THE INCIDENCE OF INTESTINAL PARASITES IN SCHOOL CHILDREN OF SAMARU VILLAGE, ZARIA, KADUNA STATE, NIGERIA

BY

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Thesis submitted in partial fulfillment
of the requirements of the degree of

MASTER OF SCIENCE

Ahmadu Bello University,
ZARIA

January, 1988

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C E R T I F I C A T I O N

This thesis titled "THE INCIDENCE OF INTESTINAL PARASITES IN SCHOOL CHILDREN OF SAMARU VILLAGE, ZARIA, KADUNA STATE, NIGERIA" by HALIMATU SAADIYA IDRIS, meets the regulations governing the award of the degree of Master of Science Zoology (Parasitology) of Ahmadu Bello University and is approved for its contribution to the knowledge and literary presentation.

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Subhanal ladhi khalaqal azwāja kulli hā mim mā tunbitul-arḍu wa min anfusihim wa mimmā lā ya'a lamūn.

(Qur'an 36:36)

"Glory be to Him Who created all things in pairs of what the earth produces and of (mankind) themselves and of things of which they have no knowledge".

(Qur'an 36:36)

A C K N O W L E D G E M E N T

I am particularly indebted to Dr. Hussein Z., the Chairman of my Student Advisory Committee and major Supervisor, who despite his over burdened schedule of duties, never relented in his effort in seeing that I was not handicapped at any stage of the studies. His wise counselling and devotion to duty, especially by reading my manuscripts and rendering useful and constructive suggestions made possible the production of the findings of this work into a readable material for literally thousands of people who are yet to be introduced into the world of parasitology.

I am also greatly indebted in no small way to Dr. Adegboye, J.D., my minor Supervisor whose services were always at my disposal. I particularly thank him for constructively criticising and offering useful suggestions on the design of the research work and the pattern to be adopted in writing my result and also in discussing the results of this findings after carefully going through the manuscripts.

I also wish to thank my father, Alhaji A.M. Idris, for sponsoring me throughout the duration of the course. His moral and financial support gave me the impetus to aim for a place of great honour among the Nigerian women. May Allah reward you both here and the world beyond. I must also thank my mother, Hajiya Zainab Idris, for her moral support and wise advices.

I also want to thank the following people who in one way or the other made the production of this thesis a success: Mallam Usman Sale helped in the identification of the various eggs and cysts of parasites in the stool samples. Mr. Ansah took photographs of the parasites. Mr. Cletus helped in developing and printing the photographs of the parasites. Mallam Ahmad who, despite his heavy load of responsibilities was always besides me rendering moral support through words of encouragement and so forth.

To others, both friends and foes, too numerous to mention who contributed in one way or the other to seeing to the success or otherwise of this programme, I say, "may Allah reward you accordingly".

A B S T R A C T

Intestinal parasites are considered as very important because of their adverse effects on both the health and development of animals including humans.

It is for this reason that lots of research works were conducted in many parts of the world, Nigeria inclusive (Okpala 1956, 1961 and 1971, Awogun 1984, Fashiyi 1983).

The study on Incidence of Intestinal parasite in school children of Samaru village was carried out among 250 school children.

Stool samples of the school children were analysed using direct smear method and sedimentation techniques. Out of the 250 school children, 145 were infected.

The incidence of infection was found to be high and some individual students harboured as many as two to three parasites.

In descending order of magnitude, Entamoeba coli, Ancylostoma duodenale, Schistosoma mansoni, Ascaris lumbricoides, Trichuris trichiura, Hymenolepis nana, Strongyloides stereoralis and Enterobius vormicularis were the prevalent intestinal parasites among the pupils. Where we recorded a total number of 76, 61, 16, 13, 11, 5, 2 and 2 pupils respectively out of 250 children examined.

Distribution of these parasites in relation to eight parameters, namely age, sex,swimming habits, type of house, structure of house, type of toilet, type of water supply

and socio-economic status of parents of pupils were discussed. E. coli, E. vermicularis, H. nana, A. lumbricoides and S. stereoralis were found only in younger children between the age of 5 - 12 while A. duodenale and T.trichiura infection was found to increase with age. S. stercoralis E. coli H. nana and T. trichiura was found to be more prevalent in females than males while the reverse is the case in the prevalence of A. lumbricoides , A. duodenale, S. mansoni and E. vermicularis. S. mansoni was found to be more prevalent in swimmers than non swimmers. The reverse is the case in S stercoralis, H. nana, A. lumibricoides. E. vermicularis. E. coli T. trichiura. A higher prevalence rate of S. stercoralis, E. vermicularis, A. duodenale, E. coli. A. lumbricoides and S. mansoni was recorded for those pupils that used pit laterine than those that used W.C toilets. E. vermicularis, A. duodenale, S. stercoralis, E. coli, H. nana, A. lumbricoides and S. mansoni were found to be more in pupils that used well water than those that used tap water.

Transmission of all parasites was found to be associated with insanitary condition of the environment thus resulting to contamination of soil, food, water supply, etc.

Possible control measures such as good sanitation and health education were suggested. Curative measures especially single dose drugs could be investigated.

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THE INCIDENCE OF INTESTINAL PARASITES IN SCHOOL CHILDREN OF SAMARU VILLAGE, ZARIA, KADUNA STATE, NIGERIA.

CHAPTER ONE

1.1 INTRODUCTION

Parasites are of great importance due to their adverse effects on both the health and development of infected individuals.

Humans, for example are known as host for more than a hundred parasites, leaving aside viruses, bacteria and fungi, (Schmidt and Roberts 1981).

Human welfare has suffered mightily through the centuries because of these parasites. Recent summaries of worldwide prevalence of selected parasites disease show that there are more than enough existing infections for every living person to have one, were they evenly distributed. Their finding was put into two columns namely, Disease category and number of human infection.

All helminths had the highest number of human infection of 4.5 billion, Ascaris species had 1.26 billion, Hookworms 932 millions, Trichuris 687 million, Filarial worms had 657 million, Schistosomes 271 million and malarial parasites had 300 million of human infection. (Le Riche 1967; Peters 1978).

Factors such as climate, water supply, environment, occupation, source and availability of food as well as the socio-economic disposition contribute to the prevalence of these parasitic infections in a community (Nnochir 1968).

Many of the important species of parasites have a world wide distribution. The majority of the more serious infections,

however, occur in the Tropic zone of the earth. This could be due to the optimum condition of temperature and humidity which are most favourable for the survival, larval development and transmission of the parasite (Brown 1975).

The above condition applies to this country, Nigeria.

1.1.1 SOCIO-ECONOMIC FACTOR

Intestinal parasites in particular are often associated with poor sanitation, domestic and personal hygience.

People create many of their own disease conditions because of high population density and subsequently environmental polution.

Despite great progress in extending water supplies and sewage disposal programs in developing countries, not more than 10% to 15% of the world population is thus served (Schmidt and Roberts 1981).

Usually an adequate water supply has first priority, with sewage disposal running a poor second. When one recalls that most parasite infections are caused by ingestion of food or water contaminated with human faeces, it is easy to understand why about 15 million children die of intestinal infections every year. Thus the prevalence of these parasitic infections shows correlation with the methods of faecal disposal and personal hygience of the people. The World Health Organization (W.H.O.) report of 1964 shows worldwide prevalence of these parasitic infections and noted that the incidence varies with the state of development of different people. The highest incidences were among the developing nations of Africa, Asia and South America (Chandler and Read 1981).

1.1.2 OCCUPATION

The occupation of people may also contribute to the type of parasite they are most likely to harbour. For instance, Dr. Warley (1976) reported that irrigation canals provide an ideal breeding ground for the snail, which is an intermediate host of the parasite that causes Schistosomiasis. And that despite heroic earlier efforts to prevent its spread, the disease became endemic in the huge Gezira irrigation Scheme in Sudan.

In Zaria City, there are lots of ponds containing stagnant water and snails, which are intermediate host of bilhazia. These waters are used in making mud bricks used in building houses. There is thus every possibility of infection of Schistosomiasis in this area (Ebele 1981).

1.2 JUSTIFICATION OF RESEARCH WORK

A lot of work on the prevalence of blood, urinary and intestinal parasites have been carried out in various parts of Nigeria. (Okpala 1956, 1961 and 1971, Awogun 1984, Fashiyi 1983, Oyerinde 1982).

The prevalence of these parasites have been associated with various factors such as:

1. Contamination of the environment with human and animal faeces(Okpala 1956).
2. Polluted water (Husting 1983).
3. Unhygienic refuse disposal (Okpala 1956).
4. The presence of insects and rodents contaminating food and utensils; and
5. Long interval between food preparation and consumption (Prof. Alex 1987).

No work has so far been done carefully and accurately on school children of Samaru village. All the cases of similar survey gave the school children concerned specimen bottles to take home and anything could happen.

There was also no work carried relating the above listed factors with the incidence of these parasites in the school children of Samaru village.

I found, also, no literature relating parameters such as toilets, occupation of parents and water supply with the incidence of these parasites in school children in Zaria in general and those children in Samaru Village in particular.

1.3 RESEARCH OBJECTIVES

The aims of this study are:

1. To determine the main species of intestinal parasite in faecal samples from local school children of Samaru village.

2. It will provide clues as to the sources of exposures, i.e, the extent to which the socio-economic background of the children predispose them to these parasites.

3. It will direct attention to the amount of illness in the school children apparently resulting from these infections.

4. This will provide some reliable base-line data for programming public health services.

5. It will also help the health Authorities to find appropriate prophylactic measures for control of the infections.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 INTESTINAL PARASITE IN OTHER PARTS OF THE WORLD

Reports of prevalence rates of Intestinal parasites were not uncommon to public health authorities throughout the world. This shows that Intestinal parasitic infections are distributed virtually throughout the world with high prevalence rates in many regions.

Cross (1976), in West Kalimantan (Borneo), Indonesia, found that out of 2,101 stool samples examined, 97% contained evidence of intestinal parasites. The most common parasites found were Trichuris trichiura (90 percent), Ascaris lumbricoides (76 per cent)and Ancylostoma duodenale (60 per cent).

In Philippines, a research on Amoebiasis and intestinal parasitic infection was carried by John Cross et al (1977), in private hospital patients in Cebu. One thousand and fourteen stool samples were examined, 528 were males and 486 females, aged one to ninety two years. Intestinal parasites were found in 800 (79 percent) of the stool samples. These include, among others,(53 percent) for Trichuris trichiura, (50 percent)had Ascaris lumbricoides, (22 percent) had hookworm, (12 percent)had Entamoeba coli and (5 percent) Entamoeba histolytica. He found out that prevalence rate of Ascaris lumbricoides, Trichuris trichiura and Dicrocoeluim like eggs were higher in females than in males, while hookworm, Entamoeba histolytica

and Giardia lamblia infections were higher in males. E. histolytica was highest in males between aged 20 - 30 years. He also found out that the prevalence of A. lumbricoides and T. trichiura decreased with age while hookworm infection were lowest in 1 to 9 years age group and highest in 10 to 19 years group.

Intestinal protozoan infection were found in all age groups but generally prevalence were lower in those above 50 years of age.

Davis and Vardy-cohen (1962) found 13.2 percent of the school children in Monrovia were infected with hookworm.

Bray (1927) in a similar survey in Charles Ville Harbel district found as much as 94 percent prevalence rate for hookworm.

Fulleborn et al (1927) found a prevalence rate of 90 percent for hookworm in Corrientes Argentina.

In a survey on Intestinal parasites in Kenyan roadworker, Arnold (1978) found 28 percent of the workers were infected with Entamoeba histolytica, 23 percent had Ascaris lumbricoides, 17 percent had Enterobius vermicularis, 48 percent Trichuris trichiura and 68 percent had Ancylostoma duodenale besides Schistosoma mansoni, Strongyloides stercoralis and Hymenolepis nana.

Malek (1975) in his study of the effect of the Aswan Dam on the prevalence of Schistosomiasis in Egypt, recorded that prevalence rate of Schistosomiasis was high especially in the Nile delta area. This was found to be a centre for

human activity as well as a breeding habitat of the snail hosts of both urinary and Intestinal schistosomiasis.

Brown et al (1981), correlated the geographical distribution of endemic schistosomiasis to the distribution of the intermediate host which is Biophalaria pfeifferi for Schistosoma mansoni in Kenya. He found out that the absence of the snail B. pfeifferi from the coastal region results in the absence of endemic Schistosomiasis amongst the large human population in the area.

In a similar survey in Mazoe river valley in Zimbabwe, Husting (1983) showed the human water contact activities in relation to the transmission of bil harziasis (schistosomiasis). He observed the reason for contact, season and time of the day of contact as well as extent of the immersion. The overall prevalence of Schistosoma haemotobuim was 30% in males against 50% for females with a peak in girls up to 90% of 7 - 9 years age group. Schistosoma mansoni was found to infect 38% in males and 53 percent in females. He reasoned that the high prevalence rate was because the rate of arrivals of females at the river was more than four times for the males. Males pattern of arrival time were determined by agricultural activities and those of females by household needs.

Ashford et al (1981) carried out a survey on intestinal parasites with special reference to Strongyloides fuelleborni in 32 isolated villages in six regions of West Papau, New Guinea. Out of 1,023 faecal samples, the examined 868

(84.85 percent) were with helminth eggs. E. fuelleborni was the causative agent of an acute fatal infection in children. The species was found to be widely distributed in Western Papua, New Guinea. Infection was found largely restricted to forest areas.

2.2 INTESTINAL PARASITES IN NIGERIA

Intestinal parasites pervades our world and our lives. As a result of their importance a lot of studies have been done to show their prevalence rates and how to control the diseases they cause.

In Northern Nigeria, for example, Ramsay (1934) studied the incidence of certain helminths infection. He found a prevalence rate of 42.5 percent for hookworm, 13.9 percent for Schistosoma mansoni and 7.9 percent Ascaris lumbricoides among hospital patients.

Jung and Jeliffe (1952) found Trichuris trichiura in over 25 percent of the population of Ibadan and they also observed that it was the cause of prolonged diarrhoea with abdominal pains and other clinical syndromes such as loss of weight. Many people believe that T. trichiura is harmless until recent studies.

In the evaluation report of Hookworm as a public problem in Nigeria Urban population, Oyerinde (1982) reported that 743 people out of the 2,797 examined for hookworm were infected. He observed that infection rate was more prevalent among the age group 16 - 25 years which he described as young adults than in older age groups. Children were found to be least infected. There was, however, no difference in the prevalence of infection in both sexes as far as he was concerned.

Collard (1962) found, in a similar survey carried out among the rural Katsina Emirate, a high prevalence rate of 58 per cent for hookworm, 2.4 percent for Taenia and 1.2 percent for Ascaris lumbricoides.

In another survey in Northern Nigeria, Ikejiani (1959) found a prevalence rate of Ascaris to be 34.0 percent, Necator americanus(29 percent), Strongyloides stercoralis (4.0 percent)and(10 percent)for Trichuris trichiura.

Pugh et al (1981) found that more than half of the 429 people examined at the Malumfashi endemic diseases research project, were infected with intestinal parasites. Hookworm was the most prevalent (40.0 percent) and found in adults mostly males. Hymenolepis nana infection was detected in 4.0 percent of the cases which were mostly children. A low prevalence rate was recorded for Schistosoma mansoni and Ascaris lumbricoides infection.

Awogun (1984) investigated the prevalence of intestinal parasitic infection in children living in Ilorin, Kwara State.. The most common intestinal parasites found were Ascaris lumbriccides(44.1 percent), Trichuris trichiura 14.2 percent, Entamoeba histolytica(5.2 percent), Hookworm(4.4 percent), Entamoeba coli(3.7 percent), Strongyloides stercoralis (1.1%) Enterobius vermucularis(0.2 percent) and Hymenolepis nana(2.0 percent). The result also showed a high prevalence of(70.8 percent) of intestinal parasites among pre-school and primary school children (4 months to 12 years).

In Eastern Nigeria Ikejiani (1959) found an infection rate of 22.0 percent for Ancylostoma duodenale, (38.0 percent) Ascaris lumbricoides, 5.0 percent for Strongyloides stercoralis and 14.0 percent for Trichuris trichiura.

Ikejiani (1960) in a survey on prevalence rate of intestinal parasites in Ibadan, Western Nigeria found incidence of 24.0 percent for Necator americanus, Ascaris lumbricoides (48.0 percent), Strongyloides stercoralis (3.0 percent) and Trichuris trichiura (12.0 percent). He also found in a similar survey, that A. lumbricoides, T. trichiura have been found to be important human parasites in Benin City.

In Western State, Cowper and Wood (1961) found 25.9 percent for hookworm prevalence rate among hospital patient, while Gulles (1964) reported a high prevalence rate for hookwor (71 percent), followed by Ascaris (70 percent), Trichuris (45 percent) and Strongyloides (21 percent).

Okpala (1956) did a survey on incidence of intestinal parasites among school children in Lagos, Nigeria. Out of the 4,759 students examined, 4,052 (85.1 percent) were infected with various helminthic and protozoal parasites. A break down of the results showed Ascaris had the highest prevalence rate of (73.4 percent), Trichuris (38.9 percent), hookworm (14 percent), Strongyloides (4.9 percent), Entamoebacoli (8.1 percent), Entamoeba histolytica (0.4 percent) and Schistosoma mansoni .04 percent. The result also showed that girls harbour less the parasites than boys. Of the 4,052 infected children O

percent (2,442) were boys and 39.7 percent (1,610) were girls.

It was also observed that in some individuals there ware as many as 2 - 4 different parasites.

Later Okpala (1957) recorded 4.0 - 7.0 percent Schistosoma haematobium and 0.06 percent S. mansoni infection. He observed that in both children and adults infection of S. haematobium and S. mansoni in males had higher percentage than in females.

In 1975, Obiamiwe surveyed the pattern of parasitic infections in the human gut at the Specialist Hospital Benin City and recorded a high prevalence rate of (16.8 percent) for hookworm, (19.5 percent) for Ascaris lumbricoides, (5.9 percent) Trichuris trichiura, 1.8 percent Strongyloides stercoralis, (0.08 percent) Taenia saginata (0.06 percent) Dicrocoelium hospes and (0.02 percent) Schistosoma mansoni.

Onabamiro (1975), in Ibadan, observed that among 380 school children of aged 6 - 15 years, boys happened to be more susceptible than girls to Ascaris lumbricoides and Ancylostoma duodenale. The former parasites was found to be higher at the end of the rainy season than the dry season.

A survey of the incidence of the blood, urinary and intestinal parasite among students and kitchen personnel of the University of Nigeria, Nsukka, show that out of 529 persons examined 277 (52.4 percent) were infected. The parasites found during the study were Ancylostoma duodenale 14.9 percent, Entamoeba coli 13,2 percent, E. histolytica 12.85 percent,

Ascaris lumbricoides (7.9 percent) and Trichuris trichiura 4.5 percent, Okpala (1971). Okpala also took into account the type of drinking water they use and the laterine they use (kitchen personnel and students). Among the students examined, he observed that male students (53.8 percent) were more susceptible to infection than the female students (36.2 percent). The reverse was the case in kitchen personnel were more females (66.7 percent) were found to harbour the parasites than the men (56.3 percent).

Nwosu (1981), surveyed two rural villages in southern Nigeria for soil borne intestinal parasites. Out of 6,842 stool samples examined, 5,434 (78.3 percent) of the population were found to be infected. 71.1 percent prevalence rate was observed for hookworm,(20.6 percent) Ascaris lumbricoides, (7.9 percent) Trichuris trichiura and(0.4 percent) Strongyloides stercoralis. The frequency of mixed infections were also observed. 15.5 percent was recorded for hookworm and Ascaris lumbricoides, 8.9 percent for hookworm and Trichuris trichiura and 3.3 percent was observed for Ascaris lumbricoides and Trichuris trichiura. In the same survey it was found that the most heavily affected (88.3 percent) were children of school age between 10 - 15 years.

Okpala and Njoku Obi (1978) carried out a survey on incidence of intestinal parasites of primary school children from rural and urban schools in Nsukka Local Government area. They found that 63.8 percent of 600 children examined were

infected. The following results were obtained, Ascaris lumbricoides (12.5 percent), Trichuris trichiura (9.2 percent) and (2.5 percent) had Enterobius vermicularis.

A similar survey on the incidence of intestinal parasites of school children in parts of Anambra and Imo States was carried out by Onubogu (1978). Out of 1,742 examined, 1,405 (81.0 percent) were positive cases of helminth infection. The result also showed that hookworm constitute (72 percent), Trichuris (19.2 percent), Enterobuis (0.6 percent), Strongyloides (0.2 percent), Ascaris (14.8 percent), Taenia (0.1 percent) and Dibothriocephalus latus (0.4 percent).

In a survey of faecal smears in southern Nigeria, 316 babies age 4 - 5 weeks old were examined. 33 (10 percent) of them were infected with hookworm and 88 percent of whom was caused by Ancylostoma duodenale.Nwosu (1981).

In Lagos a similar survey was carried on Government workers. About 515 stool samples were examined and 482 (93.6 percent) were infected with one or more species of parasites. About 91.1 percent of the infected people were found to harbour helminth parasite while 30.9 percent had protozoan parasites. Okpala (1961).

Ogunbi (1971) reported 13.5 percent prevalence rate for hookworm among hospital patients in Lagos metropolitan.

Fashuyi (1983) carried out a survey on prevalence rate of helminth eggs in human faeces deposited on the streets of Lagos. Out of the 1,865 faecal samples examined, 96.3 percent

had ova of Ascaris lumbricoides, 91.2 percent had hookworm eggs and 90.2 percent had Trichuris trichiura. The sites of faecal collection were located near markets, motor parks, residential and recreational areas, making the problems of sanitation and helminth transmission very serious within Lagos metropolis.

At Yaba Lagos, Marsden (1960), examined stool samples from 700 patient, some of whom complained of diarrhoea. He found the infections of Trichuris trichiura, Ascaris lumbricoides, Entamoeba histolytica and Ancylostoma duodenale.

In another survey of Schistosomiasis in Nigeria, Oyediran (1982) observed that both sexes of all age groups were affected by Schistosoma infection in man, and that males have a higher rate of infection than their female counterpart.

CHAPTER THREE

STUDY AREA AND MATERIALS & METHODS

3.1 STUDY AREA

The study area is Samaru Village.

This is about 10 kilometres from Sabon gari Zaria, along Zaria - Funtua Road and opposite the main campus of Ahmadu Bello University Zaria.

This could be found in the map of Samaru village.

