods viz. (i) biologic incubation, from skin penetration until the worms have arrived and matured in the venules of the intestine or urinary bladder and the females are ready to oviposit; (ii) The acute stage, which is one of active egg deposition and extrusion, and (iii) The chronic stage, that of tissue proliferation and repair (Faust, 1963).

2.5.1 **Biologic incubation** - During this period, the major pathologic effect is swimmers itch . Swimmers itch is a maculopapular eruption associated with the penetration of the skin by cercaria of non human schistosomes (Kulla Vanijaya, 1993; Kolarova et al; 1992). The penetration of the cercariae into the skin produces a prickling or itching sensation, followed by macules and papules or even urticarial and vesicular eruption in the case of heavy and repeated exposure (Thune, 1994).

The schistosomula larvae in passing through the lung may cause an eosinophilic infiltration and while developing in the portal system, parasites metabolic products cause a toxic hepatitis often accompanied by irregular fluctuating fever and allergic manifestations such as urticaria (Waren et al; 1967).

In the blood, adult S . mansoni ingest hosts (human) red blood cells (RBC) and in doing so perturbs hosts RBC shape , volume and membrane organization (Thatte, et al, 1993) but in the peritoneal of an inbred AKR/J mice, adult female S . mansoni showed no evidence of red blood cells ingestion (Bicalho,et al, 1993).

2.5.2. **The acute stage** : is characterized by active egg deposition in the intestine or bladder. During this period trauma may produce intestinal or bladder hemorrhage and pseudodysentry in Schistosoma mansoni infections.

Even in these early stages of the disease, numerous eggs may escape into the circulation rather than migrate through tissue to organ lumina. These embolic eggs later get lodged in numbers either in the small hepatic veins of the liver or that of the lungs where they exert the typical delayed hypersensitivity reaction which produce a granuloma around the affected vein (Waren, et al. 1967).

2.5.3. During the chronic stage of the disease, pathology of schistosomiasis is to a considerable extent immunological in nature. The granulomatous responses of the host to eggs in tissues are manifestations of delayed hypersensitivity (Waren et al; 1967; Waren, 1972). The granulomas are distinct form of chronic inflammation characterized by localized aggregation of activated macrophages around an inciting stimulus. Each granuloma evolves to form a fibrous scar; in schistosomiasis, the result is widespread hepatic fibrosis and portal hypertension (Amiri et al; 1992).

In Schistosoma mansoni infection, the typical granulomas occur in the colon, with the small intestine only occasionally affected. The mucosa is congested and nodules and polyps may develop. Large polyps in the active stage, and fibrotic narrowing later, may cause intestinal obstruction and even excessive protein loss (Lehman et al; 1970). Although the symptoms they cause are not certain, they can cause considerable protein loss in the gut, which is a function of the extent of the polyposis and mucosal disease and is not apparently related to the intensity of egg excretion.

Concomitant with liver damage found in Schistosoma mansoni infections, circulatory impairment produces portal hypertension, splenic enlargement, oesophageal varices and ascites (Aufses et al; 1992; Khalil et al; 1992; Aboul - eneim et al;1994).

Occasionally ova reach the nervous system (Hoff et al; 1939; Levy, 1970). The resulting granuloma may mimic a tumor in the brain or cause paraplegia if its in the spinal cord (Hersko Witz, 1972; Siddorn, 1978).

2.6 Diagnosis of Schistosomiais.

2.6.1 Parasitological diagnosis:-

This depends on microscopic examination of faeces and urine for ova of parasite (WHO.1983.) The urine samples are collected at the time of peak S. haematobium egg excretion which falls between 10.00 hours and 14.00 hours (Pugh, 1979). Different techniques has been described for the parasitological diagnosis of schistosomiasis, all of which involves microscopy. One of these methods involve filtration of a given volume of urine (Peters et al; 1976) and a given quantity of stool (Pugh, 1978). Other methods involve concentration of parasite ova in stool or urine by centrifugation (Asaolu et al; 1990, Feldmeier, 1979). This method, though very sensitive, is time consuming and its not recommended for field studies. The Kato technique being one of the cheapest, and highly sensitive technique is currently in use for field diagnosis of Schistosoma mansoni (Katze et al; 1972; Teesdale et al; 1976; Peters et al; 1980).

Rectal biopsy and bladder mucosa biopsy are diagnostic when faeces and urine give a doubtful result (Rabello, 1992). Reagent strips has also been used as indirect morbidity indicators in Schistosoma haematobium infection (Jameneh et al; 1993; Nwaorgu et al; 1992 , Savioli et al ; 1990, Wilkins et al; 1979, Evangard, 1990) and its used mostly along with the urine filtration technique. The strip has high sensitivity and specificity to heamaturia and proteinuria at trace quantities but haematuria had a higher predictive value for positive test and was considered, the overall better indicator (Nwaorgu et al; 1992; Lengeler et al; 1993). In all the techniques described above the presence of lateral spined ova in stool is diagnostic of S . mansoni and a terminal spined ova in urine of S. haematabium. However, S. mansoni ova could be seen in urine in heavy infections (Ratard et al; 1991).

2.6.2 Serological diagnosis:-

The most efficacious and practical means of diagnosing human schistosomiasis is based on infection specific antibodies (Tsang et al; 1991). Because of their high sensitivity, antibody assays remain the most practical assays for epidemiologic studies and patient management. Immunodiagnostic tests used in the diagnosis of schistosomiasis include intradermal test, Circumoval precipitin test (COPT), the cercarian Hullen reaction, the miracidial immobilization test; the cercarial fluorescent antibody test (IFAT), Enzyme linked immunoosorbent assay (ELISA) and the indirect heamagglutination test (IHAT) (Abdel-Hafez et al; 1983; Deedler et al; 1989; Eltiro et al; 1992). Intradermal test is useful as a screening test and skin reaction occur in 15-20 minutes. Its efficacy varies between 70-97%, but has the disadvantage of giving positive reaction for many years even after successful treatment of infection. Antigenicity of Schistosoma mansoni and S. japonicum eggs preserved in ethanol or acetone can be assessed using circumoval precipitin (COP) assay. The egg antigens are found to retain sufficiently their reactivity for the diagnosis of both schistosomiasis mansoni and japonica although their reactivity became lower than that of lyophilized eggs (Kamiya et al; 1991; De Noya et al; 1992). These alternative preparations for COP tests have advantages such as keeping eggs directly in fixatives soon after the egg purification process.

Indirect haemagglutination assay (IHA) is employed in testing sera of patients with Schistosoma japonicum, S. mansoni or S . haematobium using soluble S . japonicum egg antigen (Sj S.E.A) and soluble S. mansoni adult antigen (Gui et al; 1991). Reactions are best in terms of titter and sensitivity in homologous systems. Heterologous systems are less reliable, particularly those using sera from urinary schistosomiasis patient. IHA test shows high sensitivity which decreases with the progress of clinical status of the disease if adult worm antigen are used.

IHAT adult antigen is more sensitive for serodiagnosis than with cercarial antigen whereas ELISA is less sensitive using both cercarial and adult antigens (el- Ganayni et al; 1992). Immunofluorescence antibody technique (I F A T) is an immunodiagnostic test used in the diagnosis of schistosomiasis.

Antigens employed in this test can be cryosections of Schistosoma mansoni adults, formalin fixed cercaria and cryosections of infected liver from gold hamster, which contains granuloma (Hussein et al; 1992). The cryosection of adult worm is more reliable and more specific as antigens for immunofluorescence . Diagnostic efficacy can be as high as 95.52%. But the cercarial and schistosomulal antigens, both of which can be produced more quickly and cheaply than adult worm antigen, could serve as a reliable alternatives to the adult worm antigen in serodiagnosis of schistosomiasis (Kanamura et al; 1992).

Immunoenzymatic staining technique (I E S T) has also been employed in the sero-diagnosis of schistosomiasis (Gu et al; 1992). Here, PVC membrane are used instead of the slide in detecting specific antibodies in sera of patients. The PVC - I EST is simpler to perform than SLIDE - IEST, and it is thus suggested as a more suitable test for field application.

Enzyme linked immunosorbent assay (ELISA) is another accurate and rapid technique used for the detection of antischistosomal antibodies. Fast ELISA can be used in initial field screening and species specific confirmation done by immunoblot using adult microsomal antigen (Tsang, et al, 1991). Dot ELISA can have a sensitivity of 99%, specificity of 98% and high diagnostic accuracy of 98% (el - Missiry et al; 1990; Qian et al; 1993).

A monoclonal antibody (MAb) based antigen-capture enzyme linked immunosorbent assay (ELISA), which recognizes a repeating carbohydrate epitope expressed at all stages of parasite development has been reported (Hassan et al; 1992).

Overall sensitivity is 78%. It has a sensitivity of 100% for patients excreting greater than 100 eggs /g of faeces and 72% for those excreting less than 100 eggs /g of faeces. ELISA has been evaluated using soluble egg antigen (S.EA) (Eltiro et al; 1992).

The false positivity occasionally recorded with the test in endemic areas appear to be due to inapparent S . mansoni infection. Two schistosomal circulating antigens, the circulating anodic antigen (CAA) and the circulating cathodic antigen (CCA) has been assayed using a manoclonal antibody based ELISA (Van Leishout et al; 1992): both antigens could be specifically demonstrable in 82% and 88% of urine samples respectively. Highest sensitivity is achieved when serum CCA assay is combined with urine CCA assay (98%) or with the urine CAA assay (97%). A significant correlation exists between level of circulating antigens and the number of parasite eggs in faeces.

Immunodiagnosis (ELISA) and stool examination (Kato technique) used together in the diagnosis of S . mansoni, detected Schistosoma antibodies in 99% of the parasitologically positive individuals and 4.8% and 12.5% of the negative ones from endemic and non endemic areas respectively (Jemaneh, 1993), sensitivity and specificity of the test being 99% and 87.5%, respectively.

2.7 Immunology of the disease:-

The major immunologic feature in schistosomiasis infection is response to invading worms which is both humoral (Ig E, Ig M, Ig G) and cellular (eosinophils, macrophages). Studies have shown that schistosome infected individuals in an endemic area who had been treated with antischistosome drugs displayed an age dependent resistance to reinfection. Children were much more easily reinfected than were adults, suggesting that true human immunity can be acquired with age (Stites et al; 1987). However, an important unresolved question is whether immunity to schistosomiasis develops in humans after infection.

Epidemiological studies in an S . mansoni endemic area has also shown that high infection levels aggregated within certain families rather than randomly distributed. This observation suggests that human susceptibility or resistance to S . mansoni is genetically determined, and segregation analysis has provided strong evidence to suggest that susceptibility is controlled by a co-dominant major gene (Abel et al; 1991).

Adult worm appears to evade the host immune responses by a mechanism permitting the addition of host proteins to its outer surface implying that a successful vaccine can only be directed against the larval stages and designed in such a way that protective immunity is stimulated without simultaneously giving rise to blocking antibodies. With advances in molecular biology, more than 20 cloned full-length schistosome antigens have been discovered (W.H.O; 1991). However these pure antigens do not consistently induce sufficiently high levels of protection but this can be achieved by combining several of them.

The primary aim of vaccine development in schistosomiasis is not to block infection or transmission but instead to counteract morbidity resulting from granuloma formation around eggs deposited in the tissues. This is achieved either by attempting to reduce the number of parasites reaching the egg- laying stage in the host by reducing the number of eggs produced by each worm pair, or by reducing the grannulomatous response to the egg (W.H.O; 1991). Eight adult worm surface epitopes, ranging from 11KD to more than 200KD, which are also expressed on the schistosomulum membrane, have been identified (Simpson, 1987). These antigens have now been isolated, cloned and thoroughly investigated with regards to efficacy as immunogens. A 25KD molecule shows the most promise and is currently being subjected to vaccination studies in mice.

