INTESTINAL PROTOZOA AND *SCHISTOSOMA MANSONI* (SAMBON, 1907) INFECTIONS AMONG PUPILS OF SIX PRIMARY SCHOOLS IN AKKO LOCAL GOVERNMENT AREA, GOMBE STATE, NIGERIA

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OCTOBER, 2015

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BY

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A DISSERTATION SUBMITTED TO SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, NIGERIAIN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (M.Sc.) IN EDUCATION BIOLOGY

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ZARIA

OCTOBER, 2015.

DECLARATION

I declare that the work in this dissertation entitled "INTESTINAL PROTOZOA AND *SCHISTOSOMA MANSONI* (SAMBON, 1907) INFECTIONS AMONG PUPILS OF SIX PRIMARY SCHOOLS IN AKKO LOCAL GOVERNMENT AREA, GOMBE STATE, NIGERIA" was carried out by me in the Department of Biological Sciences. The information derived from literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

Mathew Sale TWAN _____ _____

Signature Date

CERTIFICATION

This dissertation entitled "INTESTINAL PROTOZOA AND *SCHISTOSOMA MANSONI*(SAMBON, 1907) INFECTIONS AMONG PUPILS OF SIX PRIMARY SCHOOLS IN AKKO LOCAL GOVERNMENT AREA, GOMBE STATE, NIGERIA'' by Mathew Sale TWAN meets the regulations governing the award of the degree of Master of Science in Education Biology of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research work is dedicated to the memory of my late father Mr Sale Kantoma who laid the solid foundation for my education.

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ABSTRACT

The prevalence of intestinal protozoa and *Schistosoma mansoni* infections among primary school pupils in Akko Local Government Area of Gombe State, Nigeria was investigated. Stool samples were collected from 450 pupils aged 5–13 years from six (6) primary schools in the three districts of the Local Government Area. A structured questionnaire was used to collect relevant demographic and risk factor data associated with intestinal protozoa and *S. mansoni* infections. The stool samples were processed using the formol-ether concentration technique and microscopically examined for protozoan cysts and *S. mansoni* eggs; 12.4 % of the stool samples were positive for cysts and eggs. The prevalences of intestinal protozoa were: 5.1 % for *Entamoeba histolytica*, 4.2 % for *Entamoeba coli* and 2.4 % for *Balantidium coli*; *Schistosoma mansoni* eggs had a prevalence of 1.6 %. The prevalence of intestinal protozoa and *Schistosoma mansoni* infections with respect to gender showed no statistically significant association (P>0.05), although male pupils had higher prevalence (14.0%) than female pupils (10.4 %). There was a statistically significant association between prevalence and age groups (P<0.05); age group 8-10 years showed the highest prevalence of 16.2%; followed by age group 5-7 years (14.6 %) and 11-13 years (6.6 %). With respect to parents'occupation, the highest prevalence was observed with fishing (27.0 %), followed by farming (17.8 %), trading (14.7 %) and civil service(6.8 %). There was also a higher prevalence of 16.9 % among the public school pupils compared to the private school pupils with 8.0 %; this difference was significant (P<0.05). The prevalence of infection by protozoa and *S. mansoni*infections in different districts and individual schools was not uniform despite the similarity in the local topography and weather conditions. Source of drinking water and type of toilet used were also found to be significantly associatedwith infection by intestinal protozoa and *S.*

mansoni($P<0.05$). The prevalence of intestinal protozoa and *Schistosoma mansoni* infections among the primary school pupils was associated with poor personal hygiene habits at home and in school, and improper disposal of human and animal waste as implied by the responses in the questionnaire. It is therefore recommended that a more concerted health education effort is necessary in order to curb the infections within the schools and the communities.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Infections by intestinal parasites are of major public health importance worldwide, especially among children in developing countries. World Health Organization(WHO) estimated that approximately 3.5 billion people are infected by intestinal parasites and about 450 million children are ill due to these infections (WHO, 2000;Warunee *et al*., 2007). Infection with intestinal parasites may have important health consequences and are known to cause iron deficiency anaemia, growth retardation in children and other physical problems (Scolari *et al*., 2000; Nasiri *et al*., 2009). Intestinal parasitic infections are linked to lack of sanitation, lack of access to safe water and poorhygiene and are therefore linked to poverty (Alhassan *et al.*, 2013).