3.1.1 SOCIAL SERVICES

Social services are generally poor. There are no general hospital or public care centres in Samaru village. The A.B.U. main campus sickbay is only for the workers of the institution or their relatives. Most of the inhabitants of Samaru prefer to visit the A.B.U. teaching hospital in Tudun Wada Zaria. There are a few private clinics and pharmacies which are also patronized by the people of Samaru village.

Within the village there are two Day Secondary Schools and eight Primary Schools, excluding those in A.B.U. main campus.

The quality of pipe borne water in Samaru village is as good as in any other part of Zaria. Some of the inhabitants, however, have no access to this and therefore make use of well water for their domestic activities.

Electricity is well distributed except for a few houses on the outskirts which are yet to be connected to the main line.

The main occupation of the inhabitants of Samaru Zaria has long been farming and gardening (fadama). Crops sown include maize, millet, guinea corn, yam and cocoayams. A wide variety of animals are also reared. These include goats, ducks, sheep, chickens and cattle.

Other than these, a great number of the inhabitants of Samaru engage in different kinds of jobs. For example, carpentry, petty trading, civil service, bricklaying, etc. Most children, after school hours are seen selling things like colanuts, roasted groundnuts, sugar cane, chin chin, pop corn and other edible things for their parents.

3.1.2 HABITS AND SANITATION

Sanitation is generally poor because of poor drainage system in some parts, poor sewage disposal and the habits of the inhabitants. A small minority defaecate in the open. Most residents might have to utilize open spaces after their pit laterines are filled up.

Some schools' toilets are of the bucket latrine system. The buckets were found to be absent. So most children defaecate on the toilet floor while some use the bush around the school compound.

3.1.3 STUDY POPULATION

The survey was carried out on children of school age in Samaru Zaria. Collection of stool samples was done in 1985 from February to May and 1986 between March and May. School children of different sexes and ages ranging from 5

years to 19 years old were selected at random. A total of 250 children were examined during the period of the survey.

Data was collected from the following schools in Samaru Zaria.

1. Bomo L.E.A.
2. L.E.A. Samaru
3. L.E.A. Saidu
4. L.E.A. Lemu
5. L.E.A. Amina
6. U.P.E. Mil Goma
7. G.D.S.S. Bomo

All these schools are non-boarding and have both male and female students.



N

ZARIA LOCAL GOVT IN KADUNA STATE



LOCATION OF PRIMARY SCHOOLS IN S/GARI WARD

ZARIA LOCAL GOVERNMENT AREA

3.2 MATERIALS AND METHODS

Children were provided with a clean paper, wooden swabs and clean specimen bottles.

The children were asked to pass the faeces only on the paper given to them so as to avoid contamination by some organisms already in the soil or on their school toilet floor. They were then told to drop the faeces with the wooden swabs into the clean bottle. They were also told to discard the used paper and the used wooden swabs and bring along with them the specimen bottles with the faeces.

The specimen bottles were labelled with each child's serial number and date for recognition. Each child was also provided with a questionaire to fill with the help of his or her teacher which was also labelled accordingly. The questionaire carry the following information: Name, age, sex, and class of child, the name of school, swimming habits, parents occupation, type and structure of house and source of water supply. Refer to appendix II. The samples and the filled questionaire were brought to the laboratory for analysis. Two methods are used here. They are the direct smear method and the sedimentation method as would be explained later.

Examination of samples were carried out immediately using direct smear method. This was because if samples were left

for too long cyst of Entamoeba coli and Entamoeba histolytica would disintegrate. If, after the direct smear method, sedimentation technique could not be done immediately the stool samples were preserved in 10% formalin until the following day.

3.2.1 REAGENTS USED AND THEIR PREPARATION

The reagents used were normal saline, Lugols iodine, 10% formalin and Ether.

NORMAL SALINE SOLUTION:

0.85gms of sodium chloride crystals were dissolved in 100ml of distilled water to make up the solution. This solution had about the same concentration with the medium of the faeces. Therefore the osmotic balance was maintained and thus no desiccation of the parasite, egg or cyst.

LUGOL'S IODINE SOLUTION:

The above solution was made using 5gms of Iodine, 10gm potasium Iodine and 100ml of distilled water. Both Iodine and potasium Iodine granules were dissolved in distilled water to make up the lugol's Iodine.

Lugol's Iodine was used for staining purpose.

10% FORMALIN SOLUTION:

80ml of distilled water was added to 10ml concentrated formaldehyde. Formalin was used as our preservative instead of 70% ethanol because alcohol was more expensive and less quantity was required of formalin than alcohol. Also the pressure of formaline on sample is less.

ETHER:

The solution of ether was prepared commercially. This solution was used so as to remove the fat in the faecal sample and used especially for Trematode eggs and Entamoeba cysts.

3.2.2 TECHNIQUES USED FOR FAECAL EXAMINATION

The faecal samples were examined for various parasites using 2 methods, namely Direct smear method and Sedimentation technique as mentioned earlier on.

DIRECT SMEAR METHOD:

A drop of saline solution was placed on a lean slide, with the aid of clean dropper. A little quantity of the faecal sample was mixed with it using a glass rod to obtain a thin smear. Large particles were removed and then a coverslip was placed on the slide. A drop of lugol's Iodine was added to the edge of the cover-slip so as to allow gradual diffusion into the saline mount. The slide was examined under the light microscope using x10 objective lens first. Then x40 objective lens was only used for closer examination of eggs and for taking some pictures of the eggs or cysts.

This method was a qualitative method of faecal examination and it involved small amount of faeces.

SEDIMENTATION TECHNIQUE:

This is a good method for the concentration of all types of eggs and cysts.

The method used here is known as Ridley and Hawgoods Formal-Ether method, and it is as follows:

About five grammes of the faeces was weighed and placed in a test tube. Normal saline was added to it and mixed with the aid of a glass rod so as to get a stool suspension. The faecal suspension was then passed through a two folded surgical gauze, which served as a sieve, into a suitable centrifuging tube. The large pieces of the stool sample was left behind on the gauze which was then discarded. The centrifuge tube was then spined in al electric centrifuge for two minutes after which it was removed and the supernatant fluid was poured out. 10ml of 10% formalin was added to the supernatant and left for 5 minutes. 3ml of ether was then added and shaken vigorously. The mixture was then centrifuged for 2 minutes at 1500rpm (revolutions a minute). The centrifuge tube was found to contain four layers. A top clear layer of ether, a narrow middle thick brown layer or fatty 'plug', below it was a thin, brown layer and at the botton of the tube was a little layer of deposit. The fatty 'plug' was loosened with the help of a glass rod. The supernatant was decanted and transferred to a clean slide, stained with a drop of lugol's Iodine, and covered with a cover-slip. The prepared slide was examined using the method as in the direct smear method.

3.2.3 IDENTIFICATION OF SPECIES

Species observed were identified using 2 books namely:

1. An identification charge of 1975 in the "Manual of Clinical and Laboratory Methods" by Opal Hepler and Charles Thomas.

2. Plates by Maurice King 1973 in his book "A Medical Laboratory for Developing Countries".

Schistosoma mansoni was distinguished due to the presence of a lateral spine and the egg measures about 128 by 52 Um.

Ascaris lumbricoides egges show ridges on the surface while the decorticated eggs (ie the ovum without the skin or cortex) do not. This could be mistaken with the eggs of hookworm. They can, however, be differentiated from one another because while Ascaris has a thick shell, hookworm has a thin one. Ascaris egg measures 65 by 36 Um.

Trichuris trichiura eggs had characteristic plug at both ends of the egg, and measures 54 by 22 Um.

Enterobius vermicularis egg is flattened at one of its sides they measure 52 Um by 29 Um.

Entamoeba coli precyst and cysts are generally round with 4-8 nuclei respectively, 17 Um by 14 Um.

Strongyloides stercoralis larva had a short mouth and small fold or notch on its tail while Ancylostoma duodenale had a pointed tail with a long mouth. Strongyloides larva measures about 280 Um by 20 Um.

Hookworm eggs are oval and had a thin membrane. Hymenolepis nana ovum had a thick shell with the walls appearing double and had 3 pairs of hooks. The outer wall measures 32 Um by 30 Um and the inner wall is 20 Um by 19 Um.

C H A P T E R F O U R

R E S U L T S

4.1 GENERAL

4.1.1 INFECTIONS:

Of the 250 students that were randomly examined, 145 (or approximately 58 percent) were infected with protozoal and various helminthic parasites. Cases of multiple infections were common. Cases of single, double and triple infection were 106, 36 and 3 respectively. Thus, while there were no cases of quadruple or more infections, a total of 39 out of 145 children had multiple infections.

4.1.2 AGE GROUPS:

The youngest child examined was 5 years old, while the oldest one was 19 years old. Four of the children were 5 years old, 23 were 6 years old, 31 were 7 years old. There were 33 children who were 8 years old, 25 that were 9 years old and 23 that were 10 years old. Fourteen children were of the age of 11, 32 children were of the age of 12 and 17 children were of the age of 13. Thirteen children were 14 years old, 14 children were 15 years old, 8 children were 16 years old, 2 children were 17 years old, 10 children were 18 years old and one child was 19 years of age.

The general results of the prevalence of the various intestinal parasites on all ages are shown in TABLES 3, 11 - 15, 16 and FIG II, X - XIV.

As far as the sexes of school children examined were concerned, 127 (50.8 percent) were boys and the remaining 123 (49.2 percent) were girls.

Taking swimming habit of the children examined, into consideration, 12 children were found to engage in swimming after school in ponds. The remaining 238 (95.2 percent) did not engage in this activity.

The type of house, that is whether bungalow or tenement, of the 250 children examined were found to be 143 (57.2 percent) and 107 (42.8 percent) number and percentage of the children respectively.

The structure of infected children's houses was also looked into. One hundred and fifty four of the children examined lived in concrete houses while the remaining 96 (38.4 percent) lived in houses made of mud.

The type of toilets used by the 250 pupils examined showed that 79 (31.2 percent) of the children use water system or flush system toilets, 170 (68.0 percent) use pit latrine and the 2 children left which forms 0.8 percent use the bush of their homes surrounding as toilets.

Water used for domestic work and drinking by the

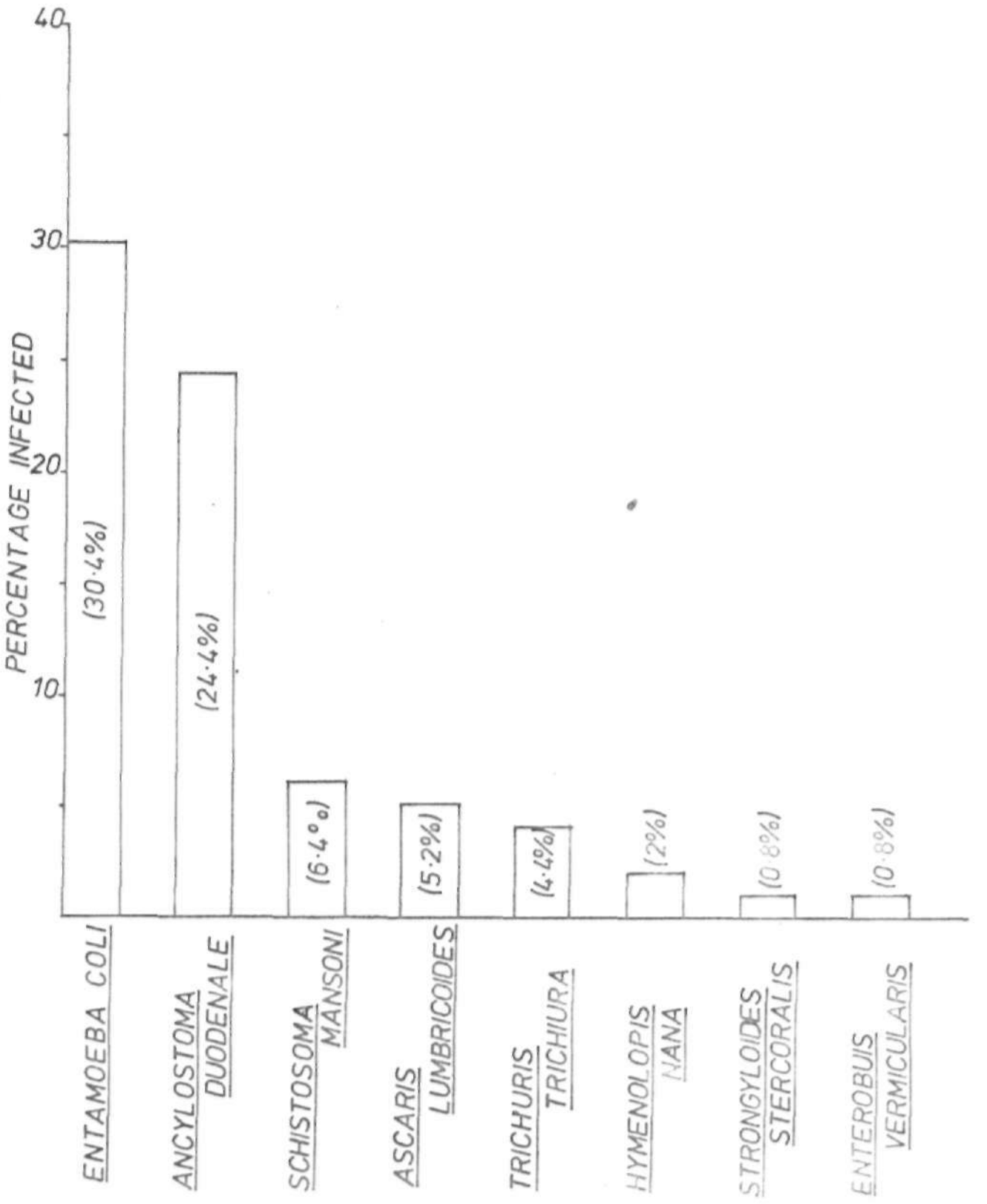
TABLE 1

THE INCIDENCE OF VARIOUS PARASITES AMONG SCHOOL CHILDREN OF SAMARU VILLAGE ZARIA:

TYPE OF PARASITE	NUMBER OF STUDENTS EXAMINED	NUMBER INFECTED	PERCENTAGE INFECTION
Entamoeba coli	250	76	30.4
Ancylostoma duodenale	250	61	24.4
Schistosoma mansoni	250	16	6.4
Ascaris lumbricoides	250	13	5.2
Trichuris trichiura	250	11	4.4
Hymenolepis nana	250	5	2.0
Strongyloides stercoralis	250	2	0.8
Enterobius vermicularis	250	2	0.8

FIG. I

THE INCIDENCE OF VARIOUS PARASITES
AMONG SCHOOL CHILDREN
OF SAMARU VILLAGE, ZARIA
(n = 145)



children was not left behind during this survey. It was found that out of the 250 children examined, 147 (58.8 percent) use only tap water, 69 (27.6 percent) use well water and 34 (13.6 percent) use both tap as well as well water. When looking into the socio-economic status of parents of the children examined, it was found that the children could be classified into 2 groups. The first group is children with intermediate working parents and the second group is children with junior working parents. The number of children with intermediate and junior working parents are 137 (54.8 percent) and 113 (45.2 percent) respectively.

4.2 INTESTINAL PARASITES:

Eight different species of parasites were identified in this study. They are Entamoeba coli, Ascaris lumbricoides, Ancylostoma duodenale, Trichuris trichiura, Schistosoma mansoni, Strongyloides stercoralis, Hymenolepis nana and Enterobius vermicularis. The pictures of all parasites are seen in plates 1 to 8. All the parasites shown here were obtained from fresh stool samples of infected children examined in this survey. See appendix I for classification of the various intestinal parasites.

4.2.1 INCIDENCE OF INTESTINAL PARASITES:

The prevalence rate of the various parasites found during the survey will be taken into account under this

heading.

As shown in TABLE I, FIG I, the commonest intestinal parasite infecting school children of Samaru village was found to be Entamoeba coli with 76 (30.4 percent) infected children out of the 250 children examined. Ancylostoma duodenale was found to be next in occurence with 61 (24.4 percent) infection rate. Schistosoma mansoni infected 16 children that is (64 percent). Ascaris lumbricoides infected 13 (5.2 percent) of the children, Trichuris trichiura 11 (4.4 percent) Hymenolepis nana was found in 5 children, thereby forming 2.0 percent. Strongyloides sterloralis recorded 2 children (0.8 percent) so also Enterobius vermicularis (0.8 percent).

4.2.2 INTENSITY OF PARASITE INFECTION:

The intensity of infection of the various parasites found during this study was determined by the number of eggs observed during faecal examination. The intensity was described as "light" when the number of eggs counted were between 1 and 15; "moderate" when eggs count were 16 to 25; "heavy" from 26 to 35 eggs; and "compact" when the number of eggs was 36 and above.

In Ancylostoma duodenale infection, out of the 61 recorded cases, 42 (68.8 percent) of the children had light infection, 12 (19.7 percent) were moderate, 7 (11.4 percent) were cases of heavy infection. None of the

TABLE 2:

INTENSITY OF THE VARIOUS PARASITIC INFECTION

PARASITE	INTENSITY OF INFECTION (in percentage)				Number Infected
	Light	Moderate	Heavy	Compact	
Ancylostoma duodenale	68.8	19.7	11.4	0.0	61
Strongyloides stercoralis	100	0.0	0.0	0.0	2
Entamoeba coli	58	22.3	14.5	5.2	76
Hymenolepis nana	100	0.0	0.0	0.0	5
Ascaris lumbricoides	23.1	61.1	15.4	0.0	13
Schistosoma mansoni	75.0	25.0	0.0	0.0	16
Enterobius vermicularis	100	0.0	0.0	0.0	2
Trichuris trichiura	45.5	45.5	9.0	0.0	11

children, however, had compact hookworm infection.

For Strongyloides stercoralis, all recorded cases, which were 2 had light infection.

Entamoeba coli infection had all the four groups of intensity. 44 children (58 percent) showed light infection, 17 (22.3 percent) were moderate, 11 (14.5 percent) had heavy infection while the remaining 4 (5.2 percent) had compact infection. All 5 children which harbour Hymenolepis nana had light infection. Out of a total of 13 children infected with Ascaris lumbricoides 3 (23.1 percent) were recorded light infection, 8 (61.5 percent) had moderate and 2 (15.4 percent) had heavy infection.

In Schistosoma mansoni infection, only light and moderate intensity were recorded with 12 (75.0 percent) as light and 4 (25.0 percent) as moderate infection. The 2 children that harboured Enterobius vermicularis had light infection.

For Trichuris trichiura infection both light and moderate intensity had 5 (45.5 percent) children each while the remaining child (9.0 percent) was heavily infected. The result on intensity is shown in TABLE 2.

4.3 ANCYLOSTOMA DUODENALE - DUBINI 1843

Ancylostoma duodenale is commonly known as hookworm. The eggs are shown in PLATE 7. The eggs are oval in shape with a thin outer covering and measured about 61 Um in length and 40 Um in width.

As earlier mentioned, a total of 250 school children were examined and 145 of them were infected with one or more species of the parasites. Out of the 145 infected children, 61 (42.1 percent) had A. duodenale infection. A. duodenale was found to rate second in terms of prevalence rate among the parasites examined in this study.

4.3.1 AGE OF PUPILS AND A. duodenale INFECTION:

Ancylostoma duodenale infection was observed in children of all ages (5 - 19 years) except for 17. TABLE 3 has the summary of the result for the age groups. The highest prevalence rate of 70 percent was recorded for age 18, in which 7 out of 10 pupils were infected. The lowest prevalence was among the 12 years old pupils, where 3 out of 32 pupils (9.4 percent) were infected. FIG. II shows the graphical representation of the result.

4.3.2 SEX OF PUPILS AND A. duodenale INFECTION:

As shown in TABLE 4, FIG. III, the boys were found to harbour more A. duodenale than the girls. Of the 127 boys examined during this survey 35 (27.6 percent) were infected with the parasite. Out of the 123 girls that were examined 26 (21.1 percent) were infected with hookworm.