In addition it has been found that sera from human subjects with low susceptibility to infection by S . mansoni react with larval 37KD surface antigen which has also been cloned (Smitt et al; 1985).

Different iso - enzyme variants of glutathionine s - transferase (GST), including 26KD and 28KD molecules from S .mansoni and S . japonicum, confer protection in several experimental animals. Among these variants, the S . mansoni 28KD GST antigen has also recently been shown to reduce egg fecundity and egg production. This effect makes Sm 28 a particularly well-suited candidate for a vaccine consisting of different combined antigens (W.H.O; 1993).

Triosephosphate isomerase (TPI) which was first isolated from the S. monsoni membrane has now been produced by genetic cloning (Shoemaker et al; 1992).

Egg shell contains no more than three protein constituents. The genes coding for these constituents have also been cloned (Harn et al; 1984). The invertebrate myofibrillar protein paramyosin, another candidate vaccine molecule, has been inserted and expressed in the BCG bacillus and preliminary results indicate that a protective response can be induced in mice (Lanar et al ; 1986).

2.7.1 Regulation of immune response.

In contrast to concomitant immunity which results from natural infection, vaccine immunity, induced by exposure to live but attenuated cercaria , or purified antigens is purely an immunological mechanism. In the rat, vaccine immunity is mainly characterized by strong Ig E response (W.H.O; 1993).

Resistance to infection seems to be controlled by two sub-populations of T- helper cells, Th 1 and Th 2 . The former causes macrophage mediated response through the production of interferon - gamma (INF-ɣ) (Sher et al; 1990) and an interleukin (IL-2).

whilst eosinophilia, and certain isotype response rely on secretion of IL-4, IL-5 and IL-10 (Yamashita et al; 1992; Sher et al; 1990) induced by the later type of cell. Vaccination of mice with non-viable irradiated cercaria results in a Th 1 response correlated to the development of resistance while infection with normal cercaria induces a Th2 response without protection as shown by egg excretion (Pearce et al; 1991; Grzych et al; 1991). Interestingly, transfer of egg to vaccinated mice incurs a switch from a predominantly Th1 response to one dominated by Th2 cells, thus permitting infection and further egg deposition (Grzych et al; 1991).

The interleukins, IL-4, IL-10 and the transformation growth factor TGF-B are potent down regulating cytokines capable of inhibiting schistosomular destruction (Oswald et al; 1992, Stadecker et al; 1990). The supernatant from a line of splenic cells emanating from a mouse infected with S . mansoni was reported to inhibit the growth of a culture of Th1 cells, an effect which could be blocked by the addition of antibodies against IL-10. Th2 activation is conceivably a strategy used by schistosomula to evade macrophage - mediated killing (Pearce et al; 1991).

Despite recent cytokine research work, the exact nature of the Th1 / Th2 balance remains unclear. On the one hand there is the finding of a reversed balance of INF-δ/IL-4 persisting at least three months after cure (Zwingenberger et al; 1990), disturbed CD3 / CD8 expressions and a reversed decrease of interleukin-1(IL-1) in patients infected with S . mansoni. On the other hand, the correlation of high levels of specific Ig E antibodies with post-treament resistance found in cohorts of African subjects infected with either S . haematobium or S . mansoni does not seem to comply with this observation (Auriault et al; 1990; Hagan et al; 1991).

2.8 Treatment

2.8.1 Chemotherapy

Treatment in schistosomiasis brings about a reduction in egg load in infected individuals thus reducing transmission rate. The risk of morbidity and mortality is also drastically reduced, enabling the infected individual to recover from reversible lesions (W.H.O, 1980).

A number of antischistosomicidal drugs have been used. One of these is sodium antimony tartrate, administered as 2mg/kg body weight intravenously on alternate days. It is effective on both S . mansoni and S . haematobium but the drug is difficult to administer and it is highly toxic. Several other modern safe anti schistosomal drugs were subsequently introduced, but none exhibits a complete antischistosomal spectrum (Green Wood et al; 1992). They include Niridazole, Metrifonate, Cyclosporin A (Cs A) Colchicine, Artemisinin (Artemether), Oxamniquine, Hycanthone and Praziquantel (W.H.O; 1980; Riley et al; 1990; Ismail et al; 1992; Wururu, 1992; El-aggan et al; 1992; Araujo et al; 1991; El-malataway et al; 1992).

2.8.1.1 Niridazole (Ambilhar).

Niridazole is administered at 25mg/kg body weight orally. It has a 75 - 95% cure rate for S . haematobium and about 75% for S . mansoni. Its antischistosomal effect involves delaying migration of schistosomula from lungs to the liver. Side effects include lassitude, nausea, vomiting, occasional convulsion and psychosis (Wururu, 1992).

2.81.2 Metrifonate (organophosphate).

It is administered as 75mg/kg body weight orally once every 2-4 weeks. It is cheap but requires 3 spaced doses and it is only effective against Schistosoma haematobium (WHO,1991). Overdoses of metrifonate causes organophosphate poisoning.

2.8.1.3 Cyclosparin A (Cs A):-

This drug has a profound antischistosomal activity and immunosupressive effect on T- helper (Th) cells. It is administered as 50mg/kg body weight for five consecutive days . It ameliorates glomerular lesion in early stages of schistosomal nephropathy, mainly by its immunosuppresive effect but in later stages, the direct antischistosomicidal effect takes the upper hand (El- aggan et al; 1992).

2.8.1.4 Colchicine:-

This is administered as 40 micrograms / kg body weight per day for 7 weeks. Colchicine has therapeutic effect against schistosomal liver fibrosis (Jiang et al; 1990). It relieves ultra structural injury of liver cells and reduces the number of active fibroblasts and collagen microfibrils.

2.8.1.5 Artenmisinin (Artemether)

The drug is administered intramuscularly as a single dose of 100mg /kg body weight per day. Experimental administration on mice, causes a marked decrease in the length of male and female worms, degenerative alterations in the parenchyma and in the reproductive system of the females , with the reduction of vitellenic material and in ovary volume and marked depigmentation of the intestinal content (Araujo et al; 1991).

2.8.1.6 Oxamniquine:-

It is administered orally as a single dose of 15- 30mg / kg body weight. In children 20mg/kg body weight is ideal. It is only effective against S. mansoni and has a cure rate of 85-95%. Side effects includes occasional drowsiness and dizziness (WHO, 1991).

Oxamniquine reverses depression of T- Cell responsiveness normally associated with schistosomiasis (Junqueira, et al. 1991).

2.8. 1.7 Praziquantel.

Praziquantel is effective in a single dose against all species of schistosomes which shows resemblance in drug response (He et al; 1991) and it is established as the drug of choice (W.H.O, 1991; Ismail et al ; 1992; Doehring- Schwerdtfeger et al ; 1992).
It is administered orally at 40mg kg body weight. Because of its lack of toxicity and simplicity in administration, it has been used in control programmes in addition to molluscicide and water purification (Greenwood et al ;1992; El-malatawy et al; 1992).

With paraziquantel, healing of hepatic pathology is slower than parasitological cure. However, hepatic healing is dose related while parasitological cure requires less doses (El-Hawey, 1990). When administered in the food of mature Biomphalaria glabrata, it destroys mature and developing cercariae within the daughter sporocyst but had no apparent effect on the daughter sporocyst (Riley et al; 1990).

2.8 .1.8 Immunotherapy:-.

Evidence has grown for the view that humans naturally acquire immunity to schistosomes at least to S.mansoni and S. haematobium, confirming the potential for vaccine development. Facing also the ubiquity of rapid reinfection after chemotherapy, there is , thus , need to find a candidate vaccine that can modulate pathology without interfering with mechanisms conferring protection (WHO/TDR,1993).

A number of parasite antigens have been discovered and cloned to serve as candidate vaccines. These include gluta thionine- S- transferase (GST) (Auriault et al; 985; Marquerite et al; 1992); trios-phosphate (TPI) (Harn et al ; 1984) and paramyosin (Larnar et al; 1986).

Others are schistosomular surface antigen including the 37 KD. 38KD and the different 22KD molecules, one of which induces a specific IgE response.

Egg antigens as well as cercarial antigens have been cloned and this may prove useful in early prevention of parasite entry (W.H.O. 1993). Antibodies to cytokines like interleukin -2(IL-2)have been used in the generation of Th2 rather thanTh1 response (Cheever, et al, 1992). All these attempts are targeted at reducing morbidity due to the disease.

2. 9 Schistosomiasis control.

The control of schistosomiasis 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 (W.H.O, 1980). The main aim of control of schistosomiasis has always been prevention of clinical manifestation of infection. This can be achieved through:

(a) Control of population morbidity

(b) Control of transmission.

Four general methods namely chemotherapy, snail control, reduction in water contact and contamination and improved living standards are commonly employed (Laughing, 1986; W.H.O, 1980; Jarallah et al; 1993; Barbosa et al; 1992).

2.9.1 Chemotherapy.

This reduces the output of live eggs from infected individuals, thus diminishing transmission. By killing worms in the treated individual, it not only reduces the risk of morbidity and mortality due to the disease, but also enables the patient to recover from reversible lesion (W.H.O. 1980).

The modern safe antischistosomicidal drugs are Oxamniquine, Metrifonate, Niridazol, Hycanthone and Praziquantel (W.H.O. 1985). Therapy could be mass or target population chemotherapy.

2.9.2 Snail control.

This can be effective but requires a prolonged and sustained effort at control (W.H.O, 1987). Snail control may be achieved by the use of molluscicides, biological control and environmental modification.

Molluscicides are the most cost effective where, the volume of water to be treated per person at risk is small. The more common mollucicides are Niclosamide, Trifenmorph, Copper etc. (Mac Culough et al; 1980).

Molluscicides of the plant origin have also been extensively studied in recent times, popular among which are Phytolacca dodeccandra and Ambrosia maritima (Belot et al; 1993). In Nigeria, Adewumi and Adewumi, (1990) showed that twenty three(23) of the plant extracts screened were molluscicidal. Common among these are Tetrapleura Tetraptera and Zingiber officinale.Many plant molluscicides, however are not target specific (W.H.O, 1980); They are piscicidal.

Biological control of snails is based on the use of potential competitors, predators or parasites such as ducks, fish, turtles, fungi and leeches. Intermolluscan competition and predation is recently gaining ground and has received considerable attention (W.H.O, 1980; Joubert et al; 1990).

Marisa cornuarietis, which has been evaluated as a potential competitor in Puerto Rico, has also been observed to feed on rice seedling. Therefore its use in control of snail hosts of schistosomiasis in rice irrigation cannot be recommended (W.H.O, 1984).

2.9.3 Control by environmental modification.

Habitat modification through drainage, land reclamation and good water management practices have been shown to be an effective means of eliminating the intermediate snail host of schistosomiasis (Bradley et al; 1978). In an irrigation scheme in Iran, swamp drainage and proper design have been cited as an important snail control measure (Herbert, 1978; Pike, 1987). In the Philippines (Santos, 1984; Makiya et al; 1986) and in China (Mao. 1986) where the amphibious oncomelania snail transmit S. Japonicum, wide range of environmental modification has been employed.

2.9.4 Crop selection.

Selection of crops , crop rotation and farming practices can play an important part in schistosomiasis control program. If preference is given to crops that do not require large amount of water, control or elimination of snail habitats is greatly facilitated (Pesigan et al; 1958). Farming practices could be scheduled so that water could be turned off at suitable intervals in snail breeding.

2.9.5 Intermittent irrigation.

In the Philippines, the number of snails has reduced from 200 to less than 1 meter square and rice yields increased by more than 50% in areas where intermittent irrigation replaced ponding (Yoshida, 1984, Tsutsui, 1984).