Human intestinal protozoan parasites live inside the small or large intestine. They are remarkably capable of avoiding or counteracting host defensive mechanisms as well as adapting easily to new host species and new habitat situation (Sandra, 1994). Among human intestinal parasitic protozoans are *Entamoeba histolytica, Giardia lamblia* and *Balantidium coli.* The infective stages of the intestinal protozoa are the cysts, which are usually ingested through contaminated water, food, fruits, vegetables (Duncan *et al*., 1996; Cheesbrough, 1999).

Schistosomiasis is the third most devastating Tropical Disease globally (after malaria and intestinal helminthiasis) and is a major cause of morbidity and mortality for developing countries in Africa, South America, the Caribbean, the Middle East and Asia (World Health Organization, 2013).

In 74 countries where the disease is endemic, an estimated 250 million people are infected and approximately 700 million people, mostly children, are at risk of infection (Ross *et al.,* 2002; Steinmann *et al*., 2006).

*Schistosoma mansoni*is wide-spread in Africa, the Eastern Mediterranean, the Caribbean, and South America (Olveda *et al*., 2013). Approximately 90% of the 250 million people infected worldwide live in sub-Saharan Africa where *Schistosoma mansoni* is the prevalence species (Vanderwerf *et al*., 2003)

1.2 Statement of the Problem

Approximately 3.5 billion people are infected by intestinal parasites and about 450 million children are ill due to these infections worldwide (WHO, 2000; Waruneee*t al*., 2007).

Intestinal protozoan parasites are known to cause severe diseases under certain circumstances and may become highly virulent and invasive, causing potentially lethal systemic diseases (Mbuh *et al.,* 2010). The incidence of intestinal protozoa and *Schistosoma mansoni* in Nigeria and surveys reporting prevalence in some towns and communities has been documented (Oguoma *et al*., 2008; Obadiah, 2012; Ngele, 2012; Alhassan *et al*., 2013 and Adenowo *et al*., 2015).

There is little or no information on the prevalence of intestinal protozoan and *Schistosoma mansoni* infection in Akko LGA of Gombe State.

1.3 Justification

The study will provide baseline data in intestinal parasitic infections on pupils in the area, create an awareness and highlight the need for treatment by the relevant agencies, if necessary.

1.4 Aim

To determine the prevalence of intestinal protozoan and *Schistosoma mansoni* infections and the risk factors among primary school pupils in Akko Local Government Area, Gombe State.

1.5 Objectives

The main objectives of the study are to determine:

i. The prevalence of intestinal protozoa and *Schistosoma mansoni* among pupils in six primary schools in Akko Local Government Area of Gombe State.

ii. The influence of age and gender on the prevalence of intestinal protozoan and *Schistosoma mansoni* infections in the area.

iii. The risk factors associated with infections in the area.

iv. The prevalence of mixed infections in the area.

1.6 Hypotheses

i. There are no significant incidences of protozoa and *Schistosoma mansoni* infections pupils of six primary school of Akko LGA.

ii. The prevalence of protozoa and *S. mansoni* infections in pupils of the six primary school in the LGA is not significantly influenced by age and gender.

iii. There is no significant association between the prevalence of intestinal protozoan and *Schistosoma mansoni* infections and the risk factors among pupils in six primary school in the area.

iv. There are no significant incidences of the mixed infections in the area.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Historical Background

Human endo-parasites are separated into intestinal and blood-borne parasites. For a parasite to be defined as intestinal, it must have an intestinal life-cycle stage. Parasites found in the intestine can be categorized into two groups: Protozoa and helminths (Arcari *et al*., 2000). The World Health Organization (1987) reported prevalence rates ranging between 50% and 80% in children worldwide due mainly to*Ascaris lumbricoides*, hookworms, *Trichuris trichura* and *Entamoeba histolytica*infections (Biu *et al*., 2012). Studies on parasitic infections in school pupils have been reportedFashuyi, (1983) Awogun (1984)and Akogun (1989); reported a high prevalence among the paediatric age group resident in Gumau District of Bauchi State, Ibadan and Ilorin respectively, while Biu and Harry (2001) and Biu and Adam (2004) reported a prevalence of 37.4% and 72.0% in school children and non-school children in Maiduguri Metropolis. Also, in a survey, Salako *et al*. (2001) estimated an overall prevalence of 70.6% in school pupils in Nigeria.