TABLE 3

INCIDENCE OF ANCYLOSTOMA DUODENALE AMONG AGES

AGE	NUMBER EXAMINED	NUMBER INFECTED	PERCENTAGE
5	4	1	25.00
6	23	5	21.00
7	31	7	22.58
8	33	9	27.27
9	25	3	12.00
10	23	3	13.04
11	14	2	14.28
12	32	3	9.37
13	17	7	41.17
14	13	4	30.76
15	14	6	42.85
16	8	3	37.00
17	2	0	0
18	10	7	70.00

FIG. II

INCIDENCE OF ANCYLOSTOMA DUODENALE AMONG AGES

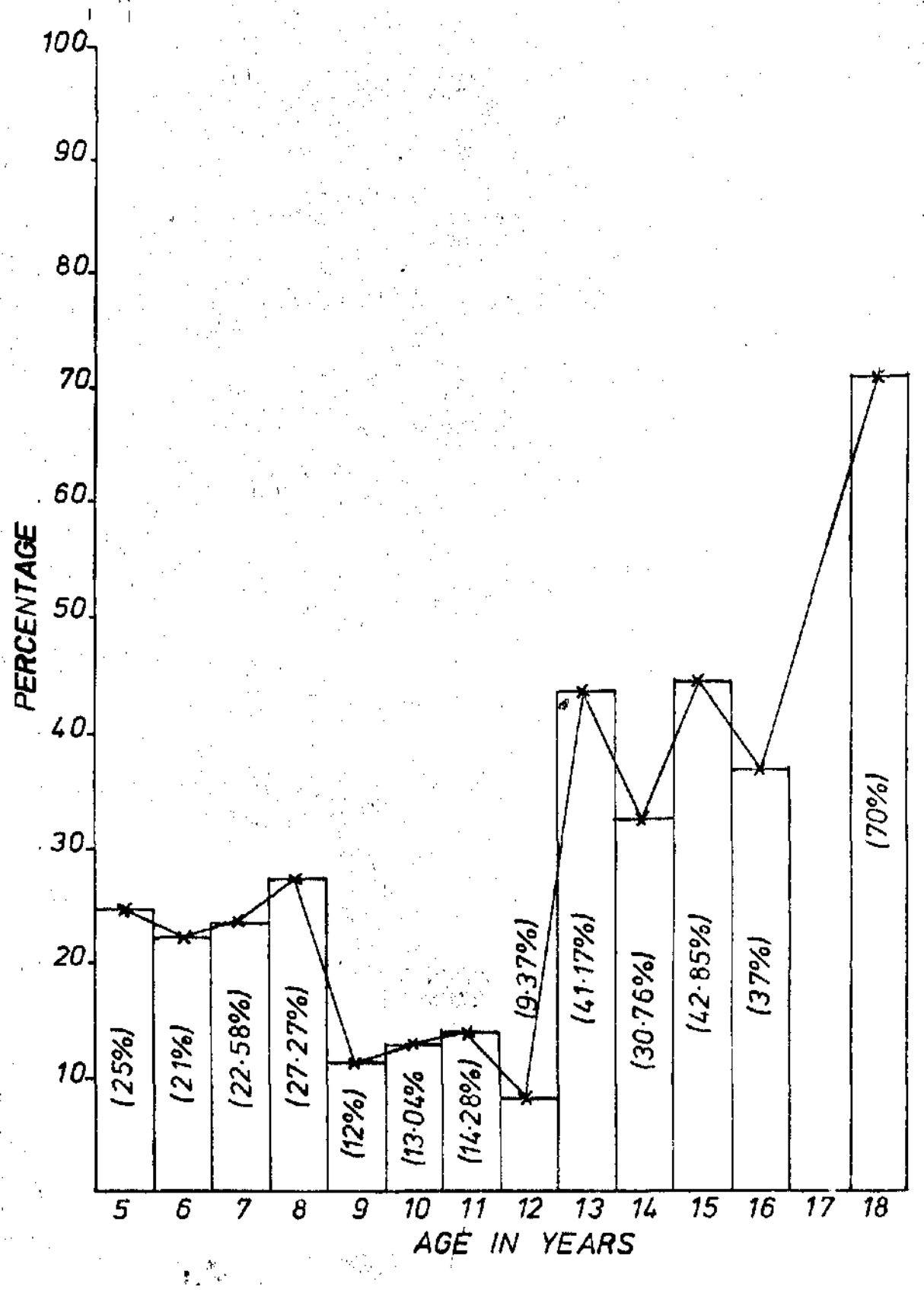


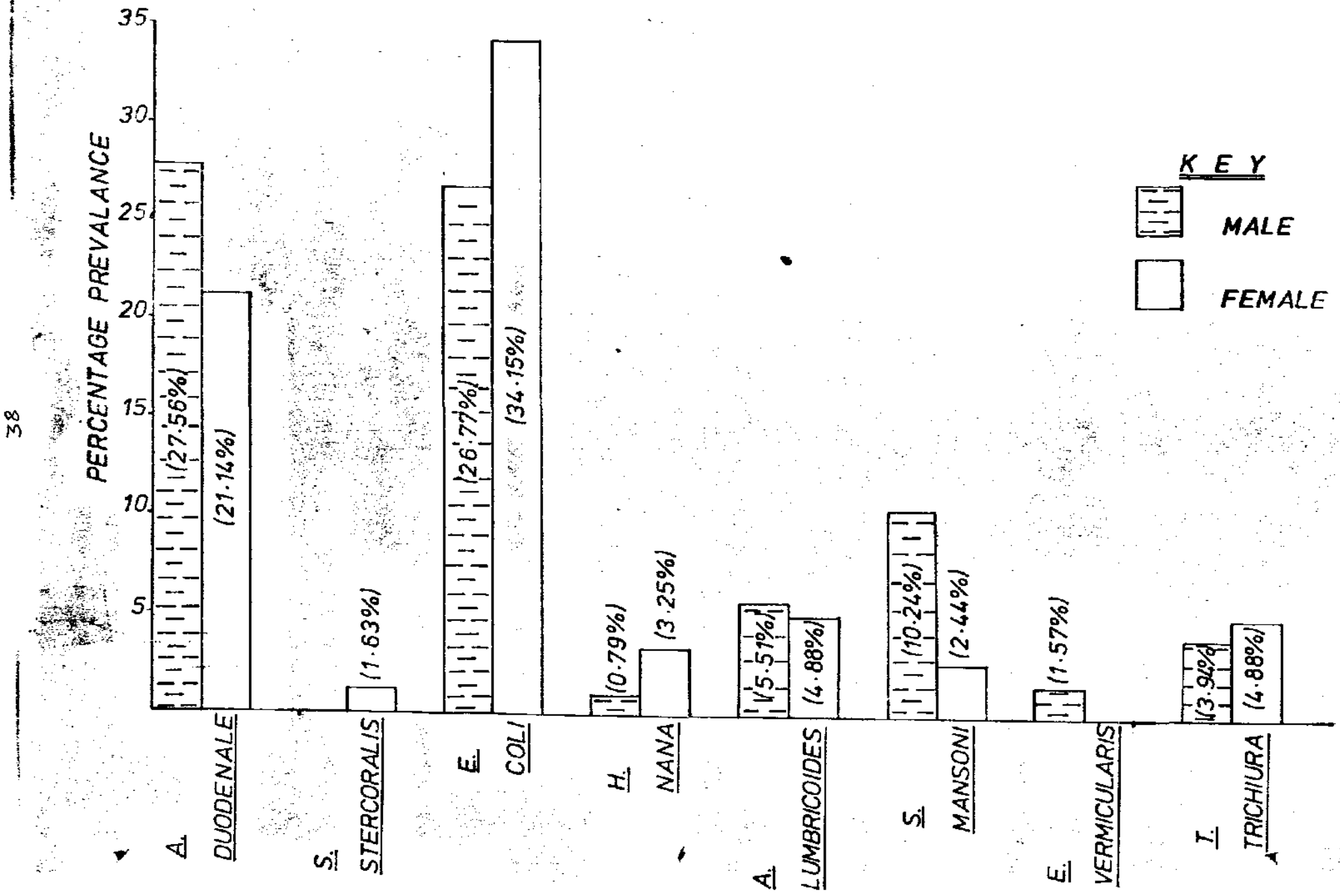
TABLE 4

INCIDENCE OF PARASITIC INFECTION AMONG SEXES

PARASITE	MALE			FEMALE		
	TOTAL EXAMINED	NUMBER INFECTED	% INFECTED	TOTAL EXAMINED	NUMBER INFECTED	% INFECTED
A. duodenale	127	35	27.56	123	26	21.14
S. stercoralis	127	0	0	123	2	1.63
E. coli	127	34	26.77	123	42	34.15
H. nana	127	1	0.79	123	4	3.25
A. lumbricoides	127	7	5.51	123	6	4.88
S. mansoni	127	13	10.24	123	3	2.44
E. vermicularis	127	2	1.57	123	0	0
T. trichiura	127	5	3.94	123	6	4.88

INCIDENCE OF PARASITIC INFECTION AMONG SEXES

FIG. III



4.3.3 SWIMMING HABITS OF PUPILS AND A. duodenale INFECTION:

The recorded case of A. duodenale infection were found in children that swam as well as those that did not. Out of 238 children examined as non-swimmers, 55 (23 percent) were infected with hookworm. The data also showed that 6 (50 percent) out of 12 children that swam were infected with the parasite.

4.3.4 HOUSE TYPE OF PUPILS AND A. duodenale INFECTION:

The effect of the type of house (whether bungalow or tenament) on infection of the pupils were also looked into in this survey. Of the 143 children that lived in bungalow houses, 36 (25.2 percent) were infected with A. duodenale. This percentage is higher than the one found for children that lived in tenament houses. Out of 107 children examined, 25 (23.4 percent) were infected. (TABLE 6,FIG V).

4.3.5 HOUSE STRUCTURE OF PUPILS AND A. duodenale INFECTION:

Out of 92 children living in mud houses 27 (28 percent) were infected with A. duodenale, while in the concrete type of house 34 (22.1 percent) out of 154 children were infected.

4.3.6 TYPE OF TOILET OF PUPILS AND A. duodenale INFECTION:

Hookworm infection was found to be more prevalent in children that used pit latrine than those that used water

TABLE 5

INCIDENCE OF PARASITIC INFECTION AMONG CHILDREN THAT SWIM AND THOSE THAT DO NOT SWIM

PARASITE	SWIMMER			NON SWIMMER		
	NUMBER EXAMINED	NUMBER INFECTED	%	NUMBER EXAMINED	NUMBER INFECTED	%
A. duodenale	12	6	50.00	238	55	23.12
S. stercoralis	12	0	0	238	2	0.84
E. coli	12	4	2.38	238	72	30.25
H. nana	12	0	0	238	5	2.10
A. lumbricoides	12	0	0	238	13	5.46
S. mansoni	12	1	8.33	238	15	6.30
E. vermicularis	12	0	0	238	2	0.84
T. trichiura	12	0	0	238	11	4.60

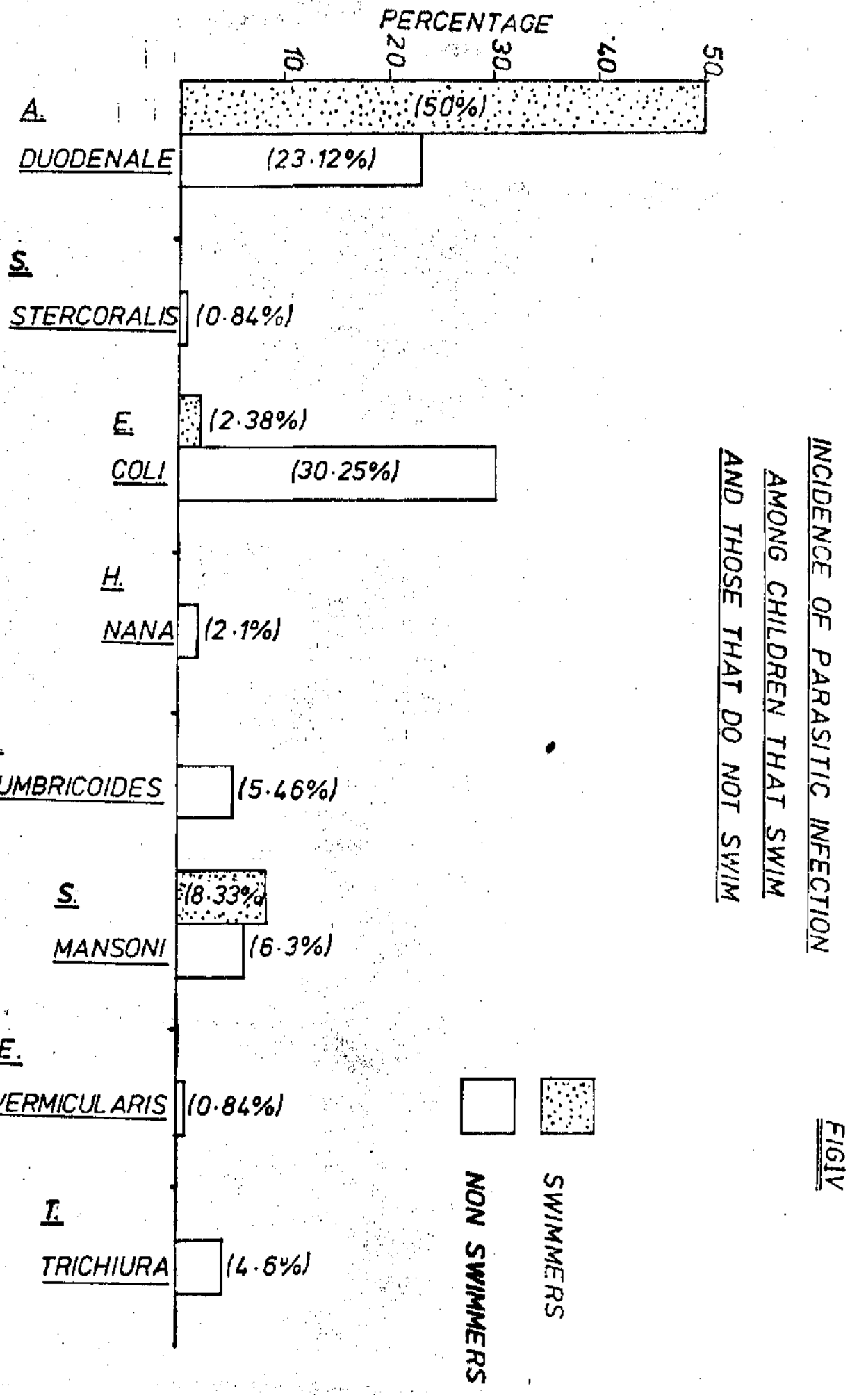


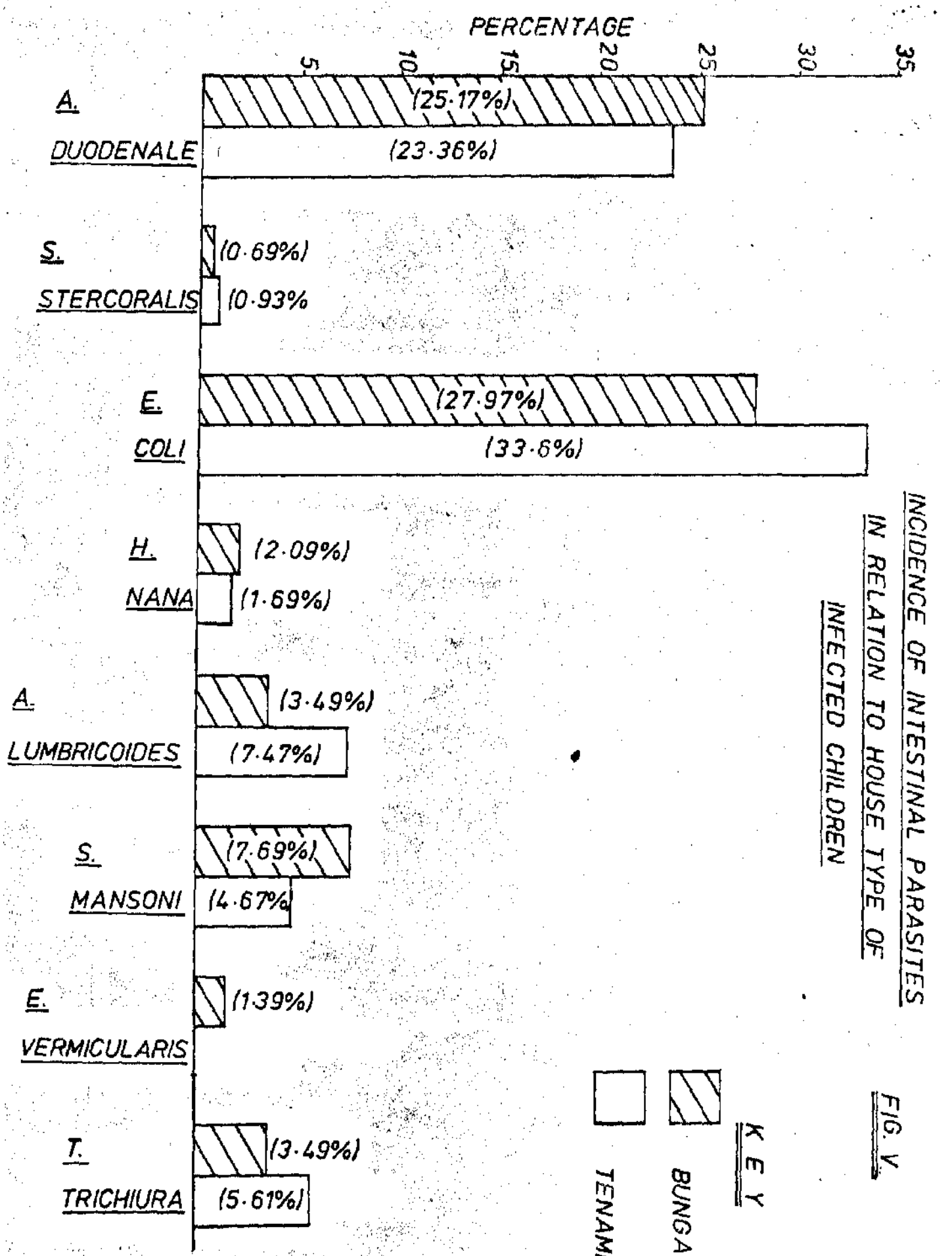
FIG IV

INCIDENCE OF PARASITIC INFECTION AMONG CHILDREN THAT SWIM AND THOSE THAT DO NOT SWIM

TABLE 6

INCIDENCE OF INTESTINAL PARASITE IN RELATION TO HOUSE TYPE OF INFECTED CHILDREN

PARASITE	BUNGALOW			TENAMENT		
	NUMBER EXAMINED	NUMBER INFECTED	%	NUMBER EXAMINED	NUMBER INFECTED	%
A. duodenale	143	36	25.17	107	25	23.36
S. stercoralis	143	1	0.69	107	1	0.93
E. coli	143	40	27.97	107	36	33.60
H. nana	143	3	2.09	107	2	1.69
A. lumbricoides	143	5	3.49	107	8	7.47
S. mansoni	143	11	7.69	107	5	4.67
E. vermicularis	143	2	1.39	107	0	0
T. trichiura	143	5	3.49	107	6	5.61



INCIDENCE OF INTESTINAL PARASITES IN RELATION TO HOUSE TYPE OF INFECTED CHILDREN

FIG. V.

TABLE 7

INCIDENCE OF INTESTINAL PARASITES IN RELATION TO HOUSE STRUCTURE OF THE CHILDREN

PARASITE	CONCRETE			MUD		
	NUMBER EXAMINED	NUMBER INFECTED	%	NUMBER EXAMINED	NUMBER INFECTED	%
A. duodenale	154	34	22.07	96	27	28.13
S. stercoralis	154	1	0.65	96	1	1.04
E. coli	154	43	27.92	96	33	34.37
H. nana	154	2	1.29	96	3	3.13
A. lumbricoides	154	11	7.14	96	2	2.08
S. mansoni	154	8	5.19	96	8	8.33
E. vermicularis	154	2	1.29	96	0	0.00
T. trichiura	154	10	6.49	96	1	1.04