2.9.6 Health education and community participation.

Health education now ranks as the highest priority in schistosomiasis control program (WHO, 1985; Teesdale, 1986). The importance of community participation has been

demonstrated by a number of workers including Ravaolimalala. (1986) and Tauner et al; (1986). All control programmes require the knowledge, attitude and practice of a community in relation to personal hygiene, perception of schistosomiasis, its diagnosis and treatment be understood before action is initiated.

2.9.7 Sanitation and water supply.

The aim of these two approaches is to reduce human water contact and contamination of water by infected individuals. The construction and use of latrines should be encouraged to improve the general standard of hygiene and to reduce the general incidence of other faecal-born diseases as well (Weir et al; 1952).

The beneficial role of water supply in the control of schistosomiasis has been highlighted (Jordan et al; 1982: Mc-Junkin. 1983). A number of innovative types of water supply has been tested in endemic areas of Brazil (Sleigh et al : 1986). The cost of water supply systems varies and must be adopted to suite local conditions (Werler, 1986).

CHAPTER THREE

3.0 MATERIALS AND METHODS:

3. 1. METHODOLOGY:

3. 1. 1. STUDY AREA:

Niger State is made up of eighteen (18) local Government Areas. It has a population of about 2. 482. 367 comprising 1.290.720 males and 1.191.647 females (Anonymous, 1992). Majority of these are farmers involved in the cultivation of crops like maize, millet, beans, rice, yam and cassava. Of these crops. rice is the most widely cultivated crop due to availability of abundant surface water. Niger state lies in the middle belt of the country and covers a total land area of 74.244 square kilometre. representing 8.1% of total land area of Nigeria. It is located at longitude 4^{0} - 8^{0} E and latitude 7.1^{0} - 11^{0} N. It has boundaries with Kebbi, Sokoto and Kaduna States to the North. Federal Capital Teritory (FCT) to the East, Benin Republic to the West and Kwara and Kogi States to the South.

Rainy season starts between April and May and ends in October. The length of rainy season varies from between 160-200 days annually. The mean annual rainfall figures range between 1.100-1.300mm with maximum in Suleja. Chanchaga. Rafi and Lapai. Dry season is between November and March each year. The mean annual temperature is 25^{0}C.

The state has numerous Rivers/Streams viz:-River Kaduna, Kontagora, Gbako, Malendo, Eku, Eba, Mariga, Mando, Chanchaga, Jatau and Gurara Rivers. Most of these Rivers are tributaries of River Niger. The rivers flood most of the plains givng rise to flood plains suitable for cultivation of cereals e.g rice (Mohammed, 1991).

The study was carried out in eight rice -farming communities of Niger State. The communities were Amale and Adunu with an estimated population of about 1, 300 and 2,000 inhabitants respectively both in Paikoro Local Government Area; Kuta, Gusoro and Shiroro with an estimated population of about 10,000, 1,200, 3000 respectively in Shiroro Local Government Area and Maikonkele, Chanchaga and Tagwai with an estimated population of 2,500, 4,000 and 2,000 inhabitants respectively in Bosso Local Government Area of the state (Fig.1).

Most of the communities studied had no pipe borne water and hospitals. They all had Schools and Market places where people buy and sell once weekly. The most common means of disposing waste like faeces is by the pit latrine which is not owned by every households in the communities. As a result, people defaecate in open fields and farm lands. These faeces are washed into nearby rivers/streams during rainy season.

Some Communities depend on dammed spring for both domestic and agricultural purposes while others rely on nearby streams or ponds for same purpose (Plate V,VI and VII). In communities where pipe borne water are not available, supply is irregular and scanty. Because of the overwhelming need to increase agricultural out-put, there also arose the need for an increase in water development projects. For example the Shiroro and Tagwai dams in Niger State.

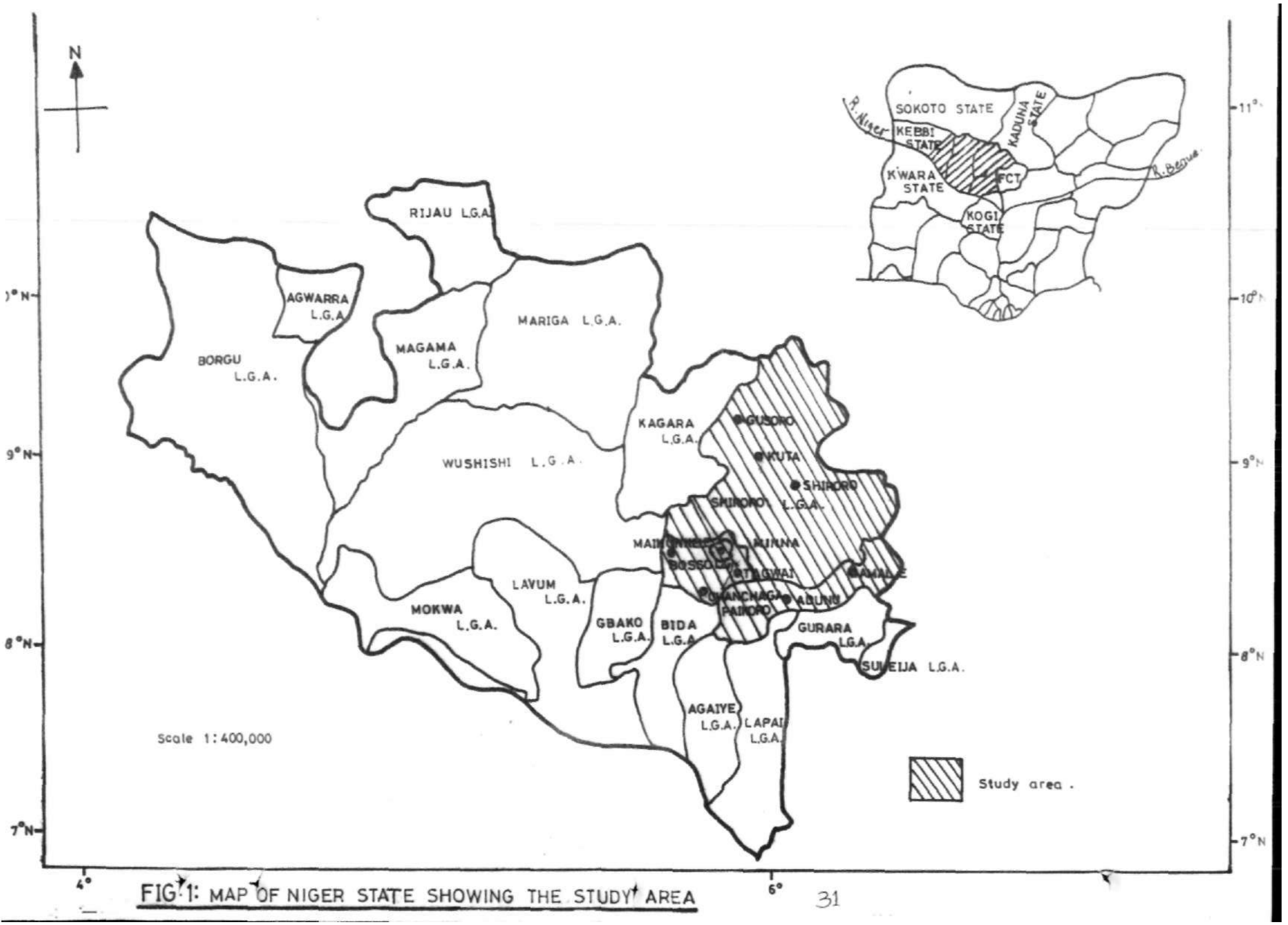


FIG 1: MAP OF NIGER STATE SHOWING THE STUDY AREA

This has led to a situation whereby large areas of land , which in the past, lacked water for most of the year, now enjoy abundanceof surface water. The ecological consequence is wide spread of fresh water snails of the genus Bulinus and Biomphalaria involved in the transmission of schistosomiasis in the study Area.

Banana plants and weeds like Commelina bracteosa growing along the irrigation cannals (plate II) provides the ecological cover required for the breeding of the amphibious snails which according to Webbe (1982) prefer shade and moisture when on land.

In all the communities studied, bathing laundry, bad hygiene, agricultural practices and fetching of water for domestic activities are the major risk factors that bring man in contact with infected water (Plate IV and V). In a rice farm, risk factors include pollution of drain water and irrigation cannal by micturation and defaecation or use of water for ablution.

Transmission thus takes place at this water ``**water contact sites**`` where the infective form of the parasite (cercariae) enters the skin. On emerging from the snail, the cercariae has only between 48-72 hours to find a definitive host or die. It achieves this by swimming about in water with the aid of its forked tail. The search is made easier for the parasite as most settlements in the study area are very close to the infected streams, rivers or cannals. This has, thus made accesibility easy for both the school children and adults who according to Pike (1987) prefer nearby streams than those farther away.

3.1.2 SAMPLE SIZE:

A total of 1,670 samples made up of 835 each of urine and stool were collected from school aged children comprising 437 males and398 females.

3.1.3 SPECIMEN COLLECTION /PRESERVATION:

Before the collection of specimens in any community, the rivers , streams or ponds in such community are searched for snail vectors. Once presence of snail were established, specimens were then randomly collected from school aged children in the community.

Prior to issueing out of specimen containers, name,sex and age of the children were noted. Two separate containers were used -one for urine and the other for stool.
Urine samples collected between 11.00 hours and 13.00 hours were preserved with 0.002% carbol fuchsin and a drop of eosin was added to each to increase subsequent staining and to remove odour (Frank et al; 1984; Pugh, 1978).

Stool samples were preserved with 10% formalin and both specimens were transported to the laboratory for analysis.

3.1.4. URINE ANALYSIS:

A filteration method for the detection of S. haematobium eggs in urine (Pugh, 1978) was used. This method involved thoroughly mixing of urine samples by drawing urine in and out with a disposable plastic syringewithout needle. 10ml alignuot was then drawn and emptied into the filteration chamber of the filtering apparatus already connected to a vacuum pump machine. The machine was then switched - on and the urine drained through the filter (Whatman No, 541) of pore size 8um by suction.
The chamber was opened and the filter removed and placed on a clean flat surface. Contamination of syringe or chamber by eggs was monitored by rinsing syringes and chamber after every filteration in a solution of detergent.

The filter papers were then moistened with freshly prepared 0.1% Ninhydrin stain and left for 3 hours at room temperature for the eggs retained on the filters to pick up the stain. The dried stained filter papers were placed on glass slides, moistened with distilled water and examined with the X10 and X40 magnification. The filter papers were scanned thoroughly and egg count per 10ml urine were recorded.

3.1.5 HAEMATURIA AND PROTEINURIA

Haematuria and proteinuria were detected using Ames multistix (Boehringer) which has test spot for blood, urobilinogen, bilirubin, glucose, protein, ketone and PH ((Wilkins et al ;1990). Urine samples that were positive for Schistosoma haematobium were tested with the reagent strip for proteinuria and haematuria. The level of protein /blood in urine was recorded. Samples that showed visible blood were also noted. Other parameters like PH, bilirubin and ketone in urine samples were also recorded (Feldmeier et al, 1982).

3.1.6 STOOL ANALYSIS.

Stool samples were analysed using a modification of Quick-Kato technique (Peters et, al; 1980; Martin and Beaver, 1968). In the method, each stool sample was forced through a cloth mesh (Size 105) tied to the mouth of the container to facilitate sieving. Each filtered sample was then used to level-fill two 8.1mm diameter holes in 1mm thick stainless steel template, previously placed flat on a glass slide. Carefull removal of the template leaves two intact plugs of faeces of 50mg each. To these plugs was added, each two drops of freshly prepared 0.1% ninhydrin, mixed with a wooden spatula and then covered with cover-slip.