2.2 Protozoa

The protozoa were first discovered in 1873 by a clinical assistant, Fedor Loschin Saint Peterburg, Russia. The patient, a young peasant with bloody dysentery was passing Amoeba in his stool. Suggestion of a parasitic etiology was first recorded in 1855 from a case where amoeba was observed in a stools sample from child with dysentery in Prague. In 1875, Feder Losch isolated *Entamoeba histolytica* from the stool specimen of a patient with dysentery (Kean, 1988).

Protozoa are single-celled organisms. There are four classes of Protozoa commonly found in concentrated faecal samples. Intestinal and luminal protozoa significant to human health include *Entamoeba histolytica Balantidium coli Giardia lamblia, Trichomona vaginalis, Cryptosporidium parvum* and *Isospora belli* (Voigt *et al*.,1999). These are differentiated by the method of motility.

2.2.1 Diagnosis of protozoa

There are two diagnostic life-cycle stages commonly seen in protozoa parasites,the cyst and the adult (trophozoite) stage. The trophozoite stagecould be observed in direct smear method on a slide but cysts require concentration technique before it could be seen under the microscope. The key diagnostic factor is that protozoan cysts are typically 5-30 microns in diameter, and as such are smaller than most helminth eggs. Protozoa are particularly difficult to see under the microscope if the sample clarity is bad because of their size.

2.2.2 *Entamoeba histolytica*

This protozoan causes the third-greatest parasitic disease responsible for death in the world after malaria and schistosomiasis (Voigt *et al*.,1999; L'Her, 2005). It affects approximately 180 million people, of which 40,000 to 110,000 die each year (WHO, 1997).*Entamoeba histolytica* has been split into two sub-species *E. histolytica*, which is pathogenic, and *E. dispar*, which is non-pathogenic (WHO, 1997). Further molecular studies have identified a third sub-species, *E. moshkovskii*, also tends to be non-pathogenic (Ali *et al*., 2003). Infection ranges from asymptomatic colonization of the large bowel to severe invasive intestinal and extra-intestinal disease.

Trophozoites

The trophozoites of *E. histolytica* recovered from dysenteric stool exhibit ingested red blood cells and clear pseudopodia. They can be up to 60μm in diameter and motility is rapid and unidirectional. On a permanently stained faecal smear e.g. Trichrome or Iron hematoxylin, the morphological features are more visible (Cheesbrough, 2009).

Cysts

Cysts of *E. histolytica* are 10-15μm in diameter and contain one to four nuclei. Chromatoid bodies are usually present in young cysts as elongated bars with bluntly rounded ends. Glycogen is usually diffuse, but in young cysts it is often present as a concentrated mass, staining reddish brown with iodine.

Life-cycle of *Entamoeba histolytica*

Entamoeba histolytica life cycle is relatively simple. Humans ingest the cyst form from contaminated sources. Mature cysts (spherical, 12–15 μm in diameter) are passed in the faeces of infected human. Another human can get infected by ingesting them in faecally contaminated water, food or hands. If the cysts survive the acidic stomach, they transform into trophozoites in the small intestine. Trophozoites migrate to the large intestine where they live and multiply by binary fission. Both cysts and trophozoites are sometimes present in the feces. Cysts are usually found in firm stool, whereas trophozoites are found in loose stool. Only cysts can survive longer periods (up to many weeks outside the host) and infect other humans (Figure. 2.1). If trophozoites are ingested, they are killed by the gastric acid of the stomach. When the trophozoite encysts the life cycle is complete and the organism can be transmitted (Haque *et al.,* 2003).