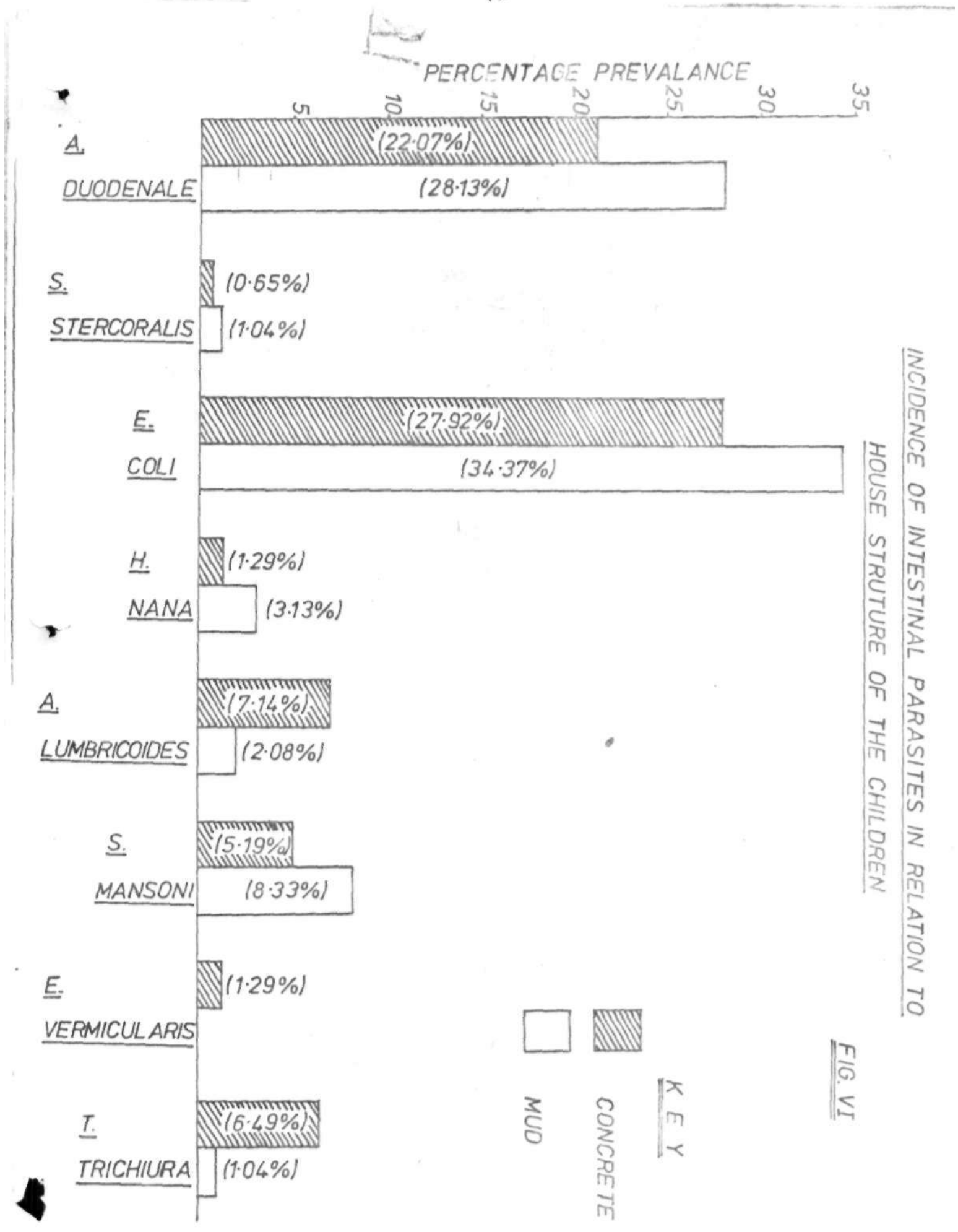


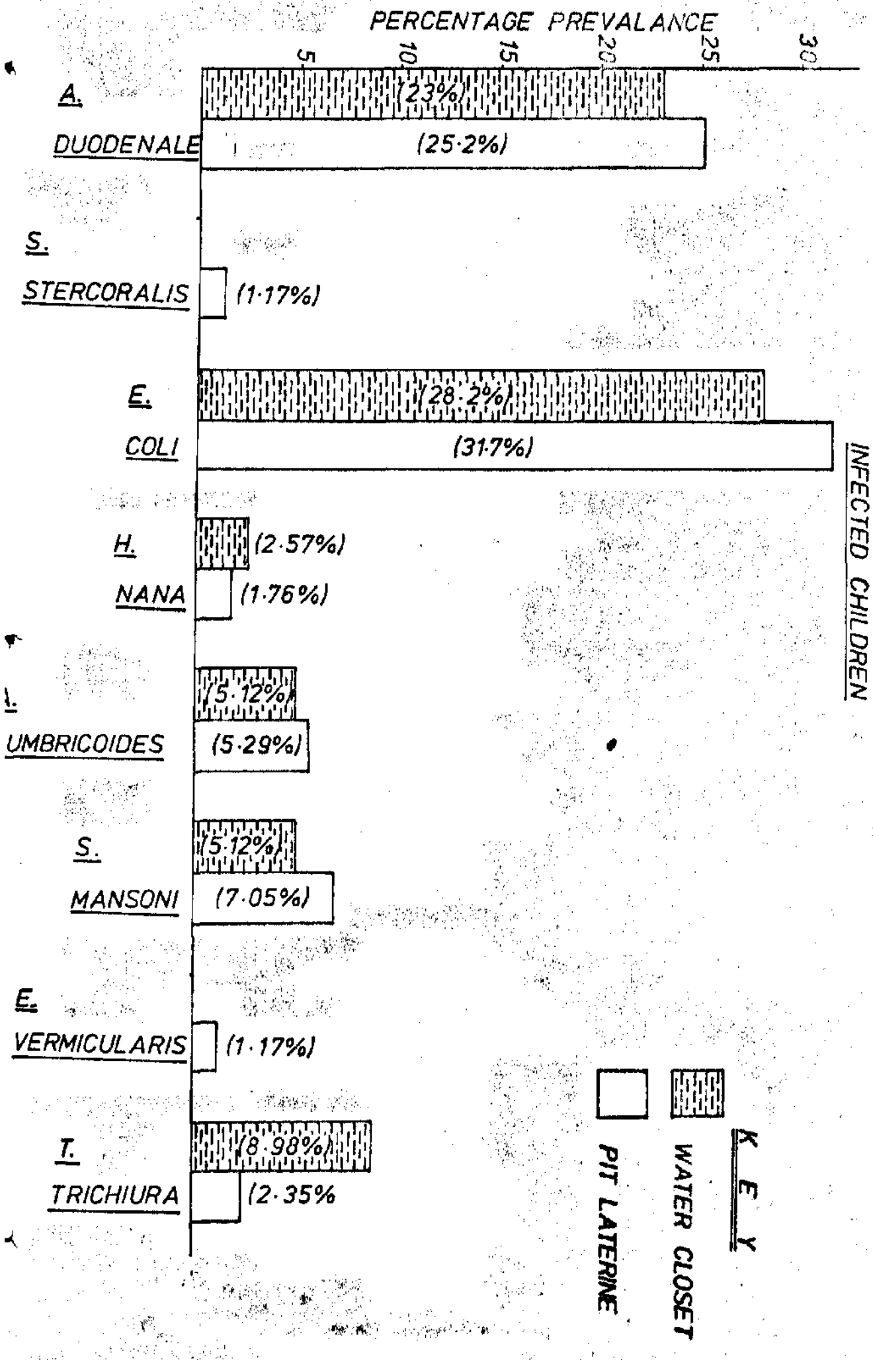
FIG. VI

INCIDENCE OF INTESTINAL PARASITES IN RELATION TO HOUSE STRUTURE OF THE CHILDREN

TABLE 8

INCIDENCE OF INTESTINAL PARASITES IN RELATION TO TYPE OF TOILET OF INFECTED CHILDREN

PARASITE	WATER SYSTEM			PIT LATRINE		
	NUMBER EXAMINED	NUMBER INFECTED	%	NUMBER EXAMINED	NUMBER INFECTED	%
A. duodenale	78	18	23.00	170	43	25.20
S. stercoralis	78	0	0	170	2	1.17
E. coli	78	22	28.20	170	54	31.70
H. nana	78	2	2.56	170	3	1.76
A. lumbricoides	78	4	5.12	170	9	5.29
S. mansoni	78	4	5.12	170	12	7.05
E. vermicularis	78	0	0	170	2	1.17
T. trichiura	78	7	8.98	170	4	2.35



INCIDENCE OF INTESTINAL PARASITES IN RELATION TO TYPE OF TOILET OF INFECTED CHILDREN

FIG. VII

(flush) system or bush. Out of the 170 children that used pit latrines 43 (25.2 percent) were infected with the parasite, while 18 (23 percent) out of 78 that used water (flush) system latrine were found to habour the parasite. No child using the bush for toilet, however, was found to be infected with A. duodenale.

4.3.7 WATER SUPPLY OF PUPILS AND A. duodenale INFECTION:

As shown in TABLE 9, FIG VIII, Ancylostoma duodenale infection was observed in children that used tap and well water for drinking and domestic activities. Out of 147 children that used tap water 37 (25.8 percent) were infected. On the other hand, 19 (27.5 percent) of the 69 children that used well water were found with hookworm parasite, 5 (14.7 percent) children that used both tap and well water were infected with A. duodenale.

4.3.8 SOCIO-ECONOMIC STATUS OF PARENTS OF PUPILS AND A. duodenale INFECTION:

A. duodenale infection was found to be more prevalent in children that have parent of the junior working class status than those with parent of intermediate working class. From the data collected, 38 (33.6 percent) out of 113 children with junior working class parents were infected. Out of 137 children with intermediate working class parents, 23 (16.8 percent) of them were infected with hookworm. TABLE 10, FIG. IX show the detailed results.

TABLE 9

INCIDENCE OF INTESTINAL PARASITE IN RELATION TO TYPE OF WATER SUPPLY OF INFECTED CHILDREN

PARASITE	T A P			W E L L			B O T H		
	NUMBER EXAMINED	NUMBER INFECTED	%	NUMBER EXAMINED	NUMBER INFECTED	%	NUMBER EXAMINED	NUMBER INFECTED	%
A. duodenale	147	37	25.8	69	19	27.5	34	5	14.7
S. stercoralis	147	1	0.68	69	1	1.44	34	0	0
E. coli	147	40	27.2	69	29	42.0	34	7	20.5
H. nana	147	3	2.04	69	2	2.88	34	0	0
A. lumbriccides	147	3	2.04	69	3	4.34	34	7	20.5
S. mansoni	147	7	4.76	69	5	0.07	34	4	11.76
E. vermicularis	147	0	0	69	2	2.88	34	0	0
T. trichiura	147	9	6.12	69	0	0	34	2	5.88

INCIDENCE OF INTESTINAL PARASITES

IN RELATION TO TYPE OF WATER SUPPLY OF INFECTED

CHILDREN

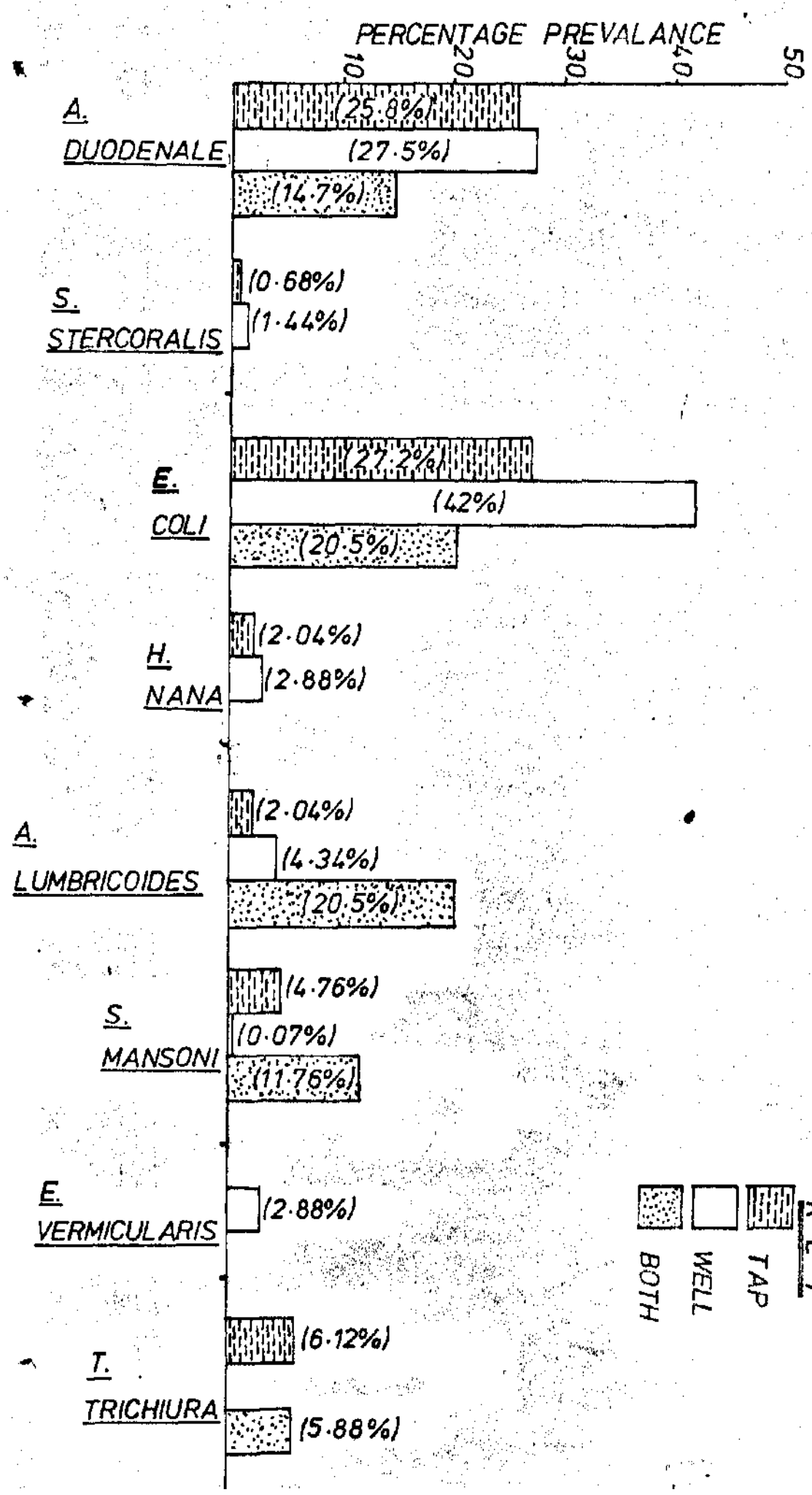


FIG. VIII

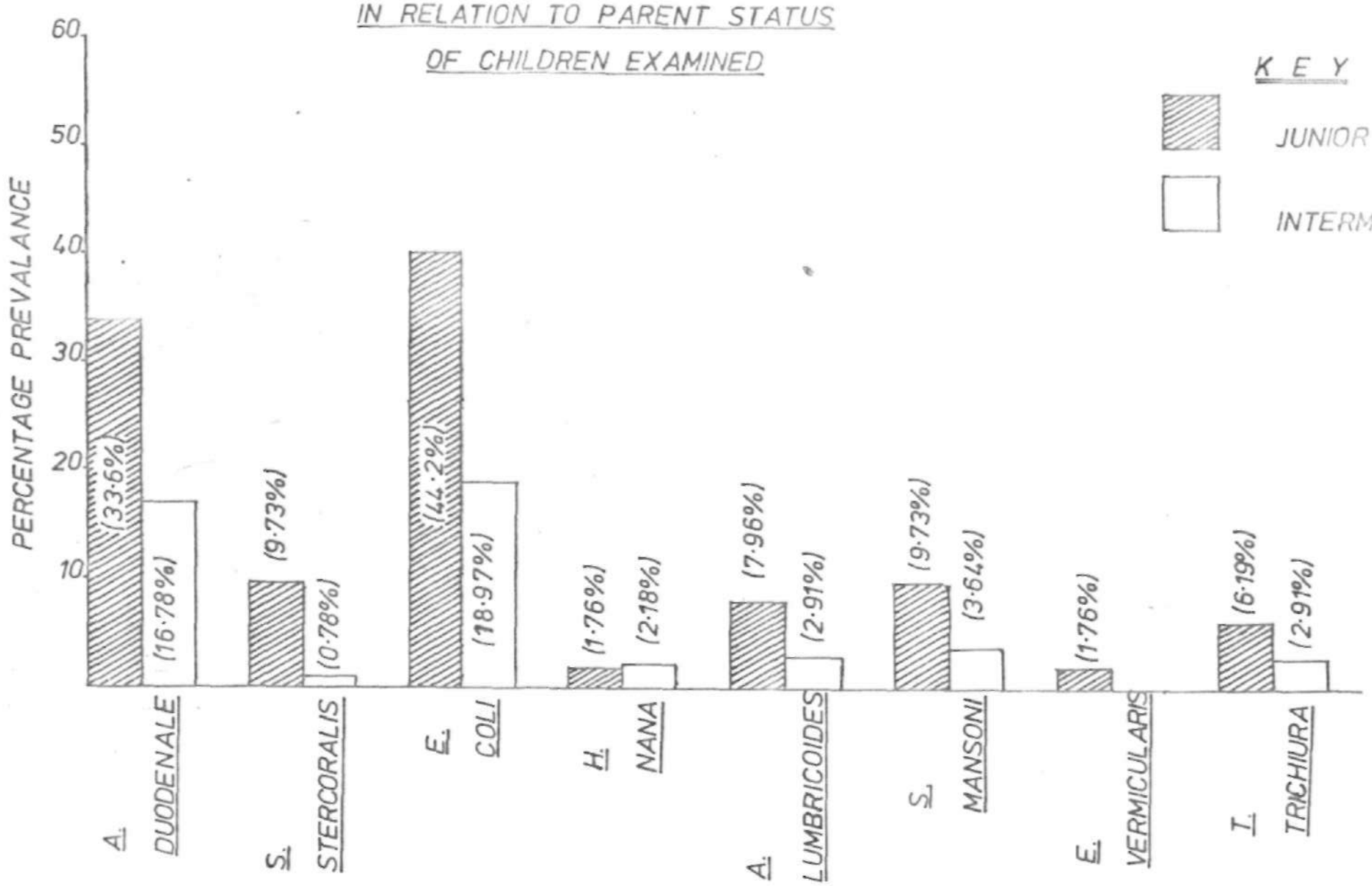
TABLE 10

INCIDENCE OF PARASITIC INFECTION IN RELATION TO PARENT STATUS OF CHILDREN EXAMINED

PARASITE	JUNIOR			INTERMEDIATE		
	NUMBER EXAMINED	NUMBER INFECTED	%	NUMBER EXAMINED	NUMBER INFECTED	%
A. duodenale	113	38	33.6	137	23	16.78
S. stercoralis	113	1	9.73	137	1	0.72
E. coli	113	50	44.20	137	26	18.97
H. nana	113	2	1.76	137	3	2.18
A. lumbricoides	113	9	7.96	137	4	2.91
S. mansoni	113	11	9.73	137	5	3.64
E. vermicularis	113	2	1.76	137	0	0
T. trichiura	113	7	6.19	137	4	2.91

FIG IX

INCIDENCE OF PARASITIC INFECTION IN RELATION TO PARENT STATUS OF CHILDREN EXAMINED



4.4 STRONGYLOIDES stercoralis - BAVAY 1876

Strongyloides stercoralis resembles the hookworm except that it has a shorter mouth and small folds on its tail. Only the larvae of S. stercoralis were found in faecal samples of infected children (PLATE 6). The larva measured about 280 Um in length and 20 Um in width.

Out of the 145 infected children only 2 children were found to harbour the parasite, thus constituting 1.4 percent of the infected children. In fact, as far as this study is concerned, S. stercoralis can be mentioned as a rare parasite among school children of Samaru village.

4.4.1 AGE OF PUPILS AND S. stercoralis INFECTION:

S. stercoralis infection was observed only in children under 11 years of age. To be precise, in a 6 year old child and another child of 10 years. The number of children examined under these age groups (6 and 10 years) was 23 each. No parasite was found in children of ages 5, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18 and 19 years old (TABLE 11).

4.4.2 SEX OF PUPILS AND S. stercoralis INFECTION:

As shown in TABLE 4, the boys were found to be free from S. stercoralis infection. Out of the 125 girls examined during this survey only 2 (1.63 percent) were found to harbour the parasite.

TABLE 11

INCIDENCE OF STRONGYLOIDES STERCORALIS AMONG AGES

AGE	No. EXAMINED	No. INFECTED	%
5	4	0	0
6	23	1	4.35
7	31	0	0
8	33	0	0
9	25	0	0
10	23	1	4.35

4.4.3 SWIMMING HABIT OF PUPILS AND S. stercoralis INFECTION:

All recorded cases of S. stercoralis infection were found in children that did not engage in swimming in ponds, lakes, etc. Of a total of 238, 2 children were infected constituting 0.8 percent (TABLE 5).

4.4.4 HOUSE TYPE OF PUPILS AND S. stercoralis INFECTION:

TABLE 6 shows that the children found infected with S. stercoralis lived in the 2 type of houses (i.e bungalow and tenament). Out of a total of 143 children that lived in a bungalow type of house 1 (0.7 percent) was infected. In tenament house 1 (1.0 percent) child out of 107 children was infected with the parasite.

4.4.5 STRUCTURE OF HOUSE OF PUPILS AND S. stercoralis INFECTION:

From the data obtained during this study it was observed that there were equal chances of contacting the parasite S. stercoralis when living in a mud house as in a concrete type of house. Out of the 96 children living in mud houses that were examined 1 (1.04 percent) was infected, while in concrete type of house 1 (0.7 percent) was infected out of 154 children examined.

4.4.6 TYPE OF TOILET OF PUPILS AND S. stercoralis INFECTION:

Out of the 250 children examined during the survey 78 were found to have used the water (flush) system, 170 used pit latrine and 2 used the bush. It was found, however, that only children (2) that used the pit toilet harboured S. stercoralis (TABLE 8, FIG VII).

4.4.7 SOURCE OF WATER SUPPLY OF PUPILS AND S. stercoralis INFECTION:

As shown in TABLE 9, FIG S. stercoralis was observed in the stool of a child that used tap water and another child that used well water for drinking and domestic purposes. The number examined for children that used tap water and well water, however, varied. One hundred and forty seven children used tap water and 69 used well water.

4.4.8 SOCIO-ECONOMIC STATUS OF PARENTS OF PUPILS AND S. stercoralis INFECTION:

From the data obtained during this study of intestinal parasite of school children (TABLE 10, FIG X), no infected child was found to have parents in the senior working class. The prevalence rate of S. stercoralis according to the parents status of infected children were 1 child out of 137 children with intermediate working parents and 1 child out of 113 children of junior working parents.

4.5 Entamoeba coli - Grassi 1879

Entamoeba coli belongs to the phylum protozoa. The cyst is shown in PLATE 5. The cyst had eight nuclei and the precyst stage had four. The endosome of the cyst were eccentrically placed. The cyst measured 17 Um in length and 14 Um in width.

Out of the 145 children infested with parasites, 76 (52.4 percent) harboured E. coli.

4.5.1 AGE OF PUPILS AND E. coli INFECTION:

Entamoeba coli had the widest distribution among the various ages. It was found in all age groups (5 - 19 years) except ages 5 and 17. FIG X. shows peaks at ages 8 and 12, where infection was found to be higher. The lowest infection rate was observed in 18 year old children (TABLE 12).

4.5.2 SEX OF PUPILS AND E. coli INFECTION:

Out of 127 boys examined 34 (26.8 percent) were infected with E. coli, and 42 (34 percent) out of the 123 girls examined were infected with the same protozoal parasite (TABLE 4 FIG). This result shows that the girls had a higher infection rate than the boys.

TABLE 12

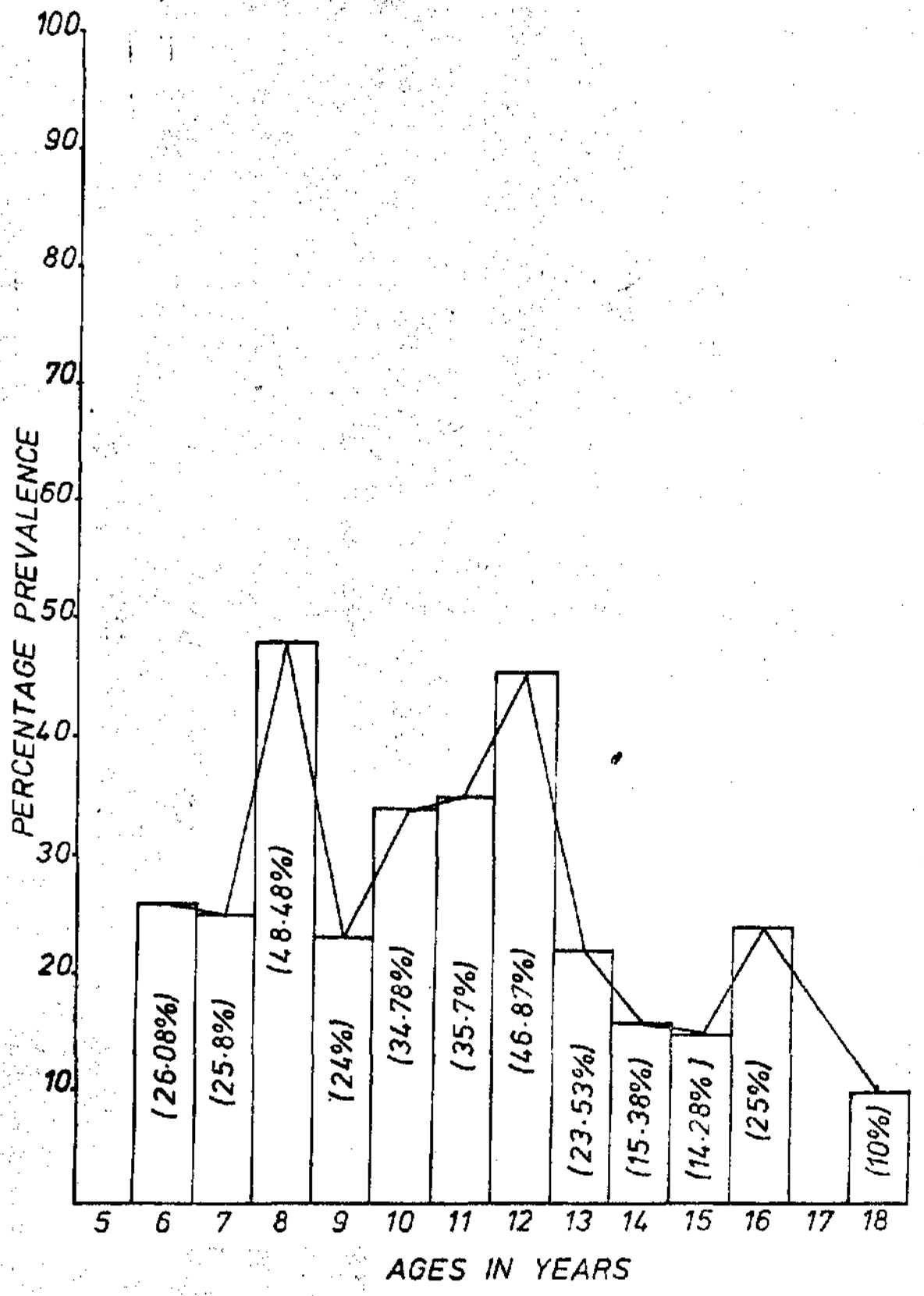
INCIDENCE OF ENTAMOEBA COLI AMONG AGES

AGE	NUMBER EXAMINED	NUMBER INFECTED	%
5	4	0	0
6	23	6	26.08
7	31	8	25.80
8	33	16	48.48
9	25	6	24.00
10	23	8	34.78
11	14	5	35.70
12	32	15	46.87
13	17	4	23.53
14	13	2	15.38
15	14	2	14.28
16	8	2	25.00
17	2	0	0
18	10	1	10.00

FIG. X.