They were then examined microscopically using the x10 objective and x10 eye pieces. The total number of eggs seen on the slide was then multiplied by 10 to give an estimate of the eggs per gram of sieved stool (Peters et al; 1980).

The used steel templates were discarded in a solution of disinfectant to be recycled for further usage.

3.1.7 SNAIL SURVEY.

Snail survey was carried out prior to sample collection. This was done by searching for the snail vectors in the water sources (Dams, rivers, streams and ponds) used by the community for domestic, recreational or agricultural activities.

Where snail vectors were established, type and distribution were noted. Each type were then sampled and taken to the laboratory for identification and evidence of cercaria shedding.

3.1.8 CERCARIAE SHEDDING.

Snails collected were washed and placed in a clean container containing 5mls of distilled water. The container and content were then exposed to light for about 2-3 hours after which it was examined for characteristic cercariae movements.

A drop of water from the container was then placed on a microscope slide, cover-slip placed and then re-examined to confirm cercaria (Kuntz, 1947).

CHAPTER FOUR

4.0 RESULT:.

4.1. Prevalence of the disease.

A total of 835 pairs of samples were collected from children within the age groups of 0.5 to 21 years in the study area. This was made up of 437 (53%) males and 398 (47%) females.

Of these, 31 (4%) had intestinal schistosomiasis. 23 (5%) males and 8 (2%) females were infected. The prevalence of the disease varied between 4% and 7% for the male age groups. The overall prevalence of intestinal schistosomiasis is higher in males than in females and peak prevalence occurred at age groups 1-5 years and 11-15 years. (Fig. 2, Appendix 4).

Seventy two (9%) children had urinary schistosomiasis out of the 835 samples examined. These comprised 51 (12%) males and 21(5%) females. Here too, prevalence was higher in males than females with peak prevalence recorded at age group 11 - 15 years for both sexes (Fig 3, Appendix 5).

In all, 103 (7%) children within the study area had schistosomiasis of either kind. Generally the difference in prevalence between the sexes and among age groups was statistically not significant.

5 (1%) males had double infection of urinary and intestinal schistosomiasis while S . mansoni eggs were found in the urine of two (1%) subjects in mixed infection.

4.2. Intensity of infection:

The mean egg load for males with S . mansoni was approximately168 eggs/gram of faeces. In females the mean egg load was 225 eggs/gram feaces, indicating that intensity was more in females than males. However, the difference in intensity between males and females and between age groups was statistically not significant (P> 0.05). The age group 11 - 15 years had the highest intensity of infection (Fig. 4. Appendix 6). The total mean egg per gram of faeces in the study area was approximately 183.

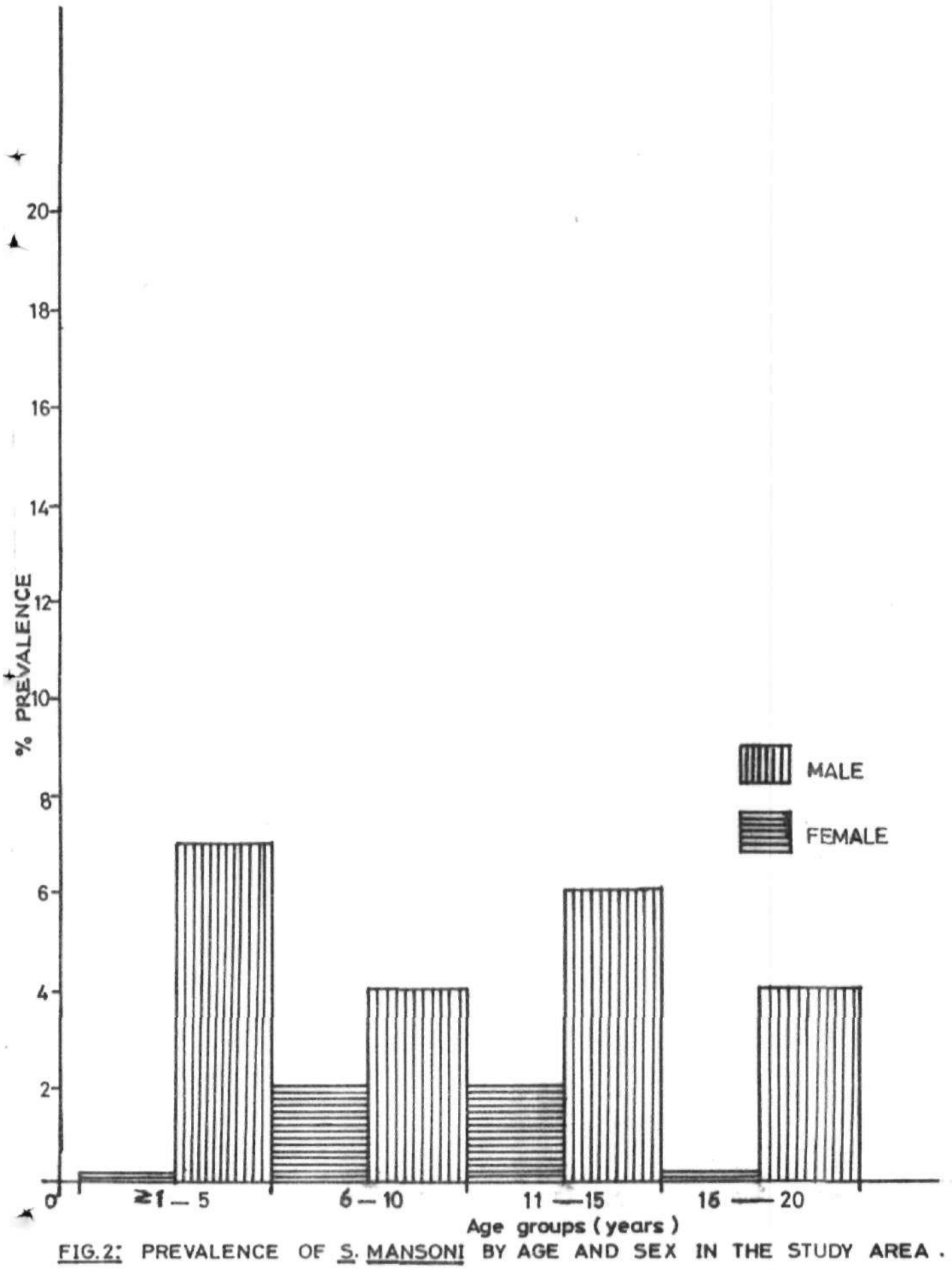


FIG.2: PREVALENCE OF S. MANSONI BY AGE AND SEX IN THE STUDY AREA.

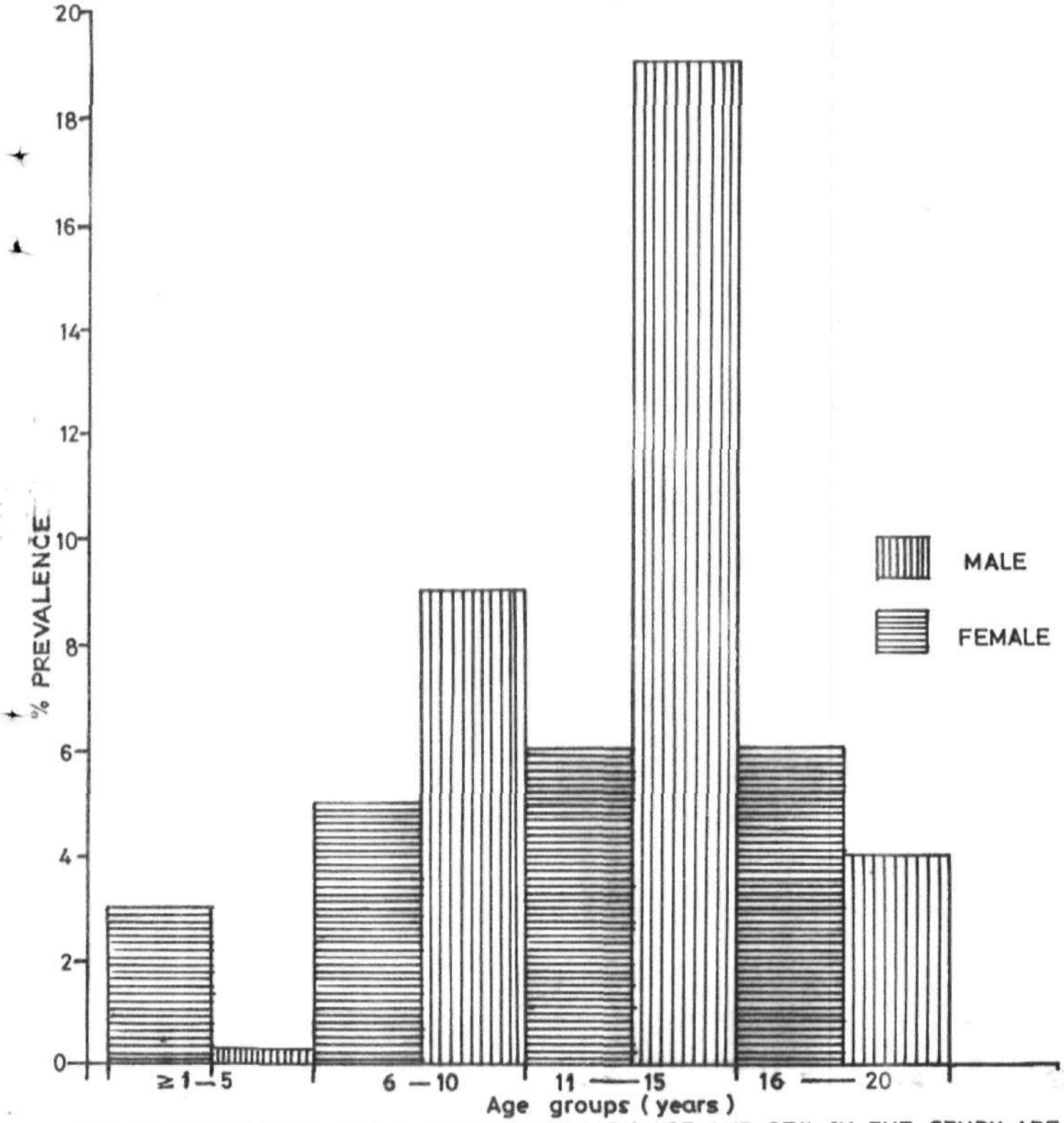


FIG. 3: PREVALENCE OF S. HAEMATOBIUM BY AGE AND SEX IN THE STUDY AREA.