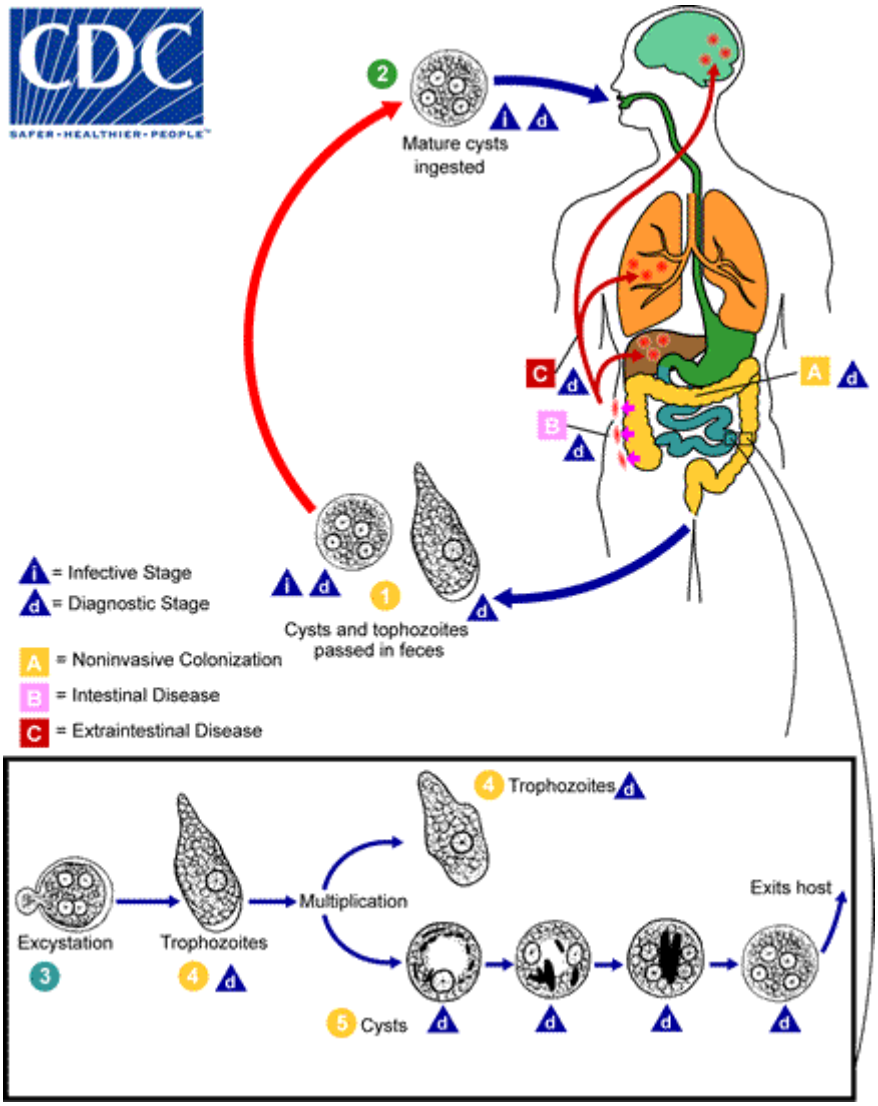


Figure 2.1: Life-cycle of *Entamoeba histolytica*

Source:http://www.parasitesinhumans.org/Entamoeba-histolytica.html

2.2.3 *Entamoeba coli*

Entamoeba coli are a non-pathogenic amoeba with world distribution. Its life-cycle is similar to that of *E. histolytica* but it does not have an invasive stage and does not ingest red blood cells (Figure 2.1).

The trophozoite is larger than that of *E. histolytica* ranging from 15-50μm in diameter. It exhibits blunt pseudopodia with sluggish movement. A permanently stained preparation shows a nucleus with a moderately large eccentric karyosome with the chromatin clumped on the nuclear membrane. The cytoplasm appears granular containing vacuoles with ingested bacteria and other food particles.

Cysts of *E. coli* are 15-30μm in diameter and contain one to eight nuclei with irregular peripheral chromatin. Chromatoid bodies are not frequently seen but when present they are usually splinter-like with pointed ends. Glycogen is usually diffuse but in young cysts it is occasionally found as a well-defined mass, which stains reddish brown with iodine (Cheesbrough, 2009).

2.2.4 *Balatidium coli*

This belongs to the family Ciliophora. *Balantidium coli* possesses simple cilia or compound ciliary organelles. It is the only member of the ciliate family to cause human disease and by far the largest organism in this group. *Balantidium coli* is widely distributed in warm climates, which is where human infections most commonly occur. The organisms inhabit the large intestine, cecum and terminal ileum where they feed on bacteria.

Balantidium coli has a wide variety of hosts including rodents, pigs (wild and domestic), camels, and primates, both human and nonhuman (Poudyal *et al*., 2011). It

is less commonly found in dogs (Bauri *et al.*, 2012; Poudyal *et al*., 2011) and equines (Headley *et al*., 2008). *Balantidium coli* are zoonotically, especially with respect to infections in pigs (Schuster and Ramirez-Avila, 2008). It has also been characterized as an emerging protozoan pathogen (Garcia, 2004; Schuster and Ramirez-Avila, 2008).