INCIDENCE OF ENTAMOEBA COLI

AMONG AGES



4.5.3 SWIMMING HABIT OF PUPILS AND E. coli INFECTION:

TABLE 5 and FIG V showed the relationship between swimming habits and infection by L. coli. Out of 238 children that were non-swimmers 72 (30.25 percent) were infected with the parasite and out of the 12 children that swam 4 (that is 33 percent) were infected.

4.5.4 TYPE OF HOUSE OF PUPILS AND E. coli INFECTION:

Pupils that lived in tenament houses, according to the data obtained during this study, had a greater chance of contacting Entamoeba coli (TABLE 6). Out of 143 children examined that lived in bungalow houses, 40 (27.97 percent) were infected. The result also showed that out of the 107 children that lived in tenament houses, 36 (34 percent) were infected with the parasite.

4.5.5 HOUSE STRUCTURE OF PUPILS AND E. coli INFECTION:

As shown in TABLE 7, FIG VI , 43 (28 percent) of the children were infected with E. coli. Out of a total of 154 children that lived in concrete houses, while out of the 96 children living in mud houses, 33 (34.4 percent) were infected. This shows that prevalence rate of E. coli is higher in children living in mud houses than those living in houses made of cement.

4.5.6 TYPE OF TOILET OF PUPILS AND E. coli INFECTION:

The prevalence rate of Entamoeba coli, according to the type of toilet the pupils used is shown in TABLE 8. Out of 78 children that used water (flush) system, 22 (28 percent) were infected with E. coli and of the 170 children that used pit latrine 54 (32 percent) were infected.

4.5.7 WATER SUPPLY OF PUPILS AND E. coli INFECTION:

When prevalence rate of E. coli was compared with the source of water supply of the children examined, it showed that the children that used well water were more predisposed to E. coli infection than those that used tap water. Of the 147 that used tap water 40 (27 percent) were infected with the parasite. The data also showed that 29 (42 percent) of the 69 children that used well water were infected. While only 7 (21 percent) of the 34 children that used tap and well water were found with E. coli (TABLE 9, FIG VIII).

4.5.8 SOCIO-ECONOMIC STATUS OF PARENTS OF PUPILS AND E. coli INFECTION:

E. coli had the widest distribution rate in children with parents with low income. Out of the 113 children with junior working class parent, 50 (44 percent) were found to be infected with the parasite, while 26 (19 percent) of the 137 children with intermediate salary earning parents were infected.

4.6 HYMENOLEPIS nana - SIEBOLD 1853

Hymenolepis nana is referred to as the dwarf tape worm. During this study, only eggs were recovered from stool samples of infected children. The egg of H. nana is shown in PLATE 8. It has 2 egg membranes, an outer membrane and an inner membrane. The egg also has characteristic hooks which are 6 in number. The egg had an average length and width of 32 Um and 30 Um respectively.

Out of 145 infected children, 5 (3.5 percent) were found with eggs of H. nana.

4.6.1 AGE OF PUPILS AND H.nana INFECTION:

Hymenolepis nana infection was found in ages 7, 8, 9 and 12. In age 7, 6.5 percent of 31 (i.e 2 out of 31) children examined were infected. In age 8, one infected child was recorded out of 33 children. In age 9, one out of 25 children examined for H. nana infection was found to habour the parasite. Finally, one infected child was also recorded among 32 children examined in age 12. Prevalence rate of this parasite is shown in TABLE 13, FIG XI.

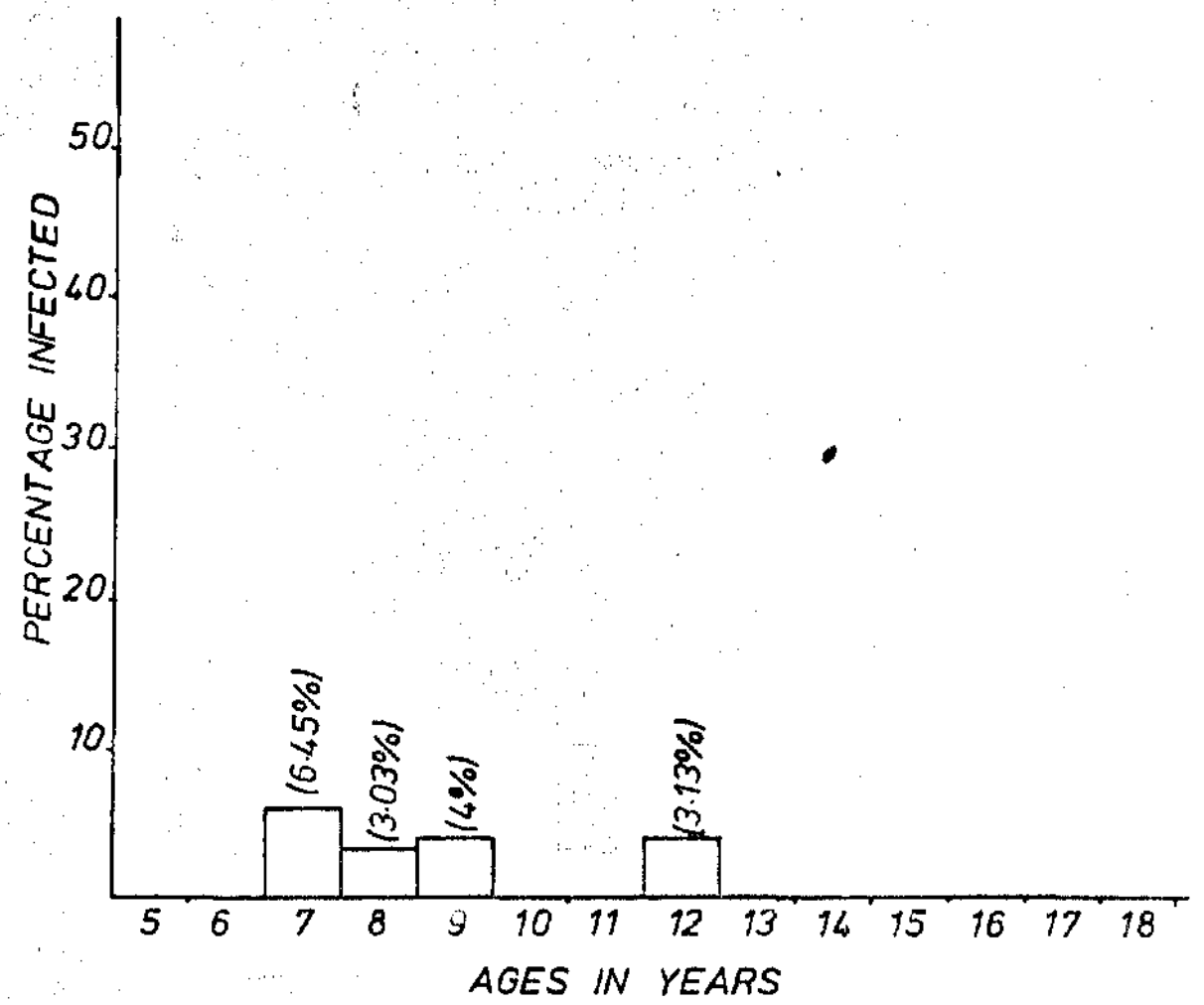
TABLE 13

INCIDENCE OF HYMENOLEPIS NANA AMONG AGES

AGE	NUMBER EXAMINED	NUMBER INFECTED	%
5	4	0	0
6	23	0	0
7	31	2	6.45
8	33	1	3.03
9	25	1	4.00
10	23	0	0
11	14	0	0
12	32	1	3.13

FIG. XI

INCIDENCE OF HYMENOLOPIS NANA AMONG AGES



4.6.2 SEX OF PUPILS AND H. nana INFECTION:

The 5 children that harboured H. nana were found to occur in a ratio of 1 boy to 4 girls (TABLE 4). Out of 127 boys examined, 1 (0.8 percent) was infected. In 123 girls examined 4 (3.3 percent) were infected with the parasite.

4.6.3 SWIMMING HABIT OF PUPILS AND H. nana INFECTION:

As shown in TABLE 5, FIG V, no child that swam harboured the parasite, H. nana. All the 5 (2 percent) infected children were non-swimmers out of a total of 238 examined.

4.6.4 HOUSE TYPE OF PUPILS AND H. nana INFECTION:

TABLE 6 showed that out of the 143 children that lived in bungalow houses 3 (2.09 percent) harboured H. nana and 2 (1.7 percent) of the 107 children examined that lived in tenament houses were infected with this parasite. This shows that, as far as this survey is concerned, children in bungalow houses are more susceptible to H. nana infection.

4.6.5 STRUCTURE OF HOUSE OF PUPILS AND H. nana INFECTION:

As shown in TABLE 7, out of 154 children living in concrete houses 2 (1.3 percent) were infected and of the

96 living in mud 3 (3 percent) were found with H. nana eggs in their stool samples.

4.6.6 TOILET TYPE OF PUPILS AND H. nana INFECTION:

Out of 78 children, that used water system toilet, 2 (2.56 percent) were infected with H. nana. The data shows 3 (1.76 percent) children out of the 170 pupils that used pit latrine were infected (TABLE 8, FIG VII).

4.6.7 TYPE OF WATER SUPPLY AND H. nana INFECTION:

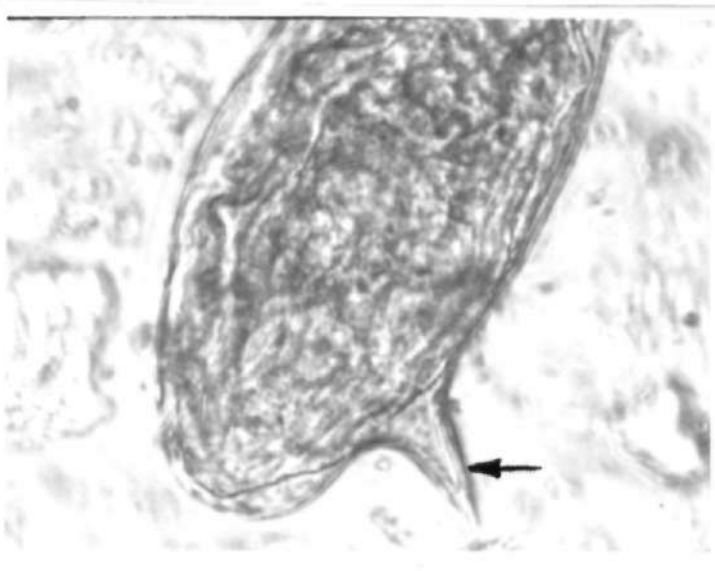
As shown in TABLE 9, FIG H. nana infection was observed in children that used well and tap water for both drinking and domestic work. The result showed that 2 (2.88 percent) out of 69 children that used well water were infected with H. nana, while of the 147 children that used tap water 3 (2.04 percent) were infected.

4.6.8 SOCIO-ECONOMIC STATUS OF PARENTS OF PUPILS AND H. nana INFECTION:

Out of a total of 137 children with intermediate working class parents, 3 (2.18 percent) were found to harbour H. nana. TABLE 10, FIG. X show that 2 (1.76 percent) children with junior working class parents were infected out of the 113 children examined.



PLATE ONE (a) Schistosoma mansoni egg.
Lateral spine (arrow).



(b) Schistosoma mansoni egg.
Enlarged to show lateral spine (arrow).

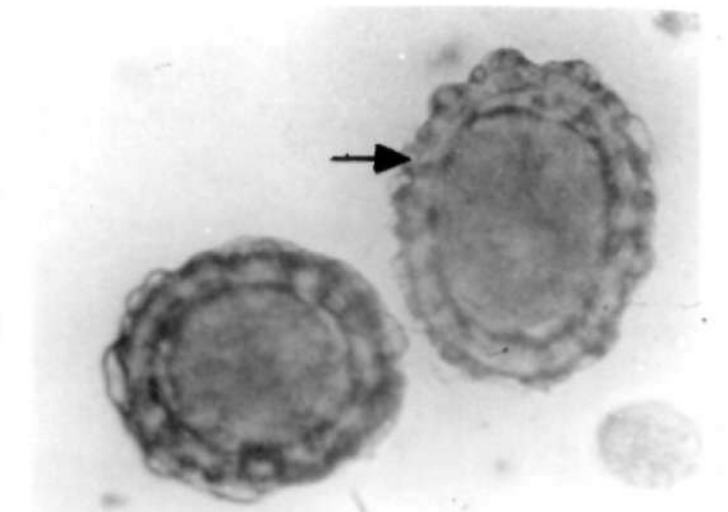


PLATE TWO: Ascaris lumbricoides egg.
Rough outer covering (arrow).

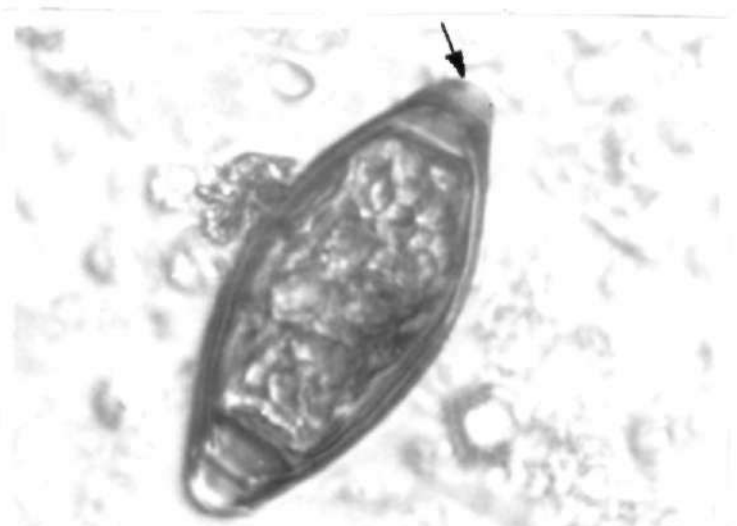


PLATE THREE: Trichuris trichiura egg.
Polar plug (arrow).

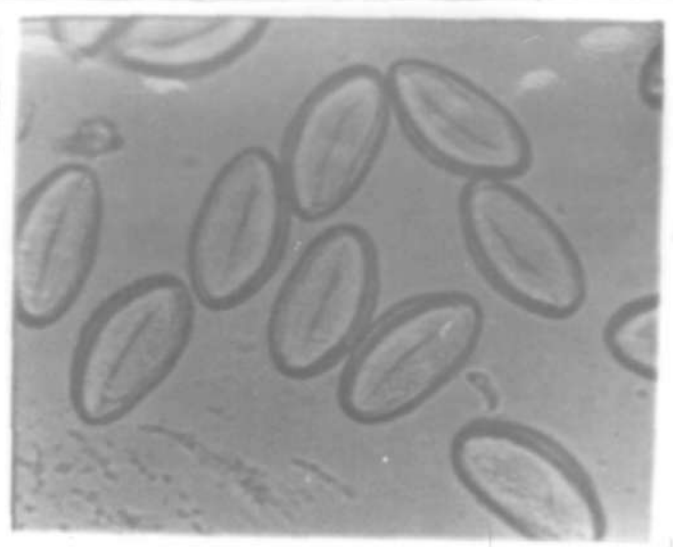
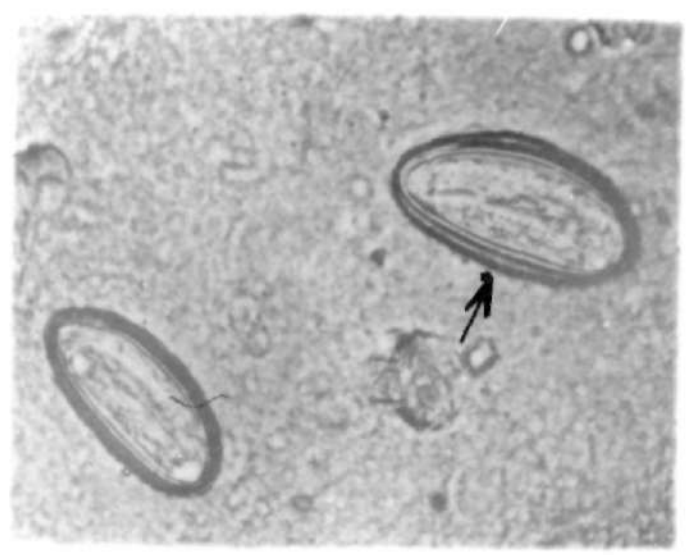


PLATE FOUR: Enterobius vermicularis egg. x 100



Enterobius vermicularis egg. x 400
Flattened side (arrow).



PLATE FIVE: Entamoeba coli cyst and precyst. x 100
Nucleus with endosome (arrow).



PLATE SIX: Strongyloides stercoralis larva. x 100

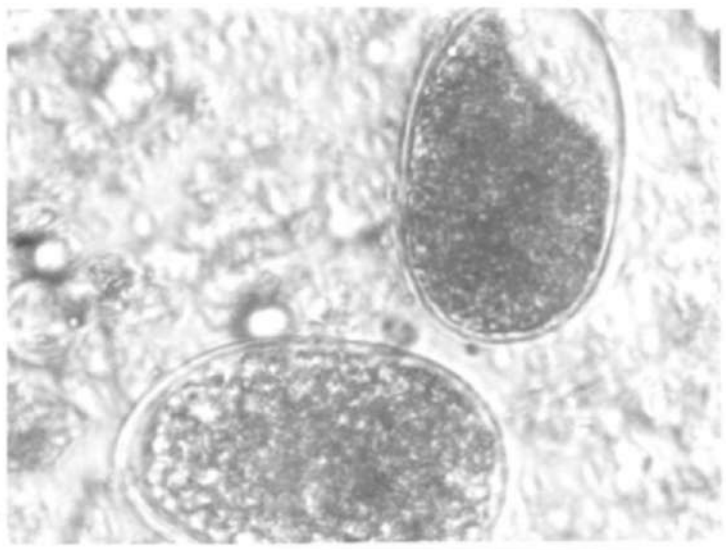
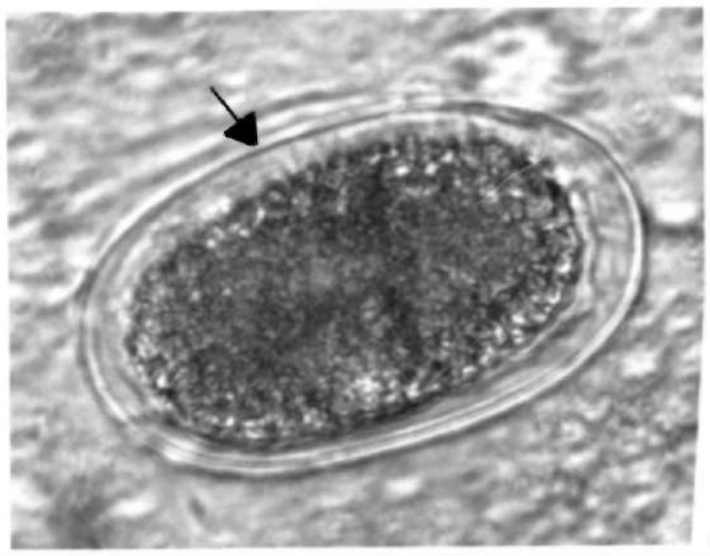


PLATE SEVEN: (a) Ancylostoma duodenale eggs. x 100



(b) Ancylostoma duodenale egg. x 400
Showing thin outer membrane (arrow).

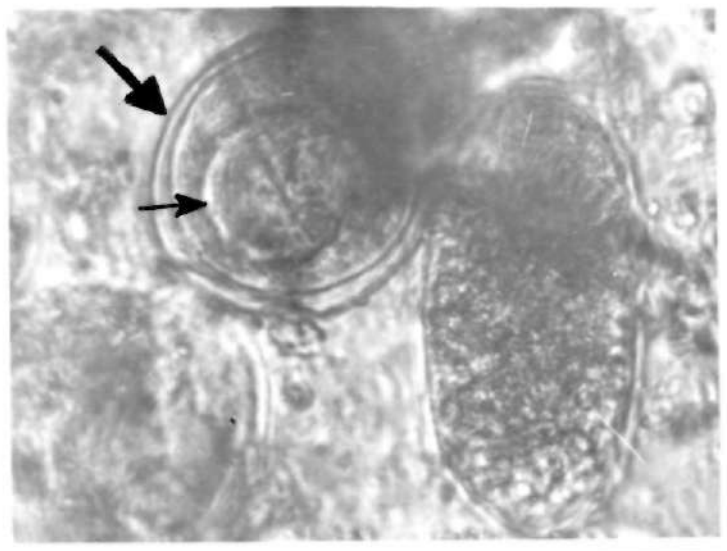
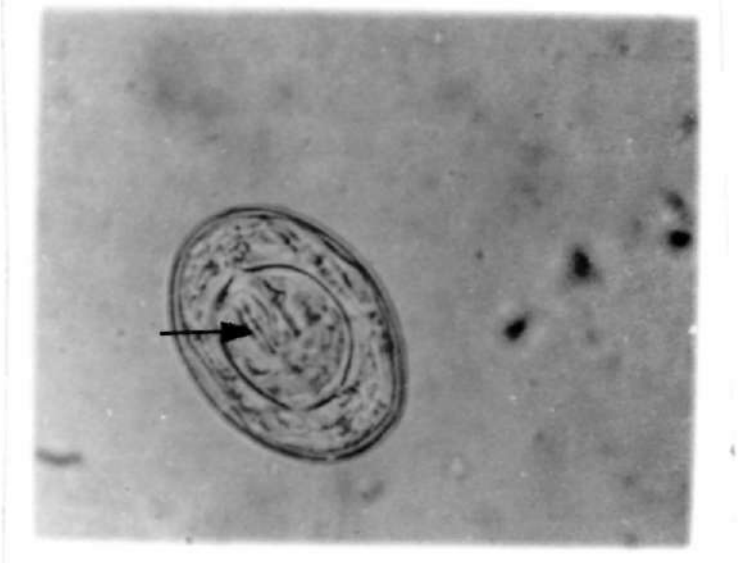


PLATE EIGHT: (a) Hymenolepis nana egg. x 100
Showing inner and outer membrane (arrows).