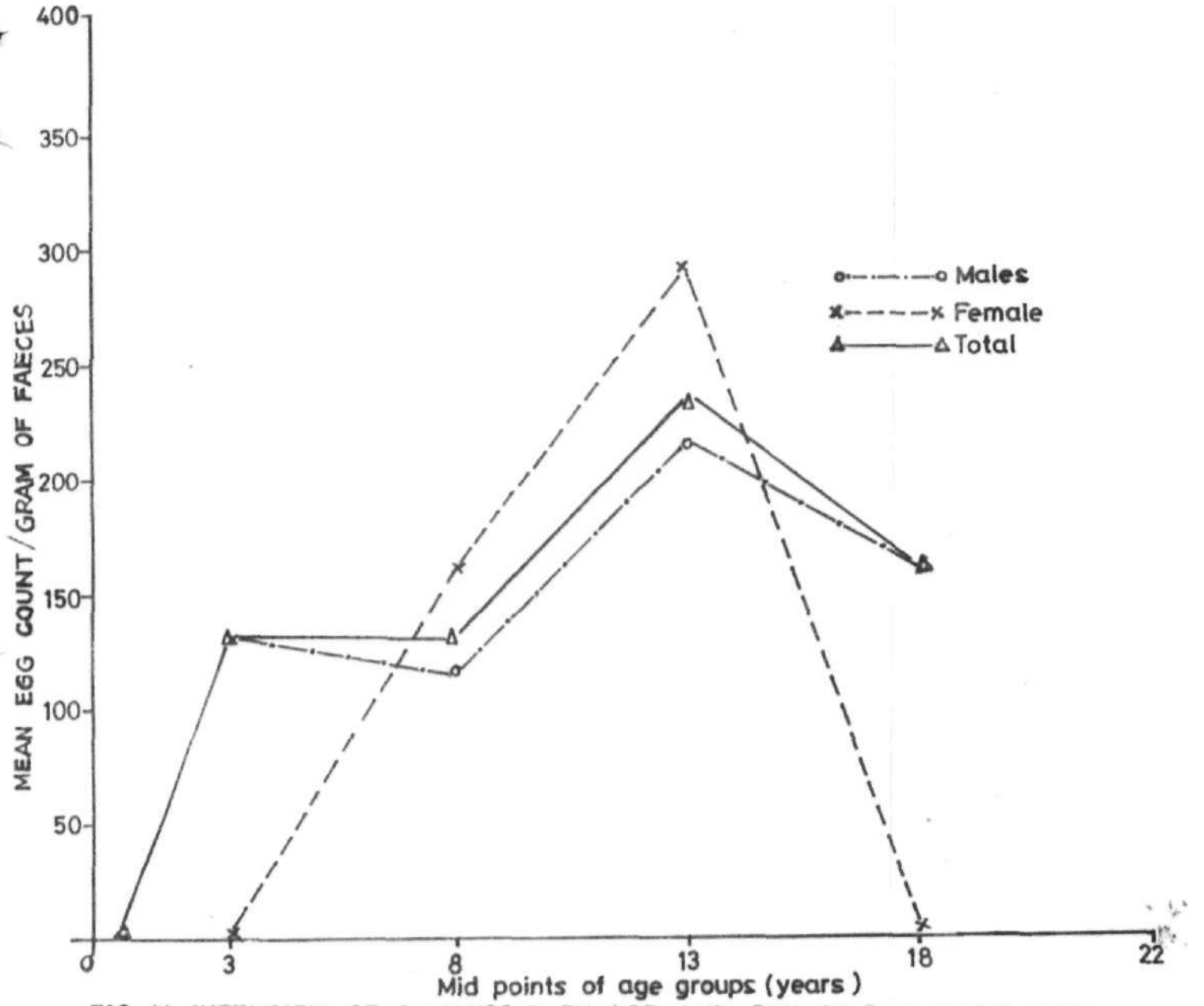


FIG. 4: INTENSITY OF S. MANSONI BY AGE AND SEX IN THE STUDY AREA.

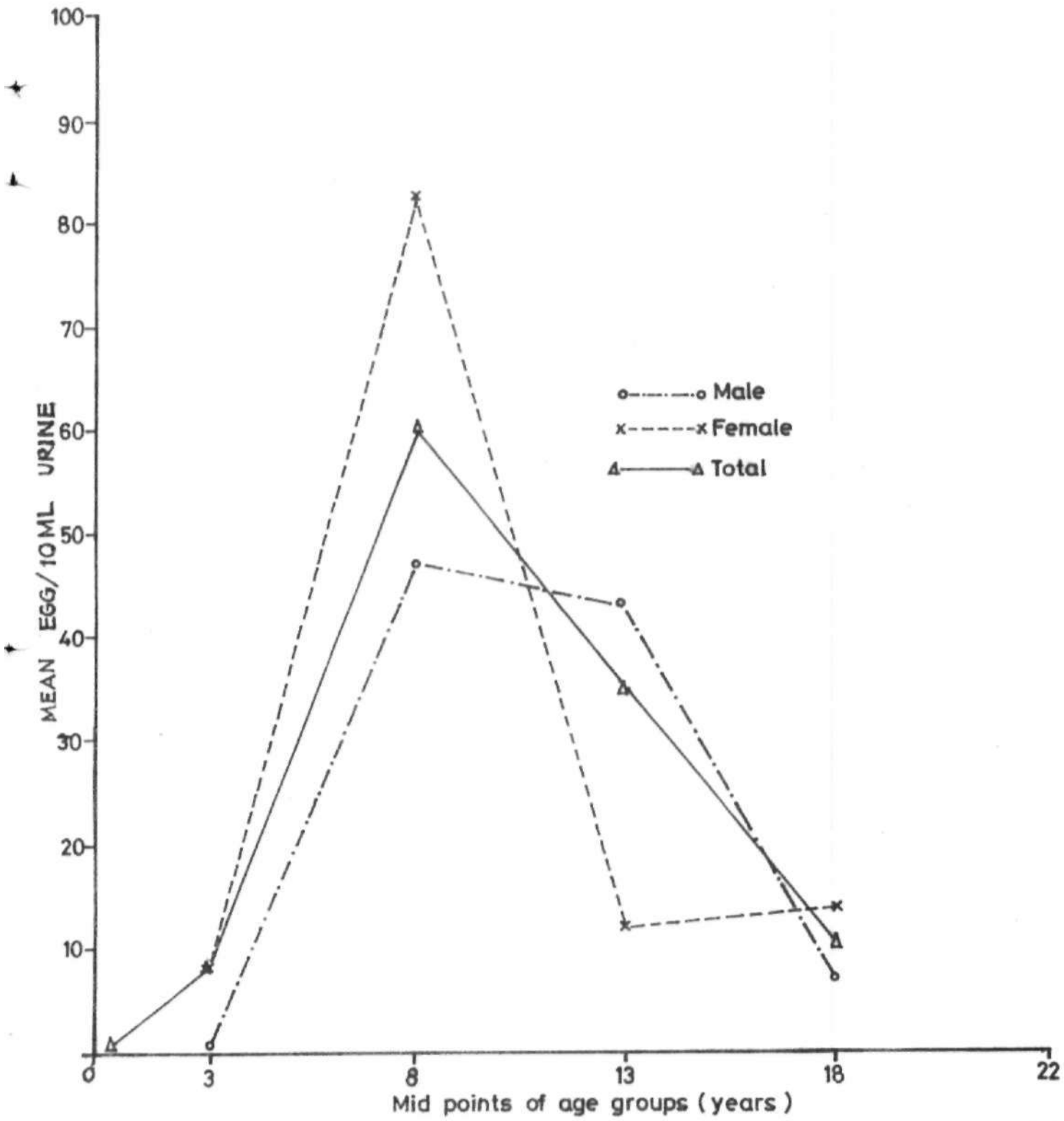


FIG. 5: INTENSITY OF S. HAEMATOBIUM BY AGE AND SEX IN THE STUDY AREA.

The mean egg load for urinary schistosomiasis was 43 eggs/ 10ml of urine. Here also, intensity was more in females than males. The intensity of infection then subsequently decreased with age (Fig. 5. Appendix 7). The intensity of infection for females drastically became minimal (Fig. 4. and 5).

4.3. Proteinuria and haematuria.

A total of 3 (1%) samples had visible blood in the urine. These samples also tested positive for blood with the reagent strip. The samples had between 560 and 645 eggs / 10ml urine (Appendix 1).

55(7%) of the subjects who were positive for urinary schistosomiasis showed no trace of haematuria. 8 (1%) had trace haematuria 6 (1%) had moderate haematuria and 3 (1%) had heavy (vissible) haematuria. That is the reagent strip detected only 17(24%) out of 72 subjects positive for S. haematobium.

The subjects without haematuria were sheding an average egg of less than 16 eggs / 10ml urine. They comprised of 39 (5%) males and 16 (2%) females.

10 (2%) of the positive subjects had heavy (> 20gll) proteinuria, 29 (4%) had moderate (1-3gll) proteinuria, 29 (4%) had trace (0.3gll) proteinuria and 4 (1%) had no protenuria. That is, reagent strip detected 68 (95%) of the positive cases using proteinuria as a diagnostic index (Appendix 1). Proteinuria correlated positively with intensity of infection (Fig. 7).

4.4. OVA OF SCHISTOSOMES.

The Ova of Schistosoma mansoni as seen under the microscope has lateral spine while that of S. haematobium has terminal spine (Plate A1) Eggs of S . mansoni were seen mixed with that of S. haematobium in urine in heavy infections of S. haematobium.

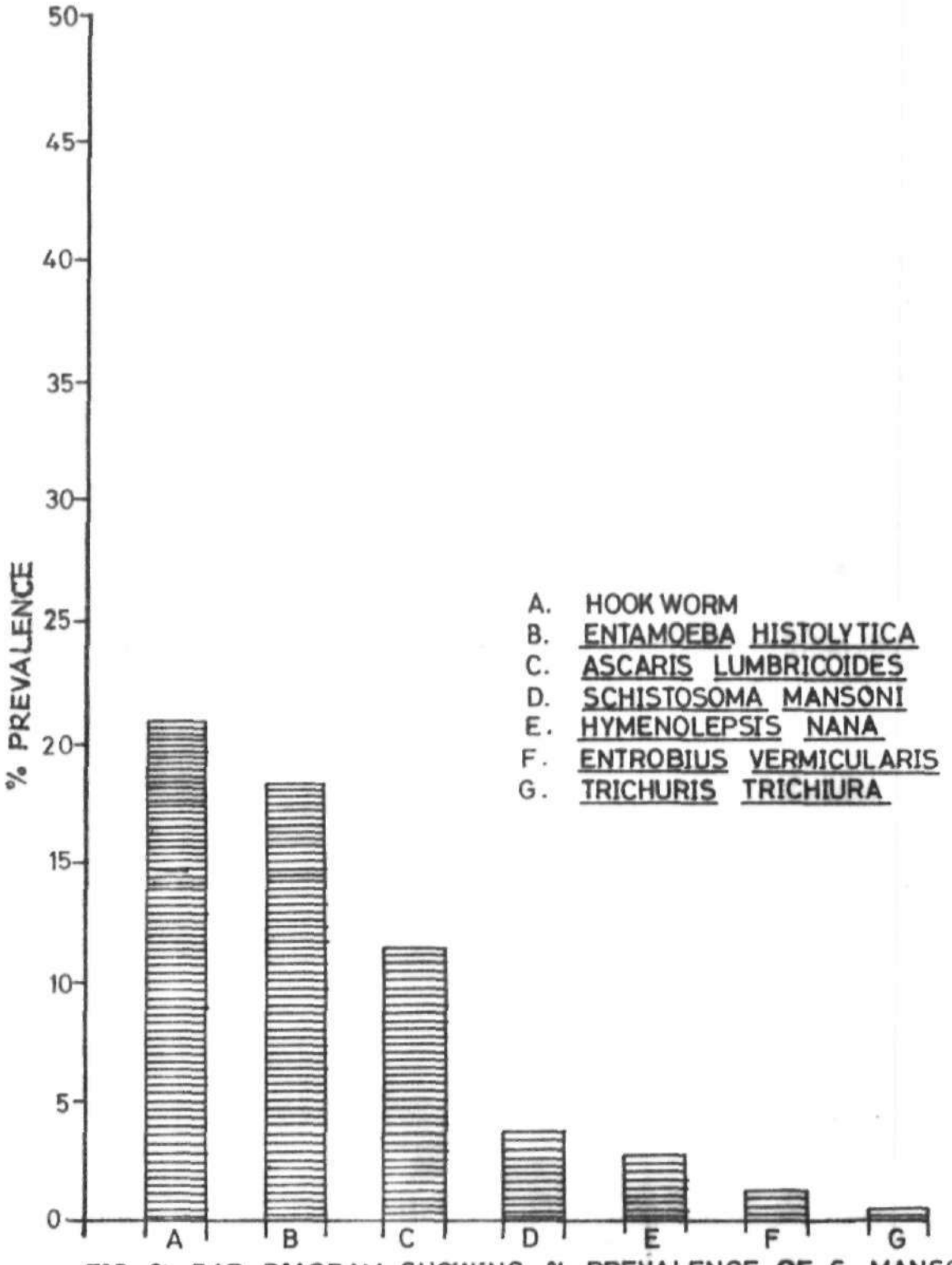


FIG. 6: BAR DIAGRAM SHOWING % PREVALENCE OF S. MANSONI IN RELATION TO OTHER INTESTINAL PARASITES IN THE STUDY AREA.