The cyst is spherical, measures from 30-200μm by 20-120μm. It contains 1 macro and 1 micronucleus. Cilia are present in young cysts and may be seen slowly rotating, but after prolonged encystment, the cilia disappear. Cysts form when diarrhea subsides and the rectal contents become formed. The cyst ingested by a fresh host, excysts to liberate the trophozoite (Cheesbrough, 2009).

Trophozoites of *B. coli* measure approximately 30-150μm x 25-120μm but have been known to attain lengths of up to 200μm. They are oval in shape and covered in short cilia. A funnel shaped cytosome can be seen near the anterior end. Multiplication is by binary fission in the trophozoite stage. In an unstained preparation, the organisms are easily recognized because of their size and rapid revolving movement. In a stained preparation, the characteristic macro and micronuclei may be observed (Figure 2.2).

2.3 *Schistosoma*

The World Health Organization estimates that schistosomiasis and geohelminthiasis represent more than 40% of the global disease burden of all tropical diseases, excluding malaria (World Health Organization, 2006). Schistosomiasis is the third most devastating tropical disease globally (after malaria and intestinal helminthiases) and is a major cause of morbidity and mortality for developing countries in Africa, South America, the Caribbean, the Middle East, and Asia (Steinmann *et al*., 2006).

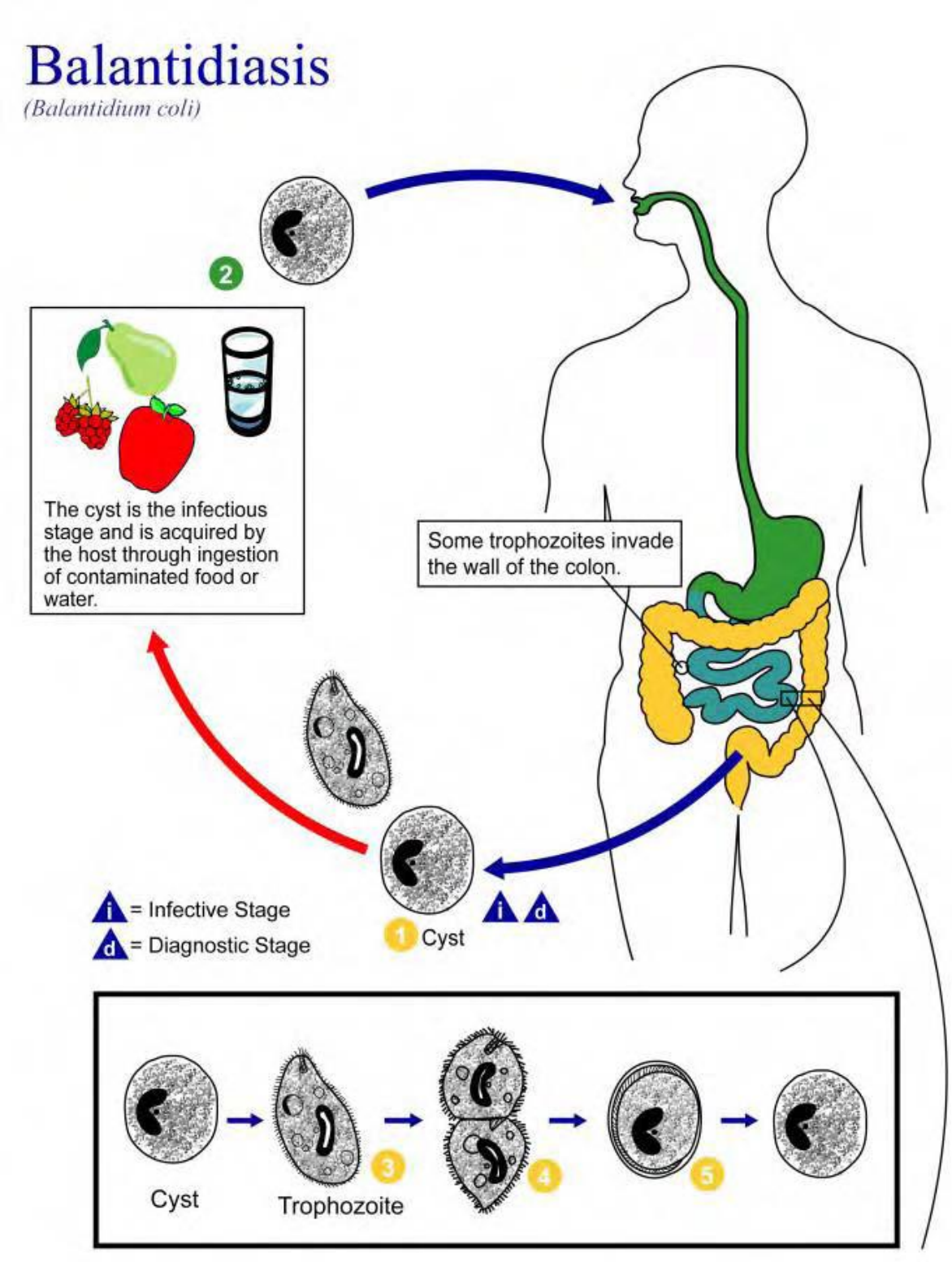


Figure 2.2 Life-cycle of *Balantidium coli*

Source: http://www.parasitesinhumans.org/balantidium-coli.html

Schistosomiasis or bilharzia is caused by schistosomes, which are parasitic trematodeworms of the genus *Schistosoma*. Five species infect humans, namely: *Schistosoma mansoni, S. japonicum, S. Mekongi, S. intercalatum* and *S. haematobium*. In 74 countries where the disease is endemic, an estimated 250 million people are infected and approximately 700 million people are at risk of infection (Ross *et al.*, 2002; WHO, 2002; Olveda *et al.*, 2013). The burden of disease attributable to the three major human schistosome species (*S. mansoni, S. haematobium* and *S. japonicum*) is estimated to be between 24-29 million disability adjusted life years (King *et al*., 2005; VanderWerf *et al*., 2003).

2.3.1 *Schistosoma mansoni*

Schistosoma mansoni is widespread in Africa, the eastern Mediterranean, the Caribbean and South America (Figure 2.3). Almost 300,000 people die annually from schistosomiasis in Africa alone (Friedman *et al*., 2007).