(b) Hymenolepis nana egg. x 400
Showing three pairs of hooks (arrow).

4.7 Ascaris lumbricoides - Linnaeus 1958

Ascaris lumbricoides is a round worm belonging to the phylum Nematoda. PLATE 2 shows some of the eggs recovered from stool samples of some infected children. The eggs are oval in shape with a rough outer covering and measured about 65 Um long and 36 Um wide. No adult worm was recovered from any of the samples examined. Out of the 145 infected children 13 (9 percent) were found with A. lumbricoides eggs (TABLE 1).

4.7.1 AGE OF PUPILS AND A. lumbricoides INFECTION:

A. lumbricoides was observed in children of ages 6, 9, 10 and 12 (TABLE 14). The highest prevalence rate was recorded for age 9, where out of the 25 children examined 4 (16 percent) were infected. This was followed by age 12 where 5 (15.63 percent) infected children were found out of the 32 children examined. Ages 6 and 10 had the same prevalence rate of 2 (8.69 percent) children out of 23 children examined.

4.7.2 SEX OF PUPILS AND A. lumbricoides INFECTION:

As shown in TABLE 4, FIG the boys were found to harbour more of Ascaris lumbricoides than the girls. Of the 127 boys examined during the study, 7 (5.51 percent) boys were infected with the parasite and 6 (4.88 percent) out of the 123 girls examined were infected.

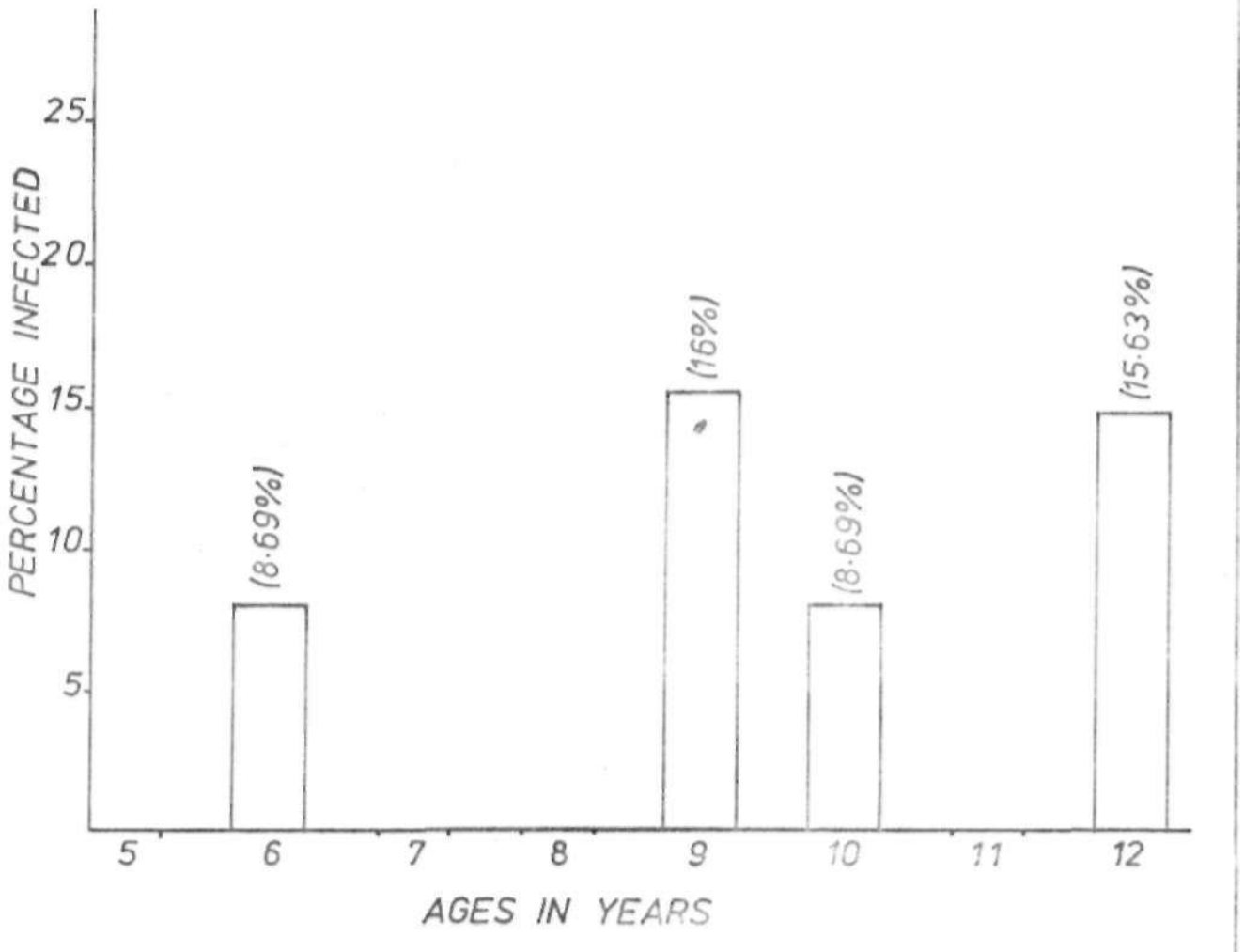
TABLE 14

INCIDENCE OF ASCARIS LUMBRICOIDES AMONG AGES

AGES	NUMBER EXAMINED	NUMBER INFECTED	%
6	23	2	8.69
9	25	4	16.00
10	23	2	8.69
12	32	5	15.63

FIG. XII

INCIDENCE OF ASCARIS LUMBRICOIDES AMONG AGES



4.7.3 SWIMMING HABIT OF PUPILS AND A. lumbricoides INFECTION:

The recorded cases of A. lumbricoides as shown in TABLE 5 FIG V were in children that did not engage in swimming in ponds and lakes. Out of 238 non-swimmers that were examined, 13 (5.5 percent) were infected.

4.7.4 TYPE OF HOUSE OF PUPILS AND A. lumbricoides INFECTION:

Pupils that lived in tenament houses, according to the data obtained during this survey had greater chances of contacting A. lumoricoides (TABLE 6, FIG V). Out of 143 children examined that lived in bungalow houses 5 (3.49 percent) were infected. Among the 107 children living in tenament houses, 8 (7.4 percent) were infected.

4.7.5 STRUCTURE OF HOUSE OF PUPILS AND A. lumbricoides INFECTION:

As shown in TABLE 7, FIG VI , there was a prevalence rate of 7.14 percent for A. lumbricoides in children living in concrete houses where out of 154 children examined, eleven were infected. This showed a higher infection rate as compared to 2.1 percent recorded for children living in mud houses in which 2 out of 96 children were infected.

4.7.6 TOILET TYPE OF PUPILS AND A. lumbricoides INFECTION:

Ascaris lumbricoides infection occurred in children that used both the water (flush) system latrine as well as

those that used pit latrine. Out of 78 children examined that used water (flush) system, 4 (5.12 percent) were infected with the parasite. Also 9 (5.3 percent) out of 170 children that used pit latrine were infected. However, the children who used the bush or dunghill were free from infection.

4.7.7 WATER SUPPLY OF PUPILS AND A. lumbricoides INFECTION:

TABLE 9, FIG 'x showed the incidence of Ascaris lumbricoides in relation to the type of water supply. Of the 147 children that used tap water 3 (2.0 percent) were infected. Out of 69 children examined that used well water, 3 (4.3 percent) were infected and 7 (20.5 percent) of the 34 children that used both tap and well water for drinking and domestic activities were infected with the parasite.

4.7.8 SOCIO-ECONOMIC STATUS OF PARENT OF PUPILS AND A. lumbricoides INFECTION:

Among the children examined, (TABLE 10, FIG X) there was no child of a senior working class parent was examined. The prevalence rate of A. lumoricoides according to parent status of infected children were 7.96 percent (i.e, 9 out of 113 children) of junior working parents and 2.91 (i.e, 4 out of 137 children) with intermediate working class parents.

4.8 Schistosoma mansoni - Sambon 1907

PLATE 1 shows Schistosoma mansoni egg which was obtained from the stool sample of an infected child. The egg has a lateral spine and it is oval in shape. The egg measured about 128 Um in length and 52 Um in width. Classification of this parasite is shown in Appendix 1. No adult worm was recovered during the survey.

Out of 145 infected children 16 (11.03 percent) were found with S. mansoni eggs in their faecal samples.

4.8.1 AGE OF PUPILS AND S. mansoni INFECTION:

S. mansoni eggs were found in all age groups (7 - 18 years) except for 5,6, 8,·9 and 19 years, where the children examined were found to be free from infection. TABLE 15 shows the summarised result. Different numbers of children were examined for different ages and the number of infected children also varied with the ages.

The highest prevalence rate of 100 percent was recorded for age 17, where the 2 pupils examined were found to harbour the parasite.

The lowest prevalence rate of 3.13 percent was in age 12, where 1 out of 32 children examined was infected.

4.8.2 SEX OF PUPILS AND S. mansoni INFECTION:

In TABLE 4 FIG the boys were found to be more

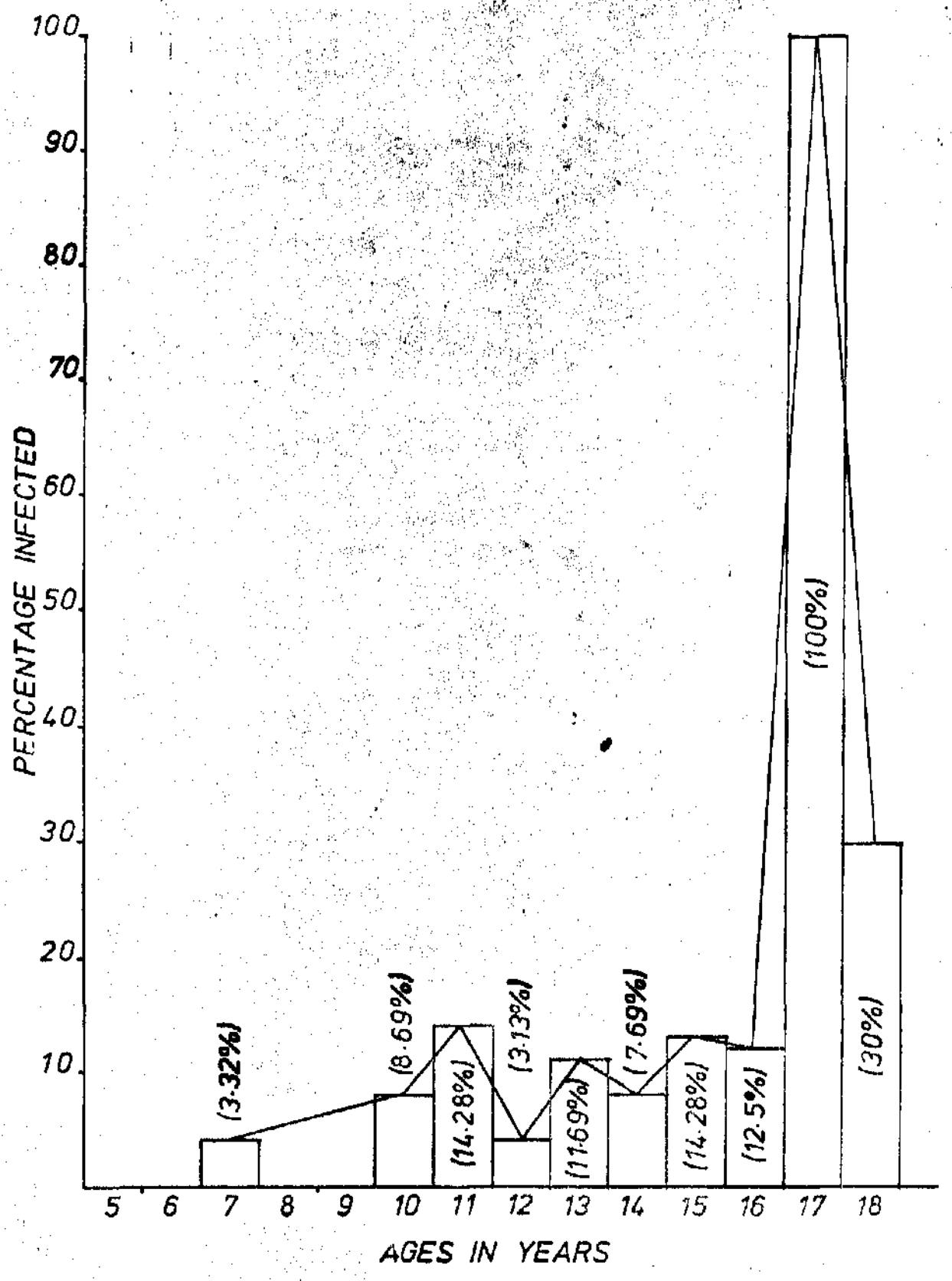
TABLE 15

INCIDENCE OF SCHISTOSOMA MANSONI AMONG AGES

AGE	NUMBER EXAMINED	NUMBER INFECTED	%
7	31	1	3.32
10	23	2	8.69
11	14	2	14.28
12	32	1	3.13
13	17	2	11.69
14	13	1	7.69
15	14	2	14.28
16	8	1	12.50
17	2	2	100.00
18	10	3	30.00

FIG. XIII

INCIDENCE OF SCHISTOSOMA MANSONI AMONG AGES



susceptible to Schistosoma mansoni infection than the girls. Of the 127 boys examined during this survey, 13 (10.24 percent) were infected with S. mansoni. Out of the 123 girls examined, 3 (2.0 percent) were infected.

4.8.3 SWIMMING HABIT OF HOST AND S. mansoni INFECTION:

The recorded cases of S. mansoni were found in both children that did not engage in swimming habits as well as those that did. Infection prevalence rate was found to be higher in those that swam than in the children that did not swim. Of the 12 swimmers examined, 8.3 percent prevalence rate was recorded as compared to 6.3 percent recorded for the non-swimming children (TABLE 5, FIG V).

4.8.4 HOUSE TYPE OF PUPILS AND S. mansoni INFECTION:

Pupils that lived in bungalow houses, according to this survey had greater chances of contacting S. mansoni than those that lived in tenament houses (TABLE 6, FIG V). Out of 143 children examined that lived in bungalow houses, 11 (7.8 percent) were infected, while 5 out of 107 children that lived in tenament houses were infected with the parasite.

4.8.5 HOUSE STRUCTURE OF PUPILS AND S. mansoni INFECTION:

As shown in TABLE 7, FIG VI a prevalence rate of 8 percent (i.e, 8 out of 96 children) were recorded or

children who lived in concrete houses, 8 (5.19 percent) were infected with S. mansoni.

4.8.6 TOILET TYPE OF HOST AND S. mansoni INFECTION:

Schistosoma mansoni infection was observed in both children that used water (flush) system toilets and those that used pit latrine. Incidence infection in water (flush) system was 5.12 percent (i.e, 4 out of 78 children) and 7.1 percent (i.e, 12 out of 170 children) that used the pit latrine.

4.8.7 WATER SUPPLY OF PUPILS AND S. mansoni INFECTION:

TABLE 9, FIG show incidence of S. mansoni in relation to water supply of infected children. Of the 147 children examined that used tap water, 7 (4.8 percent) were infected with S. mansoni. The result for well water showed that 5 (7.3 percent) out of 69 children were infected with the parasite, while the highest prevalence rate of 11.8 percent was recorded for children that used both tap and well water.

4.8.8 SOCIO-ECONOMIC STATUS OF PARENTS OF PUPILS AND Schistosoma mansoni INFECTION:

Schistosoma mansoni infection was found to be more prevalent in children that have parents of the junior working

class than those with parents of intermediate working class (TABLE 10, FIG X). The result showed that 11 (9.73 percent) cases of infected children were infected among the 113 children with junior working class parents, and 5 (3.64 percent) out of 137 children with intermediate working parents were infected with the parasite.

4.9 Enterobius vermicularis - Leach 1853

Enterobius vermicularis parasite is commonly called pinworm. The adult worms were not recovered in any of the samples but the egg were. PLATE 4 shows the eggs. The egg is elongated and flattened on one side. The average length was 52 Um and the width was 29 Um.

Out of the 145 infected children, 2 (1.4 percent) had E. vermicularis eggs in their faecal samples the result obtained showed that E. vermicularis is a rare parasite among the school children in Samaru village.

4.91 AGE OF PUPILS AND E. vermicularis INFECTION:

E. vermicularis is not a common parasite as far as this survey is concerned and not widely spread among the school children. Only children in age 7 were found to be infected, where 2 (6.45 percent) out of the 31 children examined were infected

4.9.2 SEX OF PUPILS AND E. vermicularis INFECTION:

TABLE 4, FIG showed that no girl was infected with E. vermicularis. The 2 infected children were boys, thus the prevalence rate recorded was 1.57 percent (i.e, 2 of 127) of pupils examined.

4.9.3 SWIMMING HABIT OF PUPILS AND Enterobius vermicularis INFECTION:

The recorded cases of E. vermicularis infection were found in only children that did not swim in ponds, lakes and rivers (TABLE 5).Out of 238 children, 2 (0.8 percent) were infected.

4.9.4 TYPE OF HOUSE OF PUPILS AND E. vermicularis INFECTION:

Enterobius vermicularis was found in children that lived in bungelow houses only. The prevalence rate was 1.39 percent where 2 out of 143 children examined were infected.

4.9.5 STRUCTURE OF HOUSE OF PUPILS AND E. vermicularis INFECTION:

As shown in TABLE 7, FIG VI , Enterobius vermicularis was only found in children that lived in concrete houses. A prevalence rate of 1.3 percent was recorded i.e, 2 out of 154 children were infected.

4.9.6 TYPE OF TOILET OF PUPILS AND E. vermicularis INFECTION:

E. vermicularis occurred only in children that used pit latrine. A prevalence percentage of 1.2 was recorded (i.e, 2 out of 170 children).

4.9.7 TYPE OF WATER SUPPLY OF PUPILS AND E. vermicularis INFECTION:

TABLE 9, FIG showed that E. vermicularis parasite occurred only in children that used well water for their drinking and domestic activities. The prevalence rate was 2 (2.9 percent) out of a total of 69 children examined.

4.9.8 SOCIO-ECONOMIC STATUS OF PARENTS OF PUPILS AND E. vermicularis INFECTION:

Out of a total of 250 children examined only 2 were found to be infected with E. vermicularis. The two infected children had parents of the junior working class. Prevalence rate of E. vermicularis was 1.76 percent out of the 113 children examined.

4.10 Trichuris trichiura - Linnaeus 1771

Trichuris trichiura is commonly referred to as whipworm. The adult worm was not found in any of the samples examined but the eggs were identified in some faecal samples. The eggs had a characteristic bipolar plugs (PLATE 3) and smooth outer shell. The average length of the egg was 54 Um and the average width of 22 Um was recorded. Out of 145 infected children, 11 (7.59 percent) children were infected with T. trichiura.

4.10.1 AGE OF PUPILS AND Trichuris trichiura INFECTION:

Trichuris trichiura infection was observed in children of ages 7, 8, 9, 10, 12, 13 and 14 years (TABLE , FIG). The highest prevalence rate of 11.8 percent was recorded for age 13, in which 2 out of 17 pupils were infected. The lowest prevalence rate was among the 7 year old pupils, in which 1 out of 31 pupils (3.2 percent) was infected.

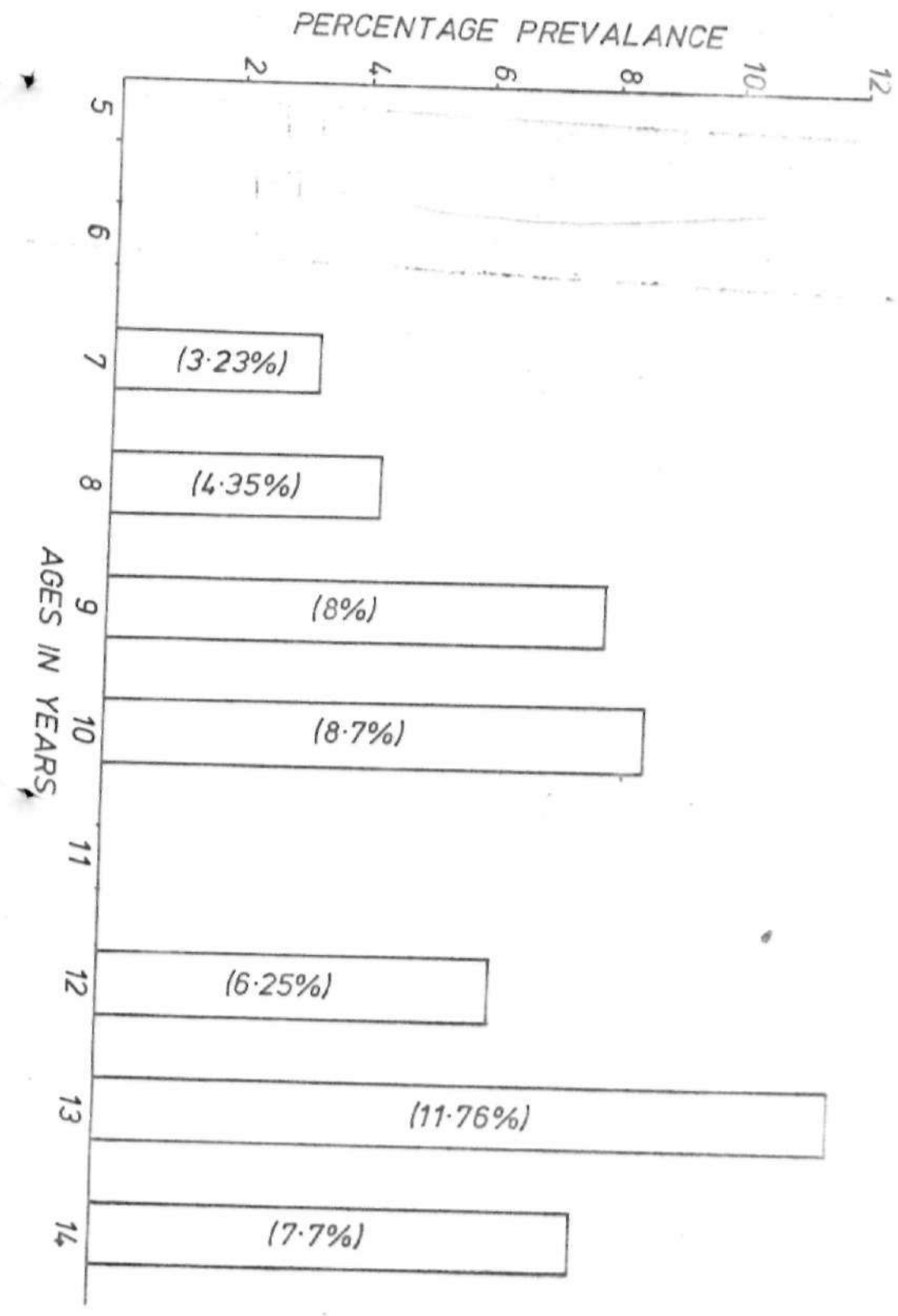
4.10.2 SEX OF PUPILS AND T. trichiura INFECTION:

From the data obtained in this survey (TABLE 4, FIG), the girls had a higher prevalence rate of Trichuris trichiura than the boys. Where 6 (4.88 percent) infected girls were recorded out of the 123, of the 127 boys 5 (3.94 percent) were recorded cases of infection.