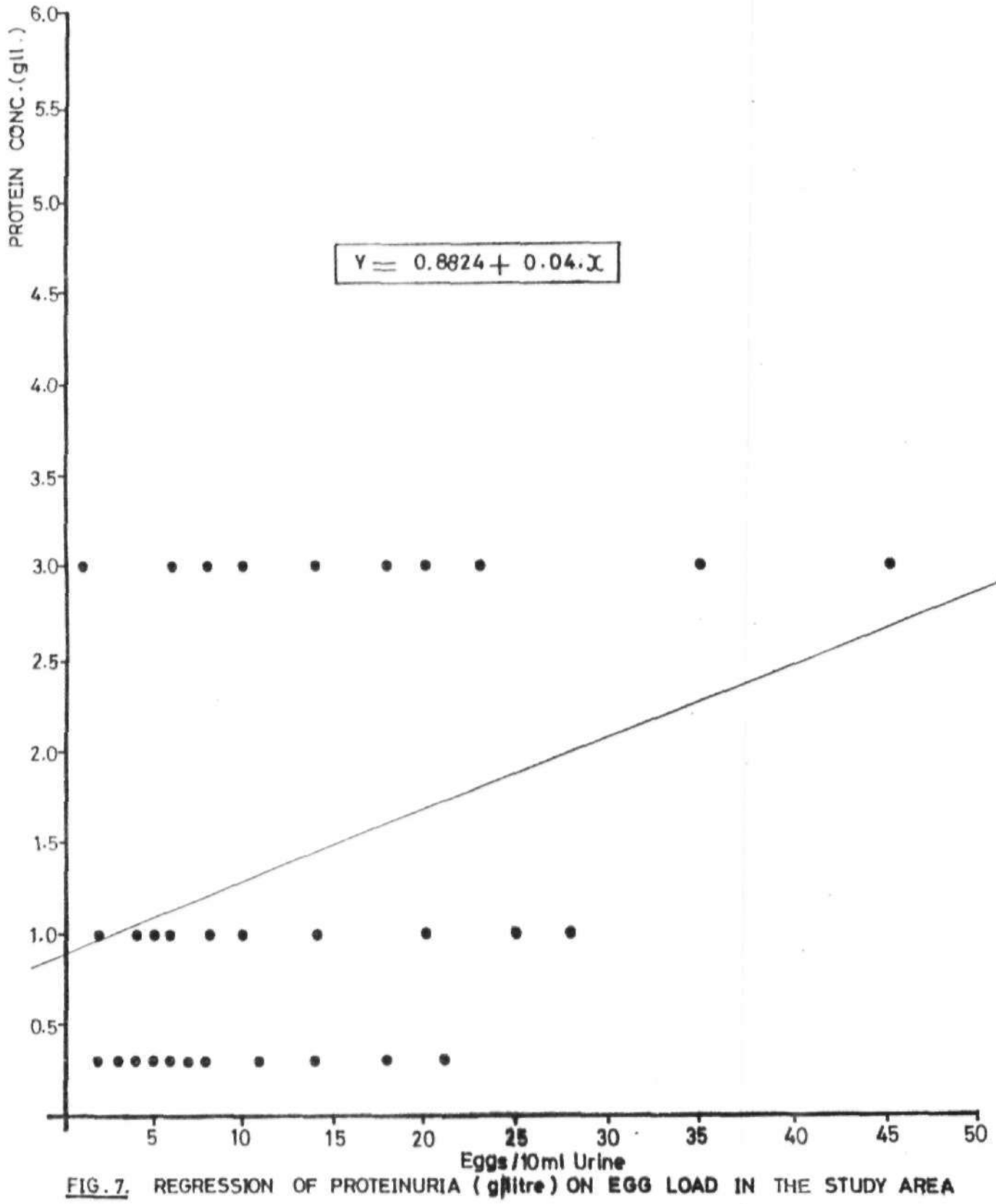


FIG. 7. REGRESSION OF PROTEINURIA (g/litre) ON EGG LOAD IN THE STUDY AREA

4.5. SNAIL VECTORS.

Three snail types were found associated with transmission of the disease in the study Area. These were Bulinus truncatus, Lymnaea truncatus and Biomphalaria pfeifferi (Plate III). It has been established that bulinus snails transmits S . haematobium and Biomphalaria species transmits S . mansoni but the role played by Lymnaea specie believed to be the vector of S . japonicum which is not common in this geographical region is yet to be established. From survey conducted, they were very few in number compared to the other two snails (Plate II).

4.6. Cercariae.

The sampled snails were observed to shed the mammalian type cercaria. It has a head and a biforked tail which it uses in swimming in search of its definitive human host (fig. 8).

4.7. Vegetation / Agricultural practice.

The rice plants provided a good ecological cover for snail breeding. This along with the agricultural practice where ridges made across irrigation channels retain standing water, favours both rice plants and snail breeding.

Banana plants growing along irrigation cannals also supported snail breeding. In addition, snails were found attached to the weed Commelina bracteosa which were abundant in most cannals feeding the rice farms (Plate II. Plate IV).

4.8. Other intestinal parasites.

490 (59%) children out of the total sampled in the study Area haboured one form of parasite or the other. Hookworm had the highest prevalence, followed by E. histolytica, Ascaris lumbricoides and S . mansoni in that order (Appendix 8, fig. 6).

28(3.4%) children had S mansoni in combination with one or more other intestinal parasites (Appendix 9).

7 (1%) had myiasis in the study Area.

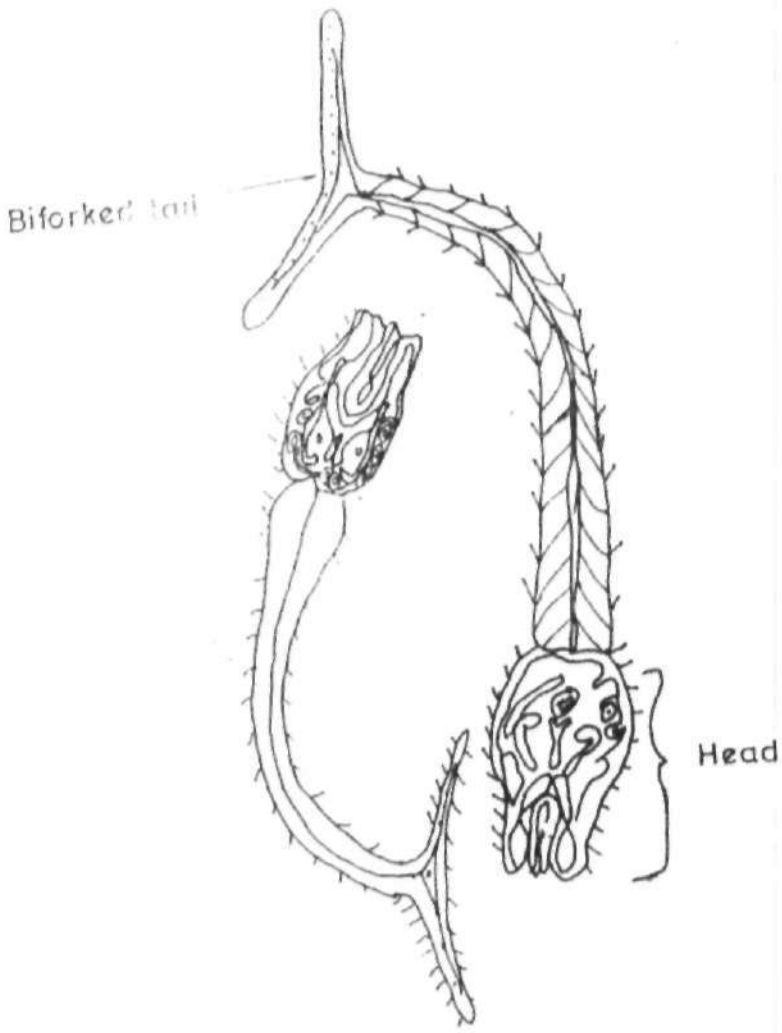


Fig 8: SCHISTOSOME CERCARIAE





S. MANSONI

S. HAEMATOBIUM

PLATE AI SCHISTOSOME OVA



Plate 1: SAMPLE COLLECTION IN THE STUDY AREA.



Plate II: SNAIL SAMPLING IN THE IRRIGATION CANNALS.