Approximately 90% of the 250 million people infected worldwide live in Sub-Saharan Africa where *S. mansoni* is the prevalent species (Friedman *et al*., 2007). About 10 million women in Africa are infected during pregnancy (Theron *et al*., 2004; Olveda *et al*., 2013).

Zoonotic transmission is possible with these species, because the parasite infects not only humans but also wild rodents (Theron *et al*., 2004; Olveda *et al*., 2013).

2.3.2 Morphology

Adult male measure up to 15 mm in length and females up to 10μm. The schistosomes remain in copula throughout their life span, the uxorious male surrounding the female with his gynaecophoric canal. The cuticle of the male is



Figure 2.3: Map of the current global distribution of schistosomiasis. Source: US CDC (2012) Retrieved from www. cdc.gov/parasites/Schistosomiasis/epi.html.

covered in minute papillae. These only occur at the anterior and posterior ends in the female as the middle section is covered by the male's body. Oral and ventral suckers are present, with the ventral one being longer to hold the worms in place, preventing them from being carried away by the blood circulatory current. The eggs of *S. mansoni* are 114-175µm long by 45-68µm wide. They are light yellowish brown, elongate and possess a lateral spine. The shell is acid-fast when stained with modified Ziehl-Neelsen Stain. A non-viable egg is dark-coloured and shows no internal structural detail or flame cell movement. Eggs can become calcified after treatment and are usually smaller, appear black and often distorted with a less distinct spine.

2.3.3 Life-cycle

Miracidia hatch out of eggs in faeces discharged into water to find a suitable fresh water snail and penetrate it. Following this, the parasite develops via mother and daughter Sporocysts, which develop into cercaria. The purpose of the growth in the snail is the numerical increase of the parasite. The ceraria propel themselves in water with the aid of their bifurcated tail; when they recognise human skin, they penetrate it within a very short time (Figure 2.4). Following a migration through the body within the bloodstream of humans, if they meet a partner of the opposite sex, they develop into sexually mature adults (CDC, 2012; Barbosa *et al*., 2013; Olveda *et al.*, 2013).

2.4 Factors Contributing to Parasitic Infections

Basic factors responsible for the spread of parasitic infections are environmental sanitation, socio-economic factor and age of host and poor personal hygiene.