TABLE 16

INCIDENCE OF TRICHURIS TRICHIURA AMONG AGES

AGE	NUMBER EXAMINED	NUMBER INFECTED	%
7	31	1	3.23
8	23	1	4.35
9	25	2	8.00
10	23	2	8.70
12	32	2	6.25
13	17	2	11.76
14	13	1	7.70



INCIDENCE OF TRICHURIS TRICHIURA

AMONG AGES

FIG. XIV

4.10.3 SWIMMING HABIT OF PUPILS AND T. trichiura INFECTION:

The recorded cases of Trichuris trichiura were found in only children that did not engage in swimming. Out of a total of 238 children examined 11 (4.6 percent) were infected with the parasite.

4.10.4 HOUSE TYPE OF PUPILS AND T. trichiura INFECTION:

The type of house, whether bungalow or tenament were also considered in this survey. Of the 143 children living in bungalow houses 5 (3.5 percent) were infected with T. trichiura. This percentage is low than the one found for children living in tenament houses, where 6 (6 percent) out of 107 children examined were infected.

4.10.5 HOUSE STRUCTURE OF PUPILS AND Trichuris trichiura INFECTION:

As shown in TABLE 7, FIG VI , Trichuris trichiura infection had a higher prevalence rate of 6.5 percent in children that lived in concrete houses where 10 out of 154 children were infected whereas in children that lived in mud houses 1 out of 96 children examined harboured the parasite, constituting 1.04 percent infection rate.

4.10.6 TYPE OF TOILET OF PUPILS AND T. trichiura INFECTION:

All recorded cases of Trichuris trichiura infection were

found in children that used either the water (flush) system or pit latrine. Out of 78 children that used water system, 7 (9 percent) were infected, while 4 (2.4 percent) out of 170 children examined that used pit latrine were infected (TABLE 8).

4.10.7 TYPE OF WATER SUPPLY OF PUPILS AND Trichuris trichiura INFECTION:

Trichuris trichiura infection was found in 9 out of 147 of the children examined that used tap water. Out of 34 children that used both well and tap water, 2 (5.2 percent) were found to be infected. No child, however, that used well water alone was found to harbour the parasite.

4.10.8 SOCIO-ECONOMIC STATUS OF PARENTS OF PUPILS AND Trichuris trichiura INFECTION:

Trichuris trichiura infection was found to have a higher prevalence rate in children with the junior working class parents, where, out of the 113 children examined, 7 (6.2 percent) were infected. The result also showed that 4 (3.0 percent) infected children were recorded out of 137 children with intermediate working class parents (TABLE 10, FIG. X).

TABLE 17

SUMMARY OF RESULTS

NON-INFECTED	I N F E C T E D			TOTAL
	SINGLE	DOUBLE	TRIPLE	
105	106	36	3	
105	1 4 5			250

TABLE 18

NUMBER OF CHILDREN EXAMINED UNDER EACH AGE GROUP

AGE (YEARS)	No. OF CHILDREN
5	4
6	23
7	31
8	33
9	25
10	23
11	14
12	32
13	17
14	13
15	14
16	8
17	2
18	10
19	1

CHAPTER FIVE

DISCUSSION

5.1 GENERAL

The observations made during the survey on the Incidence of Intestinal parasites of school children in Samaru village will be discussed here. Each parasite distribution would be looked into as well as the factors affecting the incidence of the various parasites. Possible control measures will be suggested.

5.2 INTESTINAL PARASITES OF SCHOOL CHILDREN

The results obtained in this study showed the prevalence of eight parasites, which were found in stool samples of infected school children of Samaru village (TABLE 1). The identifiable parasites were Ascaris lumbricoides, Strongyloides stercoralis, Hymenolepis nana, Schistosoma mansoni, Entamoeba coli, Ancylostoma duodenale, Enterobius vermicularis and Trichuris trichiura.

5.2.1 Ascaris lumbricoides is a parasite of man, dog, monkey and pig (William and Richard, 1985). The life cycle involves no intermediate host (Maung, 1978). Therefore the children got infected from ingesting eggs with contaminated soil. Children throughout the world, are in the habit of playing in contaminated soil and then placing their fingers or other contaminated objects in their mouths (Thitasut, 1961).

The incidence of A. lumbricoides was found only in ages 6, 9, 10 and 12 years. The present prevalence of parasite is comparable to the findings of previous authors (Ramsay, 1934; Nwosu, 1981; Obiamiwe, 1977; Okpala, 1961; Awogun, 1984; Oyerinde, 1977; Oyerinde, 1982; Onabamiro, 1975). In this study, however, there was no correlation between age group and percentage occurrence of the parasite. In a related study, by Cross (1977), however, the incidence of infection tended to decrease with age. The prevalence rate of Ascaris lumbricoides in age groups (6 - 12 years) could be attributed to the children's stage of development ("concrete operational stage", Murkherjee, (1978)). The child that plays in dirty and contaminated soil or environment, unmindful of the attendant health risks involved, readily ingests the eggs of A. lumbricoides.

It is interesting to note that boys had a higher prevalence rate of A. lumbricoides than girls (TABLE 4). This could be due to the general playfulness of boys. Okpala (1956, 1971), Onabamiro (1975), also showed a

similar finding in which boys had a higher infection rate than girls. However, Cross (1977), found that prevalence rates for A. lumbricoides were higher in females than in males. He referred to this as an unusual occurrence.

The findings of this study revealed that the incidence of A. lumbricoides is independent of swimming habit. This is expected because A. lumbricoides is not a water-borne parasite. Transmission is usually by contamination of the environment with faecal matter which contains the eggs of the parasite.

It was observed that the incidence of infection of children inhabiting tenament type of house was higher than in those inhabiting the bungalow type of house. Usually, in tenament houses, there are people with different social and cultural background, sharing the same social amenities. The high prevalence of the parasite in the tenament houses may be due to poor maintenance of the environments.

Surprisingly, there was a higher prevalence rate of A. lumbricoides in children living in houses made of concrete than those in mud houses. The higher prevalence rate could only be attributed to other factors such as age of pupils, play ground and their cultural habits to mention but a few.

A.lumbricoides was found to be more prevalent in children using pit latrine system in their homes than those using water (flush) system. In a related study on incidence of intestinal parasite in school children in Lagos, Okpala (1956) obtained a similar result. The same result was obtained when he carried out a study on kitchen personnel and undergraduates in 1971. He attributed his findings to unsanitary conditions of latrine and careless handling of human excreta. Also where the latrines were situated within flight-range of house flies, there is the possibilities of mechanical transfer of parasites' eggs from latrine to food, water and utensils.

The result of this study also showed that the incidence of infection of A. lumbricoides occurred in the following ascending order of intensity: Tap water, well water and both tap and well water. This means that children that used tap water stand less risk of infection than those that use well water. These findings also agreed with that of Okpala (1971). The high prevalence rate in children that used both tap and well water may be attributed to the fact that they used more of the well water than the tap water.

It was also observed that children of junior workers had a higher prevalence rate of A. lumbricoides than children of intermediate working parents. This is obvious

because these children come from poorer families with probably lower standard of sanitation. The result is comparable to the findings of Okpala (1971).

5.2.2 Strongyloides stercoralis is a parasite of man, dogs and cats (levine, 1980). The life cycle involves no intermediate host. There is mechanical transfer by insects such as moths, of L3 larva from areas contaminated with faeces of infected dogs and cats to human food, water, etc. Transmission of parasite (L3 larvae) could also be through the skin (Moncol and Triantaphyleu, 1978).

From the result obtained in this study, Strongyloides stercoralis was one of the rarest parasites observed in school children of Samaru village (TABLE 1). Results from previous works carried out in other parts of Nigeria also agreed with this finding (Ikejiani, 1959; Okpala, 1956; Ikejiani, 1960; Obiamiwe, 1975; and Awogun, 1984). The prevalence rate of S. stercoralis was found in children of 6 and 10 years old.

It is difficult to explain why only the girls were infected with S. stercoralis. It is assumed that if a member of a family is found to be infected with S. stercoralis all other members are likely to be equally infected (Yoeli et al, 1972). This observation is corraborated by the fact that all the infected girls in this study happened to be sisters.

It was also observed that children that engaged in swimming did not harbour the parasite S. stercoralis. This substantiates the known fact that S. stercoralis life cycle does not involve water (William and Richard, 1985).

S. stercoralis was also found to be more prevalent in children that lived in tenament houses than those that lived in bungalow. During this study, it was observed that most of the tenament houses had people with different social and cultural backgrounds, resulting in poor maintenance of the environment.

The findings of this study reveal that S. stercoralis was found in children inhabiting houses made of mud as well as those living in concrete houses. However, the percentage infection was higher in children inhabiting mud house.

Insanitary conditions and careless handling of human excreta associated with pit latrines could be the explanation to the observation that S. stercoralis infection was only observed in children that used the pit latrine.

Well water is more exposed to contamination with eggs and cysts of soil borne parasites than tap water. Thus, children that used well water were found to harbour more of S. stercoralis than those who used tap water.

In many countries endemic intestinal parasitic infections are closely related to economic and social developmental processes (W.H.O. 1986). Nigeria, in general, and Samaru village, in particular, is no exception. The result of this study showed that more children with junior working parents harboured more S. stercoralis than those with intermediate working class parents.

5.2.3 Hymenolepis nana is a parasite of man, rat and mice (William and Richard, 1985). Intermiediate host is optional. This means that the life cycle can still reach completion without an intermediate host. The intermediate host could be an arthropod like grain beetles or larval fleas (berntzen, 1970). Infection takes place when the Oncosphere is ingested either in contaminated soil or an infected insect.

Relatively high infection rates were found in children in Central Europe and Latin America (Warren, 1974). However, this was not the case in the present study (TABLE 1). The incidence of H. nana was observed in children of age groups 7, 8, 9 and 12 years. Awogun (1984) also obtained a similar result where he found that H. nana infection was limited to children of the lower age groups in Ilorin.

More girls were found to harbour H. nana than boys. It is, however, quite difficult to explain why there was a higher infection rate of the parasite in girls than in boys.

All those infected with H. nana did not engage in swimming. This could be partially explained by the fact that the parasite is a soil-borne and not a water-borne helminth.

Surprisingly, H. nana was found to be more prevalent in children living in bungalow houses. The prevalent rates of infection could be as a result of other factors such as water supply and type of toilets used in their schools or

even their playground.

The findings of this study also showed that Hymenolepis nana infection was observed more in children that lived in mud houses than those that lived in concrete houses. Mud houses have lots of cracks which serve as hiding places for insects which may be optional intermediate hosts of the parasite. As a result of the above situation, the higher prevalence rate of H. nana in children living in mud houses was observed.

H. nana was found to be more prevalent in children using water (flush) system toilet. It is assumed that the prevalence of the parasite in the children that used this type of toilet may be attributed to other factors other than the water (flush) system.

There was no significant difference in H. nana infection between the children that used well water and those that used tap water. If this parasitic infection in this case is to be associated purely to the type of drinking water then one may begin to question the purity of the pipe borne water supply to Samaru village. On the other hand, the fact that H. nana is not a water-borne parasite means that the source of water might not be involved. The level of water contamination be it tap or well water would be the major factor.

Another unusual incidence of H. nana infection was noted among children with parents of intermediate working

class. It was in the children of this category of workers that higher prevalence rate of H. nana was recorded.

5.2.4 Schistosoma mansoni is a parasite of man, cattle and rodents (William and Richard, 1985). It has a snail intermediate host, Biomphalaria glabrata, (Jobin et al, 1977). Transmission of S. mansoni requires contact with water. (husting, 1983). This is because the intermediate host is usually found in dampy environment near ponds or pools of water.

S. mansoni was found in children of ages 7 to 8 years. This agrees with the findings of Husting (1983). He found the parasite in every age group except in ages 0 - 3 years. Children of this age groups (7 - 18 years) are "hydrophylic" and more about into areas that may contain Schistosoma cercariae and hence the high prevalence rate of S. mansoni infection.

It was observed that S. mansoni was found to be more prevalent in boys than in girls. In the Nigerian society, especially the Northern part, boys have more liberty of moving about and swimming anywhere. Thus the higher possibility of coming in contact with the parasite. Studies carried out by Okpala (1967) and Oyediran (1982) confirm the above statement. Husting (1983), however, found that more females were infected with the parasite than the males.

The incidence of Schistosoma was higher in children that engaged in swimming than those that did not. From the life cycle of the parasite water happens to be a prerequisite for its completion. This is because it is only in water that

we find its intermediate host. Thus higher risk involved in swimming in such contaminated water. Husting (1983) and Warley (1976) associated the higher prevalence of the parasite to the frequency of water contact.

It was observed also that S. mansoni was found to be more prevalent in children that lived in bungalow houses. This may be due to other factors such as swimming habits of the children.

The findings of this study also revealed that more children that inhabit mud houses were found with the parasite than those in concrete houses. It is quite difficult to explain this fact except to say that children from mud houses are more likely to frequent ponds and rivers than the other children.

S. mansoni had a higher prevalent rate in children that used pit latrine than in those that used water (flush) system toilets. From all indications, it is difficult to associate the incidence of Schistosoma eggs with the type of toilet.

It is not natural, as far as this result is concerned, to associate the incidence of S. mansoni with the type of drinking water. This is because children that used both tap and well water at the same time had the highest prevalence rate, followed by children that used tap water and finally those that used well water alone. It is not necessarily the type of water that matters, simply because, though

water-borne, the parasite needs the hydrophilic intermediate host. Both tap and well waters do not harbour the host.

Children with junior working class parents had a higher incidence rate of *S. mansoni* than those children with intermediate working class parents. This may be attributed to the socio-economic status of the parents. In which the junior workers may not be in a position to provide the children with adequate preventive medicare and attention. For the purpose of this study, it may be assumed that children of the junior workers would visit ponds and rivers more than the children of intermediate workers.

5.2.5 Entamoeba coli is a commensal that never lyses its host's tissue. It is more common in humans than Entamoeba histolytica. (Schmidt and Kobert, 1985). Infection is by contamination of environment which may include drinking water. Obviously, the incidence of this parasite is a reflection of the level of sanitation and water treatment (Schimdt and Kobert, 1985). Infection with this protozoan indicates that opportunities exist for ingestion of E. histolytica.

Entamoeba coli was found in children of all ages except for ages 5 and 17 years. It tended to have one of the widest distribution of all the parasites found during this study. The present prevalence of the protozoan is comparable to the findings of previous authors (Awogun, 1984, Cross, 1977, Okpala, 1956, 1971). The result of the study also showed that the prevalence rate of E. coli tended to decrease with age. It could be explained that at the early ages children do not know the importance of hygience while as they grow they begin to know the risks involved in lack of proper sanitation.

More females (girls) harboured the protozoan than their male counterpart. Girls tend to "play house" alot after school. They usually use small tins and containers to get water from stagnant pools or even gutter to mix sand with. This could be a good entry point for E. coli. The boys may engage in playing ball or other plays.

The study also revealed that less of the protozoan E. coli was found in children that engaged in swimming as compared to those that did not swim. The life cycle of the protozoan shows that water is not a pre-requisite. Usually children get infected from contaiminated soil and water.

Children living in tenament houses had higher infection rate of E. coli than those in bungalow houses. This could be as a result of poor maintenance of the environment due to the coming together of people with different cultural background.

It was observed that children that lived in mud houses had a higher incidence rate than those that lived in concrete houses. If the house is made of mud one should expect that the floor and ground surrounding the house may not be cemented. The above reason coupled with poor sanitation may result in the higher E. coli infection.

E. coli was found to be more prevalent in children that used pit latrine in their homes than those that used the water-system toilets. In a related study,Okpala (1986) obtained a similar result. Pit latrines may not be safe, especially when built or used improperly. There are more risks of contamination from squatting slabs involved in pit latrine than in water (flush) toilets. This may be the reason for the high prevalence in children that used pit latrines.

The result of this study also showed that more children that used well water harboured the protozoan, less children that used tap water for drinking were found with the protozoan, while fewer number of children that used both tap and well water at the same time were found with E. coli. The high prevalence in children that used well water could be attributed to the fact that wells are not usually safe as they are exposed to contamination by eggs or cysts of parasites.

More children of junior working class parents harboured E. coli than those with intermediate working class parents. This could be so because these children come from poorer families with lower standard of living and probably lower level of sanitation who are ready to feed on any less nutritious food that will fill their empty stomachs. The result of this study is comparable to that of Okpala (1971).

5.2.6 Ancylostoma duodenale is a parasite of man and other primates, (William and Richard, 1985). The life cycle involves no intermediate host. Transmission of hookworm is by contamination with the free-living stages of the parasites especially the infective L3 Larvae (Roche and Layrisse, 1966).

A. duodenale had the widest distribution among all age groups. In fact, infection of the parasite was found to increase with age. This further confirms the work of Gilles (1964), Pugh et al (1980), Cross et al (1977) and Oyerinde (1982).

It is observed that boys had higher prevalence rate than girls. Though Oyerinde (1982) found that there was no difference in the prevalence of infection in both sexes. Gilles (1964) and Pugh et al (1980) associated A. duodenale to the occupation of the people. They reasoned that the high prevalence seen in males was due to their work as farmers (farming in contaminated soil).

Surprisingly enough, even though A. duodenales life cycle does not involve water medium, the parasite had a higher prevalence rate in children that engaged in swimming than those children that did not swim. The high prevalence rate in swimmers could be due to other factors such as socio-economic status of the parents and the level of sanitation.

Higher prevalence rate of A. duodenale was recorded for children that lived in bungalow houses than those that lived in tenament houses. The reason for this result could

be associated with poor sanitation. From the life cycle of the parasite, transmission is by contamination of materials, food as well as through skin, etc. with L3 larvae. Thus, if there is more prevalence rate in children that lived in bungalow houses, then the level of sanitation in such houses should be questionable.

The findings of the study also revealed that more children that lived in mud houses harboured hookworm than those that lived in concrete houses. The reasons given under the type of house could be applicable here.

More children that used pit latrine were found with the hookworm parasite than those that used water (flush) toilets. Uncovered pit latrines are easily accessible to flies and this could be the source of contamination. Thus there may be mechanical transmission of parasite from latrine to food, and drinking water.

The result of this study also showed that A. duodenale occurred in the following decreasing order of intensity: well water, tap water and both tap and well water at the same time. This means that children that used well water stood the highest risk of infection than those that used tap water. Hookworm infections will remain prevalent as long as people have no easy and convenient access to clean water supplies and better sanitary condition.

Children with junior working class parents had higher

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Children with junior working class parents had higher

prevalence rate than those children with intermediate working class parents. Hookworm infection is associated with people living in environments where the sanitary disposal of human waste is poor and with people engaged in subsistence farming with little or no money to purchase shoes. Majority of the junior working people of samaru village were known to inhabit such an environment and practice the above mentioned type of farming and hence the higher incidence of the parasite in their children.

5.2.7 Enterobius vermicularis is a parasite of humans especially small children. Certain primates and rodents had been found with the parasite. It has no intermediate host. Transmission is principally from fingers, contaminated clothing or by inhalation of eggs from dust (William and Richard 1985).

The parasite was found in only 2 7-year old children. This further confirmed the above statement. E. vermicularis is a household parasite. If one person in a family harbours it the other members of the family are likely to infected. It is possible then that the infected children may have contacted the disease from within their respective families.

Only boys were found with E. vermicularis during this study. It is possible that the infected children might have come from infected families as explained above.

All those found with the parasite did not engage in swimming. Transmission of the parasite is either by air or through direct contamination of materials with its eggs. Thus water is not a medium for E. vermicularis transmission. Hence the absence of correlation between the incidence of the parasite and swimming habits.

The study revealed that pinworm was observed only in children that lived in bungalow houses. As mentioned earlier, this parasite is a household parasite and only 2 children harboured it. Therefore, it is likely that they

got infected from their respective families. In related studies Cross, 1977; Okpala, 1971; and Awogun, 1984; showed that fewer number of individuals were infected with the parasite.

Results of this study also showed that only children living in concrete houses harboured the parasite. Reasons for this observation could be as earlier explained.

No child that used water closet system was found with the parasite only children that used pit. It is obvious that the misuse of pit latrine can result in the contamination of fingers, food or water with eggs of the parasite, which will subsequently lead to the infection of pinworm.

The two children found with pinworm infection used only well water. It is likely that due to the poor sanitary conditions of the environment, the well water might have been contaminated with eggs of E. vermicularis. Thus using the contaminated water could lead to the infection of the children with the parasite.

It was also observed that only children with junior working class parents harboured the pinworm. The junior working class parents may be ignorant of the existence of the parasite. It is also possible that due to their socio-economic status they may not be in a position to provide for medical care since E. vermicularis is a household parasite, its non-treatment could lead to its infecting many members of the family.

5.2.8 Trichuris trichiura is a parasite of humans (Schmidt and Roberts, 1985). It's life cycle involves no intermediate host. The spread of the parasite is rapid where sanitation is poor (William and Richard, 1985). It is generally believed that T. trichiura may be regarded as a harmless and assymptomic infection but Jung and Jelliffe (1952) disagreed with this view. They found the parasite to be present in over 25% of the population of Ibadan and concluded that it was the cause of clinical syndrome consisting of prolonged diarrhoea with blood, abdominal pain and loss of weight.