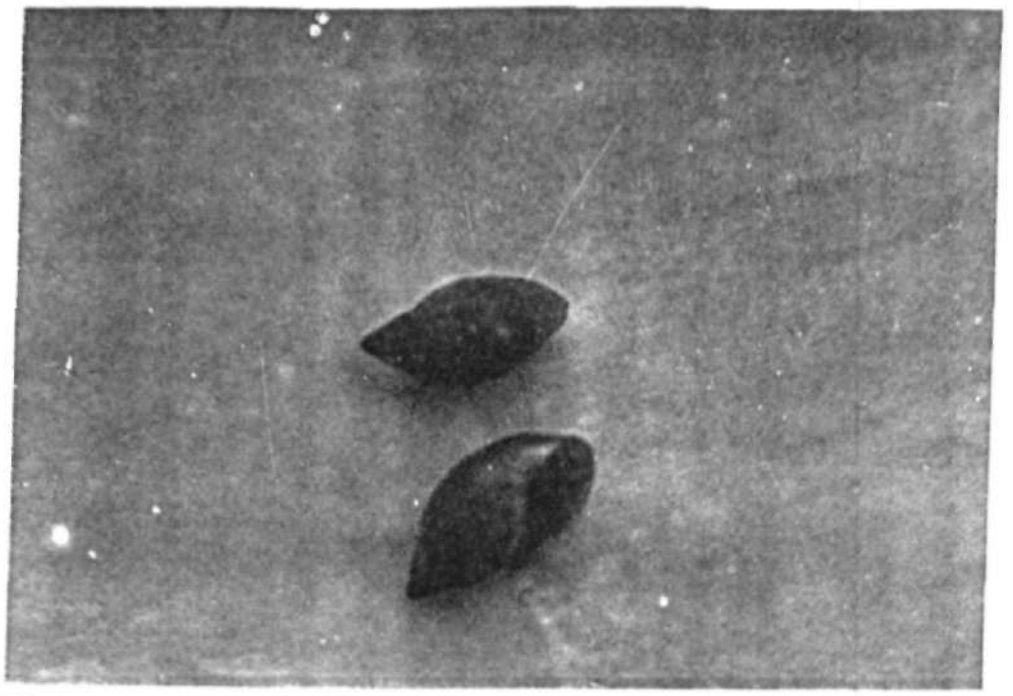
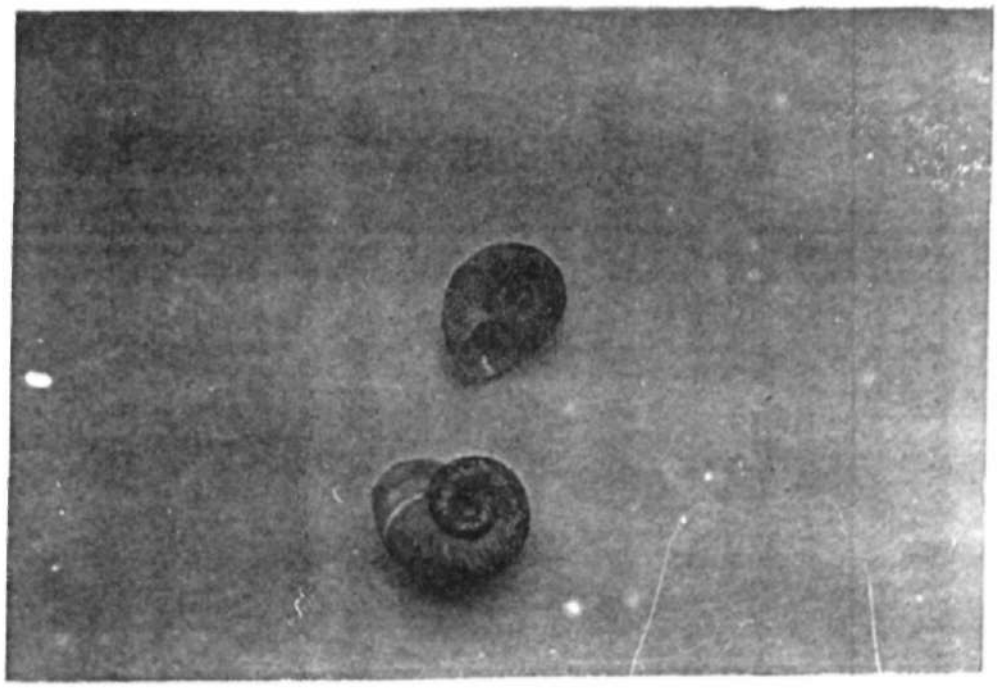
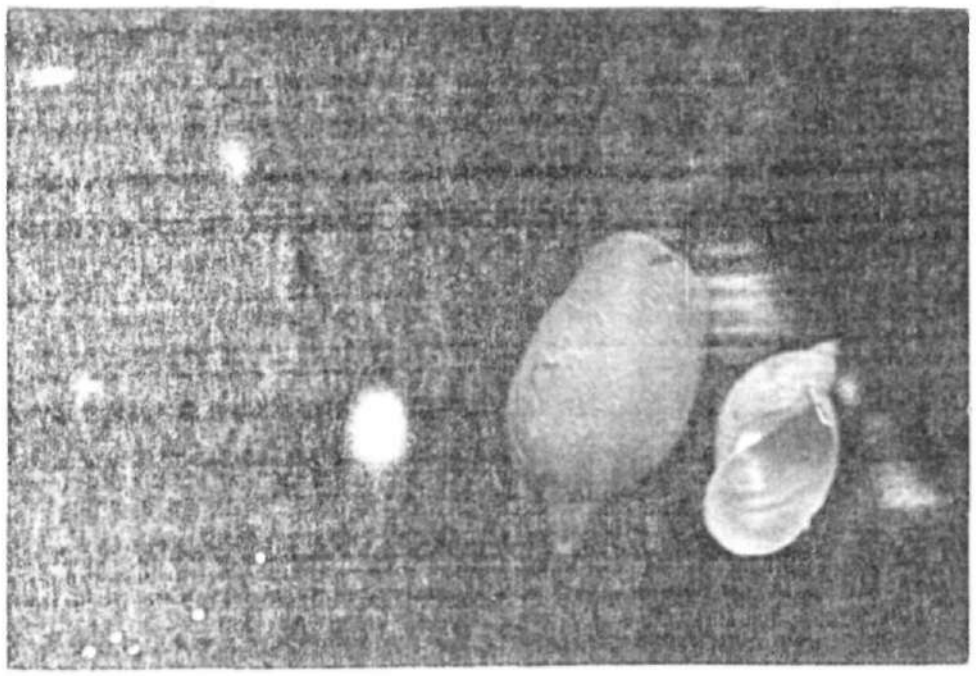


Plate III:

(a) BULINUS TRUNCATUS.



(b) BIOMPHALARIA PFEIFFERI



(c) LYMNAL TRUNCATUS



Plate IV: RISK FACTOR BEHAVIOUR ON A RICE FARM.

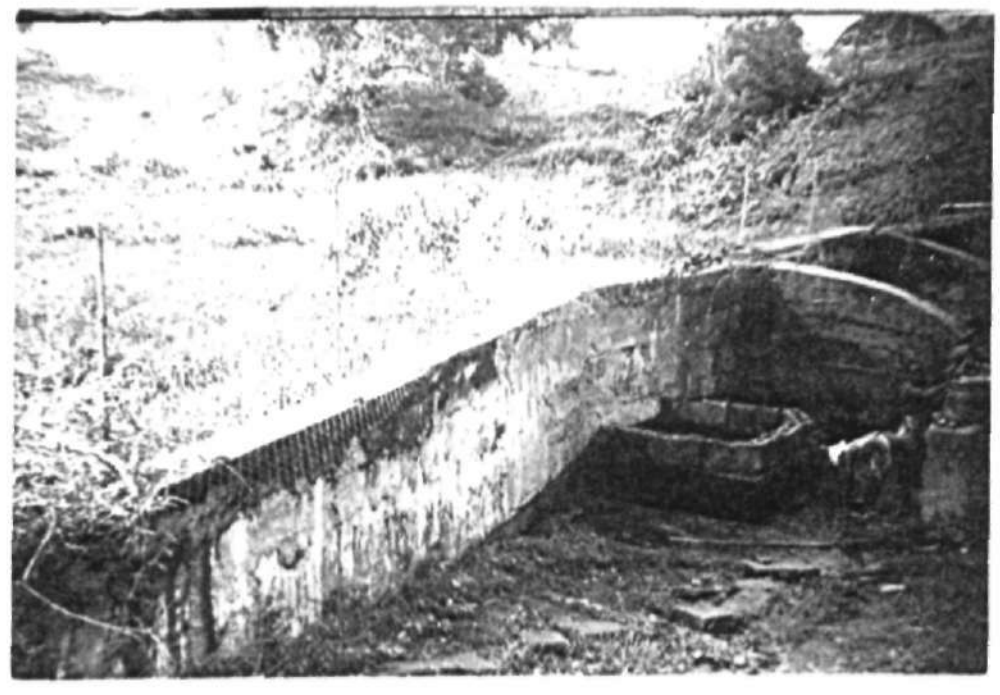


Plate V: B.T.S DAMMED SPRING WATER IN ADUNU.



Plate VI: A RIVER SERVING BOTH FOR DOMESTIC AND RECREATIONAL ACTIVITIES



Plate VII: PONDS USED BY COMMUNITIES DURING THE DRY SEASON.

CHAPTER FIVE

DISCUSSION AND CONCLUSION.

The prevalence of urinary schistosomiasis is higher (9%) than that (4%) of intestinal schistosomiasis (Appendix 4 and 5). This could be due to the relative abundance of Bulinus snails over that of Biomphalaria (the vector for Schistosoma mansoni). The abundance is brought about by the wider adaptability of the Bulinus snails to most habitats compared to Biomphalaria snails. This agrees with the work of Webbe (1982) and Madsen (1992) who made similar observations. Prevalence was also observed to be higher in males than females (Fig. 2 and 3) in the study Area. This could be due to the more frequent and longer contact periods males had with water body than females. As a result of this frequent contact with parasite, males develop more tolerance to the parasite than females. This may also explain why intensity is generally higher in females than males (Fig 4 and 5) as observed by Nworgu et al; (1992) and Istifanus et al; (1990).

In fig. 3, the peak prevalence of S haematobium was observed in age group 11 - 15 years while peak intensity occurred at age group 6 - 10 years (Fig. 5) and the intensiy suddenly droped down. This observation could be due to the age - dependent immunity to the parasite. That is, young people are more susceptible to the disease than adults. In S . mansoni peak prevalence occured at <1 - 5 years and 11 - 15 years (fig. 2) whereas peak intensity occurred at 11 - 15 years (fig. 4). The high prevalence recorded at this early age of <1 - 5 years could be due to practice by mothers who sit their children in infected water in bath basins near streams while doing laundry or bathing. The observations above agree with that of Shimada (1994) who observed that in human community, the peak intensity and peak prevalence of Schistosoma haematobium infection occurred at adolescence and suddenly declined thereafter.

The variation in prevalence between males and females could also be due to cultural practices. Males generally enjoy greater degree of freedom of movement than their female counterparts. Mos of the children were seen swimming in streams, rivers or ponds were males.

Five (1%) children had double infection while two (1%) of these showed mixed infections in which S . mansoni ova were seen along with those of S . haematobium in urine. Though very rare to find S. mansoni ova in urine , Ratard et al; (1991) did observe that presence of S. mansoni ova is a possibility in heavy infections of S. haematobium. This is particularly true of these children who had heavy infection of S . haematobium (Appendix 1).

Egg burden in children was generally light except in few cases where egg load was as high as 645 eggs/ 10ml. Children with this level of egg load had visible blood in their urine. In S . mansoni infections, the average egg load was 183 eggs/ gram faeces in the study area. This is in conformity with the work of Ekanem et al; (1994) who observed that as a result of light ova burden among children in the West African subregion, there was a lack of discernable effect of schistosomiasis on performance of children and concluded that differences in the strains of the parasite between regions may be important determinants of morbidity.

Myiasis - an infection of the body by larvae (maggots) of flies or insects and their subsequent contamination of urinary passage was observed in two rural communities (Adunu and Amale) of the study Area. The infected children might have acquired the infection as a result of over exposing their bodies as children in the Villages hardly wear shirt. This, however was not observed in children in sub-urban areas like Chanchaga, Maikonkele and Bosso.

Only samples positive for urinary schistosomiasis were tested with the reagent strip because this way, the significance of proteinuria and haematuria as diagnostic indexes could be assesed. Furthermore, one could also determine if any correlation exists between egg load and proteinuria. Though haematuria as a diagnostic index shows high sensitivity, it did not detect some of the already established positive cases. This could be due to the light egg- burden observed in some of the subjects in the study area. The reagent strip only detected haematuria when the egg burden in urine was high. This sensitivity was higher for females than males.

Although higher prevalence was found in males, females shed more eggs as a result of heavier infection. Because of the low egg count in males, false negativity was observed for males than for females using the reagent strip to detect haematuria since haematuria is a measure of the pathologic effect of the number of eggs extruded into the lumen of the bladder.This implies that more eggs are trapped in granuloma in the bladder wall of males than that of females. Haematuria as a diagnostic index has a high predictive value for female positive cases than for male positive cases. Although most females involved in this study were below puberty age, the limitation with the use of haematuria as a diagnostic index is where menstrual blood contaminates urine during sample collection. It will thus be appropriate to establish for all mature females with visible blood in urine, if they are menstruating or not during sample collection. Similarly, proteinuria as a diagnostic index was highly sensitive for positive cases but it should be realized that not all proteinuria cases are due to schistosomiasis infection. However, almost all haematuria cases are due to schistosomiasis haematobia. Thus, haematuria has a higher predictive value for positive cases than proteinuria. This is in line with the works of Nworgu et al; (1992 and Lengeler et al; (1993) who observed that the reagent strip had a high sensitivity and specificity to haematuria and proteinuria at trace quantities but haematuria had a higher predictive value for positive test and was considered the overall better indicator. For the positive schistosomiasis haematobia cases, protein conentration in urine correlated positively with level of infection (Fig. 7). This is in consonance with the observation of Lehman et al; (1970) who reported a considerable protein loss in the gut due to schistosomiasis infection. They also observed that the protein loss, though not apparently related to the intensity of egg excretion, Feldmeier et al; (1979) did observe that the number of viable eggs in the urine is a measure of the number of worm pairs in the urinogenital organs. In other words, the egg burden could be a measure of worm burden and hence the level of polyposis resulting in protein loss.