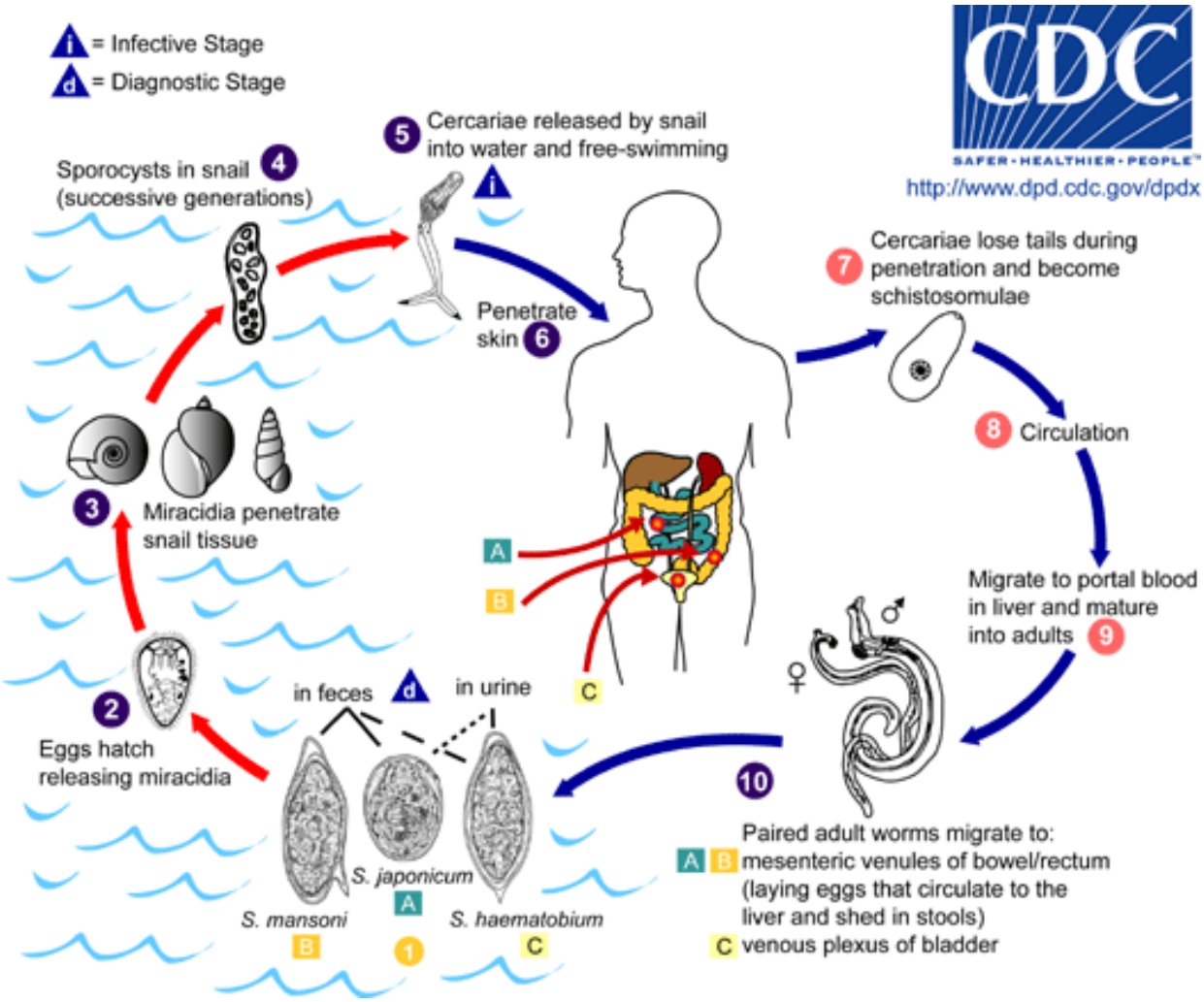


Figure 2.4: Life-cycle of *Schistosoma mansoni*

Source: www.parasitesinhumans.org/Image

2.4.1 Environment

The environment is a complete ware of physical, chemical and biotic factors that interact and impact upon all living things and their surroundings Thus, the quality of the environment plays an important role in parasitic infection. Insanitary environmental conditions greatly facilitate the spread of parasites by faecal, oral and person to person routes. Statistics have shown that about two-thirds of the diseases affecting the populace has been identified as due to poor water and sanitation conditions (Okoronkwo, 2011).

Sanitation is not considered a priority in primary schools because people do not realize the need for a safe and clean environment, thus, most school environments have been turned into rubbish dumping sites. Toilet are absent in schools and pupils defecate around the compound especially behind the classrooms (Alhasan *et al*., 2013).