As far as this study is concerned, the prevalence of T. trichiura decreased with age. Children of ages 15 and above years did not harbour the parasite. Cross (1977), also found that T. trichiura decreased with age.

More females were found with the whipworm parasite than their male counterparts. This result is comparable to the work of previous authors (Cross, 1977; and Awogun, 1984). From past and present findings, it is difficult to explain why there was the higher incidence of the parasite in the females. It was however observed that the girls were found to engage in selling things such as chin chin, guava and lots of edible materials which were exposed to contamination. These same girls may also eat what they sell and get infected by the parasite.

The parasite, T. trichiura was found only in children that did not engage in swimming. This is obvious because of the nature of its life cycle which does not involve water as a medium. This does not explain why swimmers should not harbour the parasite.

It was observed that T. trichiura was found more in children that lived in tenament houses than those living in bungalow houses. It is knownthat the parasite transmission is aided by lack of good sanitation. Most occupants of tenament houses hardly maintain their household amenities properly thereby exposing them to easy contamination by the parasite.

Oddly enough, more children that lived in concrete houses harboured the parasite than those in mud houses. It is possible to associate the incidence of the parasite in the concrete houses to the fact that the latter were of the tenament type, while the mud houses were usually a one family type of housing.

The result of the study also revealed that children that used water (flush) toilets had a higher prevalence rate of T. trichiura than those that used pit latrine. If the type of toilet used was solely responsibile for the incidence of the parasite, then it may be suspected that the water (flush) system toilets were poorly maintained thereby leading to the higher incidence of the parasite.

Only those children that used both tap and well water at the same time for drinking and other domestic activities were found with T. trichiura. Since no child using solely tap or well water was infected it is possible that those infected with the parasite from both tap and well water might have contacted the parasite through other sources such as the type of houses or the status of the parents.

T. trichiura had higher prevalence rate in children with junior working class parents than those with intermediate working class parents. The results indicated that socio-economic status of parents influenced the incidence of the parasite. The junior working class parents are generally known to be either ignorant of the need to provide their families with adequate medicare or are unable to do so due to their poor financial condition and hence the higher incidence of the parasite in their children.

5.3 FACTORS AFFECTING THE INCIDENCE OF PARASITES:

A number of factors were considered in relation to the prevalence of the parasites in Samaru school children. The factors are age, sex of pupils, swimming habit of pupils, type of house of pupils, structure of house of pupils, type of toilet used by pupils, the type of water supply available to the pupils and the socio-economic status of the parents of pupils.

5.3.1 AGE OF PUPILS AND INCIDENCE OF PARASITE:

The age range of children examined was between 5 and 19 years. Parasitic prevalence by age are listed in TABLES 3, 11 - 17. Enterobuis vermicularis, Hymenolepis nana, Ascaris lumbricoides and Strongyloides stercoralis were found only in the younger children between the ages of 5 - 12 years. Children at this age groups are normally very playful, in dirty and contaminated soil or environment and are not usually mindful of the attendant health risks involved. Some of the parasites such as H. nana and E. vermicularis are household parasites hence infection may be by contamination of food, water, beddings in the family. The incidence of Ancylostoma duodenale and Trichuris trichiura was found to increase with age while Entamoeba coli was found to have

higher prevalence rate in younger children. Transmission, of the three parasites mentioned, is aided by insanitary environment. And children of these ages (5 - 19 years) are somehow careless about sanitation.

5.3.2 SEX OF PUPILS AND INCIDENCE OF PARASITES:

Sex differences occurred in the distribution of some parasitic infections. Prevalence rates for Entamoeba coli, Hymenolepis nana and Trichuris trichiura eggs were higher in female than in male pupils. The reverse is the case in the prevalence of Ascaris lumbricoides, Ancylostoma duodenale and Schistosoma mansoni. During this study girls in Samaru village could be easily seen after school hours engaging in playing house as well as in the selling of food items. As a result they could have become easy targets to intestinal parasitic infection as they usually ate from the exposed food materials meant for sale. The higher prevalence rate of the parasites in the boys could be attributed to their rough and careless attitudes. Boys normally enjoy a certain degree of freedom of movement from their parents which they sometimes misuse by engaging in some hazardous activities such as playing in contaminated soil. They are thus being easily predisposed to infection by the parasites.

Enterobius vermicularis infection was found to be absent in females while Strongyloides stercoralis infection

was absent in males. These two parasites are household parasites and their incidence in the boys and girls respectively could be associated with the respective families of the affected children. Thus, it is possible that other members of the respective families might be infected with the parasites irrespective of their sex.

5.3.3 SWIMMING HABIT OF PUPILS AND INCIDENCE OF PARASITES:

Higher prevalence of A. duodenale and Schistoma mansoni was found in children that engaged in swimming. The high prevalence rate of S. mansoni in the children that engaged in swimming confirmed the known fact that water is a prerequisite for the completion of the life cycle of the parasite. The higher prevalence of A. duodenale in children that engaged in swimming could only be explained on the basis that the banks of the pond in which the children swam could be contaminated with infected faeces which could have been a source of infection.

S. stercoralis, H. nana, A. lumbricoides, E. vermicularis and T. trichiura were found only in children that did not engage in swimming while a higher prevalent of E. coli was also recorded for the non-swimmers. Infection by these parasites is known to be as a result of poor sanitary conditions while their transmission is by ingestion of their eggs in contaminated soil, food and water.

5.3.4 TYPE OF HOUSE OF PUPILS AND INCIDENCE OF PARASITES:

Two types of houses were identified during this study. There was the bungalow type of house and the tenament type. Enterobius vermicularis was found in children that lived in bungalow house while Ancylostoma duodenale, Hymenolepis nana and Schistosoma mansoni had a higher prevalence rate in children living in bungalow type of houses than those living in tenament houses. From the life cycle of the parasites, it is known that transmission is by contamination of food and water. Thus, the level of sanitation in the bungalows is questionable. This is because one expects the level of sanitation in a bungalow to be better than that of tenament. E. vermicularis is a household parasite. Its prevalence in children that lived in bungalow houses may be from contamination by other infected members of the family. The high prevalence of the other parasites could be associated with other factors such as age, socio-economic status of the parents, among others.

Strongyloides stercoralis, Entamoeba coli, Ascaris lumbricoides and Trichuris trichiura, however, had a higher prevalence rate in children that lived in tenament houses than those that lived in bungalow houses. Tenament houses are usually inhabited by people with different social and cultural backgrounds sharing the same social amenities. The high prevalence may be due to poor maintenance of the environment. Thereby exposing them to easy contamination

with the eggs and cysts of the parasites.

5.3.5 STRUCTURE OF HOUSE AND INCIDENCE OF PARASITES:

Surprisingly enough, Enterobius vermicularis was found only in children that lived in concrete houses. This parasite is also a household parasite. Therefore, the incidence may be due to the presence of an infected or infected member(s) of the family. The presence of the parasite may also be associated with the fact that, though the houses were built of concrete, they were also of a tenament type.

Children living in concrete houses also had higher prevalence rate of Ascaris lumbricoides and Trichuris trichiura. The reasons mentioned earlier on may also be applied here. The high prevalence may also be associated with other factors such type of house, age, etc. Ancylostoma duodenale, Strongyloides stercoralis, Entamoeba coli, Hymenolepis nana and Schistosoma mansoni had higher prevalence rate in children that inhabited mud houses than those living in concrete houses. The mud houses were known to have lots of cracks in their walls. These cracks may serve as hiding places for insects which may serve as intermediate host of some of the parasites such as H. nana. There are higher risks of contamination in the soil due to lack of cemented floors.

5.3.6 TYPE OF TOILET OF PUPILS AND INCIDENCE OF PARASITES:

The parasitic infection could also be grouped according to the type of toilets used by the pupils in their houses. S. stercoralis and E. vermicularis were found only in children that used pit latrine. A. duodenale, E. coli, A. lumbricoides and S. mansoni had higher prevalence rate in children that used pit latrine than those that used water (flush) toilets, while H. nana and T. trichiura recorded higher prevalence rate in children that used water (flush) toilets. Uncovered pit latrines are easily accessible to flies, thus serving as ready sources of contamination. The flies may therefore act as mechanical vectors of the parasites. In other words, insanitary conditions of the latrines and careless handling of human wastes may lead to contamination. The higher prevalence of H. nana and T. trichiura in children with water (flush) latrines could be as a result of poor maintenance as well as other factors such as age of pupils.

5.3.7 TYPE OF WATER SUPPLY AND INCIDENCE OF PARASITES:

A. duodenale, S. stercoralis, E. coli and H. nana had higher prevalence rate in children that used well water than those that used tap water. E. vermicularis was found solely in children that used well water. Well water are not sually safe as they are exposed to contamination by eggs and/o

cysts of parasites. If the well water is contaminated with the parasites, using such contaminated water could lead to the infection of the children with the parasite. T. trichiura had higher prevalence rate in children that used tap water, while A. lumbricoides and S. mansoni were recorded as having higher prevalence rate in children that used tap and well water for drinking and other domestic purposes. The incidence of A. lumbricoides and S. mansoni in children that used tap is an unusual case, especially with the knowledge that tap water undergoes lots of processing during purification and also knowing that the 3 parasites were associated with insanitary condition. The only explanation could be attributed to the unhygienic handling of the tap water and other factors mentioned in previous discussions.

5.3.8 SOCIO-ECONOMIC STATUS OF PARENTS OF PUPILS AND INCIDENCE OF PARASITES:

The parents of pupils examined in this study have been put into two groups, namely junior working class parents and intermediate working class parents. Children of the junior working class parents were found with eight parasites in this survey. E. vermicularis, for example, was only found in children with junior working class parents, while higher prevalence rate of A. duodenale, S. stercoralis, E. coli,

A. lumbricoides, S. mansoni and T. trichiura was also recorded for the same category of children. Junior working class parents experienced lower standard of living. Thus, due to their status they may not be in a position to provide adequate preventive medicare. Coupled with the above reason could be ignorance of the existence of the parasites which could lead to its non-treatment. E. vermicularis has been identified as a household parasite, its non-treatment of an infection could, therefore, lead to its infecting many members of the family.

Only H. nana was found to be more prevalent in children with intermediate working class parents. As far as H. nana infection is concerned it could be that other member(s) of the family were infected. The age of the children or the after school activities they engaged in could also contribute to the level of infection.

5.4 EPIDEMIOLOGY AND CONTROL

Intestinal parasitic infections are distributed virtually throughout the world, Nigeria inclusive, with high prevalence rates in many regions. The amount of harm caused by intestinal infections to the health and welfare of individuals such as school children and the communities at large depends onfive factors namely:

1. The parasitic species;
2. The intensity and cause of infection;
3. The nature of the interraction between the parasite species and concurrent infections;
4. The nutritional and immunological status of the population;and
5. Numerous socio-economic factors (W.H.O., 1986) such as those included in this study

For effective control of any intestinal parasite, the type of parasite and its life cycle must be known as well as the aforementioned factors. Control measures could be aimed at the parasite itself or/and its intermediate host if any, or at the environment of the human host.

Most of the parasites found in the study were soil-borne helminths and protozoan and are associated with insanitary condition. In subsequent discussion control measures of each parasite will be suggested.

5.4.1 Ascariasis is transmitted through ingestion of infective eggs from contaminated food, hands or water, thus insanitary condition. Prevention and control of Ascaris lumbricoides can reduce both morbidity and mortality caused by the parasite within a short time. In addition to sanitary measures and health education, large scale chemotherapy can effectively lower the population of worms in school children in a given area such as Samaru village. Mass treatment is justified when the prevalence in all age groups is high, while selective chemotherapy is appropriate when adequate laboratory facilities are available (W.H.O., 1986).

5.4.2 Infection with Hymenolepis nana is not considered as a public health problem but rather as a familiar one and is approached in that way (William and Richard, 1985). If a person in a household is found to be infected, the following have to be undertaken:

1. Determining the number of infected persons and treating all of them;
2. Cleaning the dwelling - clothing, bedding, bathrooms and the hooks and corners;
3. Killing insects in the house and making it less attractive for them. (Insects as earlier mentioned can serve as intermediate host of the parasite - Refer Chapter 5).

4. Teaching measures of personal hygiene , especially to children who might not yet have developed fastidious habits.

It is important to rid all persons of their infection and to undertake preventive measures at the same time. Cleanliness and personal hygience are keys to ensuring that transmission is stopped.

5.4.3 Morbidity and mortality from hookworm depend much on the worm load. Therefore, the control of light infections and the reduction of local prevalence may be achieved by sanitary measures and better health education alone. Heavy and intensive infection in children, when diagnosed, require regular chemotherapy, which reduce worm load. Oddly enough, help sometimes comes from unexpected sources. Hookworm infection in Egypt as reported by Walton (1981), has declined because of the availability of inexpensive plastic shoes. The protection that these shoes provide seems to have reduced the prevalence of hookworm infection. This condition can be applied to inhabitants of Samaru village. Parents should be given the advise to buy shoes for their children and ensure that they wear them.

5.4.4 Transmission of Enterobuis vermicularis is principally from fingers, contaminated clothing, or by inhalation of eggs with dust. Pinworm infection is a house hold disease.

If one person in a family is found to be infected, usually other children and adults will also be infected (William and Richards, 1985). Therefore, everyone in the family should be treated regardless of whether they have evidence of the infection.

In addition to treating the children and adults, scrupulous cleaning of the house and frequent washing of bed linens and under clothing are essential to ridding the house of infective eggs.

5.4.5 Strongyloides stercoralis is likely to be a widespread problem only in areas with warm, moist climates. Prevention and control involve sanitary disposal of human waste, treatment of infected persons and elimination of infection in companion animals or/and astringent animal control measures.

If a member of a family is diagnosed as having S. stercoralis infection, all of the other members and companion animals should be examined and treated if necessary. The source of the infection should be sought in the vicinity.

5.4.6 With the basic knowledge of the pattern of the life cycle of Schistosoma mansoni comes the keys to its control. It is obvious that sanitary disposal of human

excreta and reducing populations of snails were the steps to take. Infected persons, in this case, children can be treated. Preventing infections in humans could be accomplished by immunization or by preventing the penetration of cercariae. There is, however, still no vaccine marketed for developing artificial immunity. Prevention of penetration of cercariae could be achieved by the application of substances to the skin which act as an impenetrable barrier, or kill or repel them (William and Richard, 1985). Children should be discouraged from engaging in swimming before or after school hours.

5.4.7 Entamoeba coli is a commensal that never lyses its host's tissue (Schimidt and Robert, 1985). It is more common in humans which include school children, partly because of its superior ability to survive in putrefaction, (Schmidt and Robert, 1981). Infection is by contamination of environment. Obviously, this is a reflection of the level of sanitation and water treatment. No treatment is required for E. coli infection. However, infection with this protozoan indicates that opportunities exist for ingestion of E. histolytica, which causes amoebic dysentery (Schmidt and Robert, 1985).

5.4.8 The two requirements for Trichuris trichiura to

become a serious health problem in children are poor standards of sanitation in which human faeces are deposited on the soil and the combination of physical conditions that allow the worm's survival and development. The parasite survives in moisture-retaining soil, high humidity and dense shade (Schmidt and Robert, 1985). Children get infected by either drinking contaminated water or by placing egg-contaminated fingers in their mouths.

It may be expected that the intensity and the prevalence of trichuriasis will decrease with the improvement of general sanitation and health education, (W.H.O., 1985).

5.5 SUMMARY

1. The title of this study is the Incidence of Intestinal parasite of school children of Samaru village.

2. The study was carried out among 250 school children out of which 145 were infected.

3. The incidence of infection was found to be high and some individual students harboured as many as two to three parasites.

4. In descending order of magnitude, Entamoeba coli, Ancylostoma duodenale, Schistosoma mansoni, Ascaris lumbricoides, Trichuris trichiura, Hymenolepis nana, Strongyloides stercoralis and Enterobius vermicularis were the prevalent intestinal parasites among the pupils.

5. Distribution of these parasites in relation to eight parameters, namely age, sex swimming habits, type of house, structure of house, type of toilet, type of water supply and socio-economic status of parents of pupils were discussed.

   Where we recorded a total number of 76, 61, 16, 15, 11, 5,2 and 2 pupils respectively out of 250 children examined.

6. E. coli, E. vermicularis, H. nana, A. lumbricoides and S. stercoralis were found only in younger children between the age of 5 - 12 while A. duodenale and T. trichiura infection was found to increase with age.

7. S. stercoralis, E. coli, H. nana and T. trichiura was found to be more prevalent in females than males while the reverse is the case in the prevalence of A. lumbricoides, A. duodenale, S. mansoni and E. vermicularis.

8. S. mansoni was found to be more prevalent in swimmers than non swimmers. The reverse is the case in S. stercoralis, H. nana, A. lumbricoides, E. vermicularis, E. coli and T. trichiura.

9. The higher prevalence rate of S. stercoralis, E. vermicularis, A. duodenale, E. coli, A. lumbricoides and S. mansoni was recorded for those pupils that used pit latrine than those that used water closet toilets.

10. E. vermicularis, A. duodenale, S. stercoralis, E. coli H. nana, A. lumbricoides and S. mansoni were found to be more in pupils that used well water than those that used tap water.

11. Transmission of all parasites was found to be associated with insanitary condition of the environment thus resulting to contamination of soil, food, water supply, etc.

12. Possible control measures such as good sanitation and health education were suggested.

5.6 RECOMMENDATION:

From the foregoing discussions, it is obvious that eradication of these parasitic infections is the ideal objc objective. Eradication will be difficult because of the high cost, the development of resistant strains of the parasites against drugs and also the poor social services. Control measures, however, may be more realistic.

The Government should formulate appropriate policies which will improve the basis health services and provide the basic social amenities such as clean drinking water, sanitary places for refuse disposal, etc.

Effective campaigns (using the mass media) on environmental sanitation and personal hygiene should be continuously monitored. Efforts should also be made to train and retrain adequate personnel (including teachers) for the control measures against intestinal parasitic infection.

Special attention should be given to schools because school children are very receptive and will easily follow the teacher's direction. Thus the Ministry of Education should include Health Education in the school curricula.

Those pupils found with the parasite(s) should be given adequate and correct treatment (drugs).

5.7 AREAS OF FURTHER RESEARCH

Incidence of urinary parasites, blood, sputum, aspirate and biopsy in school children of Samaru village could be looked into to give us the prevalence of the various parasites found in the various parts of the body.

One factor which is not taken into account in this write up is pets. This, coupled with the examination of stool sample or any of the other samples mentioned above, could be looked into to see if the disease has a zoonotic origin or not.

If the parasites are of zoonotic origin, various methods of control can then be formulated aimed towards its eradication and/or control.

Curative measures for pupils with parasites especially single dose drugs could be investigated.

Appendix 1

CLASSIFICATION OF PARASITES SEEN DURING THE SURVEY

1.	PHYLUM	:	Protozoa
	SUBERCLASS	:	Sarcodina
	CLASS	:	Rhizopodea
	ORDER	:	Amoebida
	GENUS	:	Entamoeba
	SPECIES	:	*Entamoeba coli*
2.	PHYLUM	:	Nematoda
	CLASS	:	Phasmidea
	ORDER	:	Ascaris
	GENUS	:	Ascaris
	SPECIES	:	*Ascaris lumbricoides*
3.	PHYLUM	:	Nematoda
	CLASS	:	Phasmidea
	ORDER	:	Strongylata
	FAMILY	:	Ancylostomidae
	GENUS	:	Ancylostoma
	SPECIES	:	*Ancylostoma duodenale*

4.	PHYLUM	:	Nematoda
	CLASS	:	Aphasmidea
	ORDER	:	Trichurata
	FAMILY	:	Trichuridae
	GENUS	:	Trichuris
	SPECIES	:	Trichuris trichiura
5.	PHYLUM	:	Platyhelminthes
	CLASS	:	Trematoda
	SUBCLASS	:	Digenea
	ORDER	:	Strigeata
	FAMILY	:	Schistomatidae
	GENUS	:	Schistosoma
	SPECILS	:	Schistosoma mansoni
6.	PHYLUM	:	Nematoda
	CLASS	:	Phasmidea
	ORDER	:	Rhabditata
	FAMILY	:	Strongyloidae
	GENUS	:	Strongyloides
	SPECIES	:	Strongyloides stercoralis

7.	PHYLUM	:	Platyhelminthes
	CLASS	:	Cestoda
	ORDER	:	Cyclophyllidae
	FAMILY	:	Hymenolepididae
	GENUS	:	Hymenolepis
	SPECIES	:	Hymenolepis nana
8.	PHYLUM	:	Nematoda
	CLASS	:	Phasmidae
	ORDER	:	Oxyurata
	FAMILY	:	Oxyuridae
	GENUS	:	Enterobius
	SPECIES	:	Enterobius vermicularis

Appendix 2

QUESTIONAIRE

TOPIC:- THE INCIDENCE OF INTESTINAL PARASITES IN SCHOOL CHILDREN OF SAMARU VILLAGE.

Please answer the following questions in the spaces provided and submit it along with your stool and urine specimen.

1. NAME OF CHILD:.....
2. AGE OF CHILD:.....
3. SEX OF CHILD:.....
4. NAME OF SCHOOL:.....
5. CLASS OF CHILD:.....
6. SWIMMING HABIT:.....
7. PARENT'S OCCUPATION:.....
8. TYPE OF HOUSE: (a) TENEMENT/BUNGALOW*
   (b) MUD/CONCRETE*
9. TYPE OF TOILET FACILITY: PIT/WC/BUSH/OTHERS*
10. SOURCE OF WATER SUPPLY:.....
11. DO YOU SUFFER ANY INTESTINAL INFECTION? YES/NO*
12. IF YOU DO WHAT TYPE? .....

Thank you for your cooperation.

* Delete the inapplicable.

Appendix III

EDU:/1442/VOL/1-2

L.E.A. Office,
Zaria.

11th February, 1985.

HALIMATU SA'ADIYYA IDRIS

The above named is a post-graduate student at the department of Biological Science, A.B.U. Zaria. She is hereby permitted by the authority to collect urine and stool samples from the under mentioned schools at any time she wishes to do so.

The schools are:-

(1) SA'IDU L.E.A.
(2) SAMARU L.E.A.
(3) AMINA L.E.A.
(4) LEMU L.E.A.
(5) BOMO L.E.A.
(6) MIL-GOMA L.E.A.
(7) JAMA'A GARI L.E.A.
(8) G.D.S.S. BOMO

(Sgd)
S.B. Baballe
E.O. Samaru Area,

R E F E R E N C E S

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