1 3 NOV

In conclusion, the prevalence of urinary schistosomiasis in the study area was 9% while that of intestinal schistosomiasis was 4%. Males were more infected than females but intensity was generally higher in females than males. This result compared favourably with that of Istifanus et al: (1990) who also recorded low prevalence among school children in Bauchi state. This prevalence result is however very low when compared to that obtained by Okpala (1961) and Akinkugbe (1962) in western parts of Nigeria. The peak of infection was found in the age group 11 - 15 years while the highest intensity was found in the age group 6 - 10 years for S. haematobium and 11 - 15 years for S. mansoni. Proteinuria correlated positively with level of infection for the positive cases but haematuria had a higher predictive value for the positive tests and was considered overall better indicator. Nworgu et al ; (1992) also made similar observation when they assesed the diagnostic value of haematuria and proteinuria in Schistosoma haematobium infection in Southern Nigeria. Snails of the general Bulinus truncatus, Biomphalaria pfeifferi and Lymnae truncatus were found associated with transmission in the study area.

Weeds like commelina bracteosa and banana plants growing along irrigation cannals provided the ecological cover required for snail breeding. With the above in sight, it will therefore be appropiate to recommend the following control measures to check further spread and transmission of this disease in the study Area particularly and the state in general:-

(i) Government, should as a matter of urgency provide the infected comunities with portable water so as to reduce transmission rate.

(ii) Dams, rivers, streams or cannals should be shielded to prevent children from urinating or deaficating in them. This way the life cycle of the parasite can be broken.

(iii) The Local health Authority should educate the communities on risk factor practices associated with transmission . This is to enable the communities avoid risk behaviours associated with transmission.

(iv) Pit - latrines, where not available in the communities, should be provided and its proper utilization ensured. This way, both life cycle and transmission of the parasite can be checked.

(v) Weeds like Commelina bracteosa growing in the cannals should be cleared. Banana plants and other plants that may provide shade should not be allowed to grow very close to the cannals. This way, snail breeding can be discouraged.

(vi) Snail vectors should be destroyed through use of molluscicides like Bayluscicide, copper sulphate or pentachlorophenol. Vector destruction is important in schistosomiasis control.

(vii) Hybreed crops should be selected and distributed to farmers. Such hybreed rice plants will require less amount of water for growth. This is to prevent standing - water normally associated with snail breeding in rice farm.

(viii) Alternate wetting and drying of rice farm should be practiced by farmers where this does not affect yield. This method checks snail breeding .

(ix) Finally, to ensure proper control / erradication of the disease in the state, the prevalence status in other parts of the state should be established immediately and this should be followed with mass chemotherapy of all infected individuals using a relatively non toxic drug like praziquantel. If all these observations and recomendations are strickly Implemented, the transmission of the disease in the study area will be brought under control if not totally eliminated. This will go along way in reducing morbidity due to the disease hence an increase in productivity of the farmers. This means more food for Niger State indigens particularly and Nigerians in general.

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APPENDICES

APPENDIX 1

PROTEINURIA/HAEMATURIA AMONG URINARY SCHISTOSOMIASIS SUBJECTS IN STUDY AREA.

S/NO	SEX	AGE	HAEMATURIA	PROTEINURIA (g/l)	EGGS/10ML	
1	M	14	-	3	305	**
2	M	11	-	3	6	
3	F	12	-	3	4	
4	F	7	H	20	610	
5	F	8	trace	0.3	6	
6	m	8	Trace	3	72	**
7	F	18	-	0.3	14	
8	M	9	-	1	6	
9	M	7	+	-	15	
10	M	15	Trace	-	6	
11	F	11	-	3	80	
12	F	12	-	0.3	3	
13	F	12	Trace	1	2	
14	M	15	Trace	1	4	*
15	M	8	-	3	8	
16	M	12	-	1	2	
17	M	11	Trace	3	14	
18	M	15	-	3	10	
19	F	10	-	0.3	18	
20	M	8	-	3	8	
21	F	8	Trace	0.3	7	
22	M	10	-	0.3	2	
23	M	11	-	0.3	7	*
24	M	10	-	3	20	
25	M	13	-	0.3	15	
26	M	10	-	3	1	
27	M	10	-	0.3	3	
28	M	7	-	20	13	
29	M	7	H	20	560	
30	M	7	-	3	23	
31	F	7	-	-	4	
32	M	10	-	20	29	
33	M	11	-	0.3	5	
34	M	13	-	3	14	
35	F	12	-	-	1	
36	M	12	-	0.3	21	

APPENDIX 1

PROTEINURIA/HAEMATURIA AMONG URINARY SCHISTOSOMIASIS SUBJECTS IN STUDY AREA.

S/NO	SEX	AGE	HAEMATURIA	PROTEINURIA (g/l)	EGGS/10ML	
37	F	12	-	0.3	6	
38	M	11	-	1	5	
39	F	4	-	1	8	
40	M	11	-	1	8	
41	M	11	-	20	10	
42	M	9	-	20	15	
43	M	10	-	0.3	2	
44	M	10	-	0.3	11	
45	F	9	-	0.3	6	
46	M	12	-	1	20	
47	M	11	-	0.3	4	
48	F	10	-	3	18	
49	M	12	-	1	5	
50	M	12	+	1	25	
51	F	10	-	0.3	5	
52	M	15	-	0.3	2	
53	M	12	-	0.3	3	
54	M	11	-	0.3	6	
55	F	12	-	0.3	3	
56	M	12	-	0.3	8	*
57	M	12	-	20	25	
58	M	13	-	1	10	
59	F	10	+	20	67	
60	M	12	-	1	28	
61	M	10	-	1	14	** - Mixed infection
62	F	15	-	0.3	7	(S. mansoni ova in urine)
63	F	15	-	0.3	5	* - Double infection.
64	F	11	-	0.3	4	(S. mansoni + S. haematobium)
65	M	12	+	20	80	
66	M	12	-	0.3	5	
67	M	16	-	0.3	7	
68	M	11	H	20	645	
69	M	13	+	0.3	8	
70	M	13	-	3	45	
71	M	14	Trace	3	20	
72	M	12	-	3	35	

APPENDIX 2

INTESTINAL SCHISTOSOMIASIS IN THE STUDY AREA.

S/NO	SEX	AGE	EGG/GRAM FAECES	
1	M	14	120	*
2	M	8	80	*
3	M	16	160	
4	F	12	200	
5	F	12	400	
6	M	6	160	
7	F	7	80	
8	M	15	240	*
9	F	10	320	
10	M	10	40	
11	F	11	160	
12	M	12	240	
13	M	10	80	
14	M	7	160	
15	M	11	400	*
16	M	10	160	
17	F	6	80	
18	M	5	160	
19	M	5	200	
20	M	11	120	
21	F	11	400	
22	F	10	160	
23	M	7	120	
24	M	4	40	
25	M	6	120	
26	M	12	200	
27	M	12	100	
28	M	12	80	
29	M	12	400	*
30	M	12	360	* - double infection (S. mansoni + S. haematobium)
31	M	11	120	

APPENDIX 3

AGE AND SEX DISTRIBUTION OF SUBJECTS IN THE STUDY AREA

			MALE		FEMALE	
(YRS) AGE GROUPS	TOTAL	% TOTAL	NO SAMPLED	%	NO SAMPLED	%
< 5 - 5	72	9	41	9	31	8
6 _ 10	385	46	198	46	187	47
11 _ 15	338	40	175	40	163	41
16 _ 21	40	5	23	5	17	4
GRAND TOTAL	835	100	437	100	398	100

APPENDIX 4

% PREVALENCE OF S. MANSONI BY AGE AND SEX IN THE STUDY AREA.

		MALE			FEMALE			
AGE GROUPS (YRS)	TOTAL	NO SAMPLED	NO POSITIVE	%PREVA.	NO SAMPLED	NO POSITIVE	%PREVA.	%TOTAL PREVA.
< 1 - 5	72	41	3	7	31	0	0	4
6 _ 10	385	198	8	4	187	4	2	3
11 _ 15	338	175	11	6	163	4	2	4
16 _ 21	40	23	1	4	17	0	0	3
GRAND TOTAL	835	437	23	5	398	8	2	4

APPENDIX 5

% PREVALENCE OF S. HAEMATOBIUM BY AGE AND SEX IN THE STUDY AREA.

AGE GROUPS (YRS)	TOTAL	MALE			FEMALE			TOTAL % PREVA.
		NO SAMPLED	NO POSITIVE	% PREVA.	NO SAMPLED	NO POSITIVE	% PREVA.	
< 1 - 5	72	41	0	0	31	1	3	1
6 _ 10	385	198	17	9	187	9	5	7
11 _ 15	338	175	33	19	163	10	6	13
16 _ 21	40	23	1	4	17	1	6	5
GRAND TOTAL	835	437	51	12	398	21	5	9

APPENDIX 6.

INTENSITY OF INFECTION OF S. MANSONI BY AGE AND SEX IN THE STUDY AREA.

	MALE			FEMALE			TOTAL EGGS PER	TOTAL NO	TOTAL MEAN
AGE GROUPS	EGGS PER GRAM FAECES	NO POSITIVE	MEAN EGGS LOAD	EGGS PER GRAM FAECES	NO POSITIVE	MEAN EGG LOAD	GRAM FAECES	POSITIVE	EGG LOAD
< 1 - 5	400	3	133.33	0	0	0	400	3	133.33
6 _ 10	920	8	115	640	4	160	1540	12	130
11 _ 15	2380	11	216.36	1160	4	290	3560	15	236
16 _ 21	160	1	160	0	0	0	160	1	160
GRAND TOTAL	3860	23	167.83	1800	8	225	5660	31	659.33

APPENDIX 7.

INTENSITY OF INFECTION OF S. HAEMATOBIUM BY AGE AND SEX IN THE STUDY AREA.

	MALE			FEMALE			TOTAL EGGS PER	TOTAL NO	TOTAL MEAN
AGE GROUPS	EGGS PER 10ML URINE	NO POSITIVE	MEAN EGG LOAD	EGGS PER 10ML URINE	NO POSITIVE	MEAN EGG LOAD	10ML URINE	POSITIVE	EGG LOAD
< 1 - 5	0	0	0	8	1	8	8	1	8
6 _ 10	802	17	47.18	741	9	82.33	1543	26	59.35
11 _ 15	1405	33	42.58	115	10	11.5	1520	43	35.35
16 _ 21	7	1	7	14	1	14	21	2	10.5
GRAND TOTAL	2214	51	43.41	878	21	41.81	3092	72	42.94

APPENDIX 8

% PREVALENCE OF S. MANSONI IN RELATION TO OTHER INTESTINAL PARASITES IN THE STUDY AREA.

PARASITES	TOTAL NO POSITIVE	TOTAL NO SAMPLED	% PREVALENCE
HOOKWORM	177	835	21%
ENTAMOEBA HISTOLYICA	151	835	18.10%
ASCARIS LUMBRICOIDES	94	835	11.30%
SCHISTOSOMA MANSONI	31	835	3.70%
HYMENOLEPSIS	24	835	2.90%
ENTROBIUS VERMICULARIS	10	835	1.20%
TRICHURIS TRICHMRA	3	835	0.35%
GRAND TOTAL	490	835	59%

APPENDIX 9

PARASITOLOGICAL PROFILE OF CHILDREN INFECTED WITH SCHISTOSOMIASIS IN THE STUDY AREA

PARASITE SPECIES & COMBINATION	NO OF SAMPLE	% PREVALENCE
S. MANSONI + HOOKWORM	11	1.30%
S. MANSONI + HISTOLYTICA	9	1.10%
S. MANSONI + H. NANA	1	0.10%
S. MANSONI + A. LUMBRICOIDES	2	0.20%
S. MANSONI + HAEMATOBIUM	5	0.60%
TOTAL	28	3.40%

* 7(1) had myiasis