The lack of potable water and poor environmental sanitation are the reasons why diseases associated with unhygienic disposal of human faeces and refuse are so common in developing countries especially in Nigeria (Dzwairo *et al*., 2006).

Parasitic diseases associated with low standard of sanitation remain the leading cause of morbidity and mortality in many developing countries. The prevalence of amoebiasis varies from as low as 2 percent to as high as 60 percent or more in areas devoid of sanitation. Salako *et al*. (2001) estimated an overall prevalence of 70.6% in school pupils in Nigeria.

2.4.2 Socio-economic factor

Diseases that are human-induced or self-inflicted, which are mostly brought about by humans either as individuals or collectively as a society are described as social diseases (Iwueze *et al*., 2014). Several environmental and socio-economic factors have been identified to be responsible for the continual propensity of intestinal parasites in

children (Pomajbikova *et al*., 2013). Most diseases caused by micro-organisms in tropical Africa are as a result of poverty and its accompanying features such as insanitation, malnutrition, illiteracy, overcrowding coupled with ignorance (Alhasan *et al*., 2013).

Human behaviour, cultural practices, socio-economic conditions, customs and tradition of the population help to aggravate the spread of tropical diseases (Traub *et al*., 2004). The continuing cycle between parasites and humans is often the result of using human excrement as fertilizer, exposing bare feet to soil or standing water, eating undercooked or raw meat and fish and defaecating in open fields (Kathleen and Arthur, 2002). Parasitic infections cause human suffering and economic loss worldwide, but the burden is greatest in the developing countries. This is as a result of absence of basic amenities such as good drinking water, and poor sanitation. The parasites cause social problems and their effects are increased by the conditions in poorly organised societies.

2.4.3 Age of host

Age is the most important determinant. Mortality and morbidity rate often show a relationship to age (Obadiah, 2012). School children belong to the age group with the highest prevalence of parasitic infection in most communities (Obadiah *et al*., 2011). Young children are most vulnerable to chronic blood loss as a result of hookworm infection while pinworm typically affects children between the ages of 5-15 years old (Franchot, 2000).

2.4.4 Poor personal hygiene

Intestinal parasitic infections sometimes mirror the socio-economic status and are often a reflection of family and community hygiene (Bethony *et al*., 2006). Amoebiasis can be spread when infected people do not dispose of their faeces in a sanitary manner or do not wash their hands properly after going to the toilet. The lack of potable water and poor environmental sanitation are the reasons why diseases associated with unhygienic disposed of human faeces and refuse are so common in developing countries (Dzwairo *et al*., 2006). Parasitic infections, food and water contamination, malnutrition, inadequate sanitation, poor hygiene and poor health services, coupled with poor housing are some of the causes of poor health (Traub *et al*., 2004).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

The study was carried out in Akko local Government Area (LGA) of Gombe State, in North Eastern Nigeria. Akko LGA, is one of the eleven (11) LGAs of Gombe State, it has its headquarters in the town of Kumo on the A345 highway south of the State Capital Gombe. Akko town for which the LGA is named, is located west of Gombe at10°17′N and 10°58′E (Figure 3.1). The LGA has an area of 2,627 km² and a population of 337,853 during the 2006 census. The inhabitants of Akko LGA are generally traders, farmers, tailors, cattle rearers, and civil servants. The sources of drinking water for household use are wells, streams and bore-holes.

3.2 Study Population

The study population included 450 male and female pupils aged 5-13 years of different sexes, from six primary schools, two from each of the three districts in the Local Government Area. The parents of the pupils in the selected schools were also included.

The Primary Schools include:

A. Kumo District
   i. Central Primary School, Kumo
   ii. All Saints Primary School, Kumo

B. Pindiga District
   i. Asas Primary and Secondary Schools, Kashere
   ii. Central Primary School, Kashere

C. Akko District
   i. Central Science Primary School Bogo, Akko
   ii. Standard Academy Primary School Tunfure

3.3 Ethical Clearance and Permission to Carry out the Study

An introductory letter was obtained from the Department of Biological Sciences, Ahmadu Bello University, Zaria before the commencement of the study. Permission to conduct the study was obtained from the Akko Local Government Education Authority (Appendix I). A written consent from the parents of the enrolled pupils was also sought before collection of the stool samples. Only subjects who gave informed consent to participate in the research were used in the study.

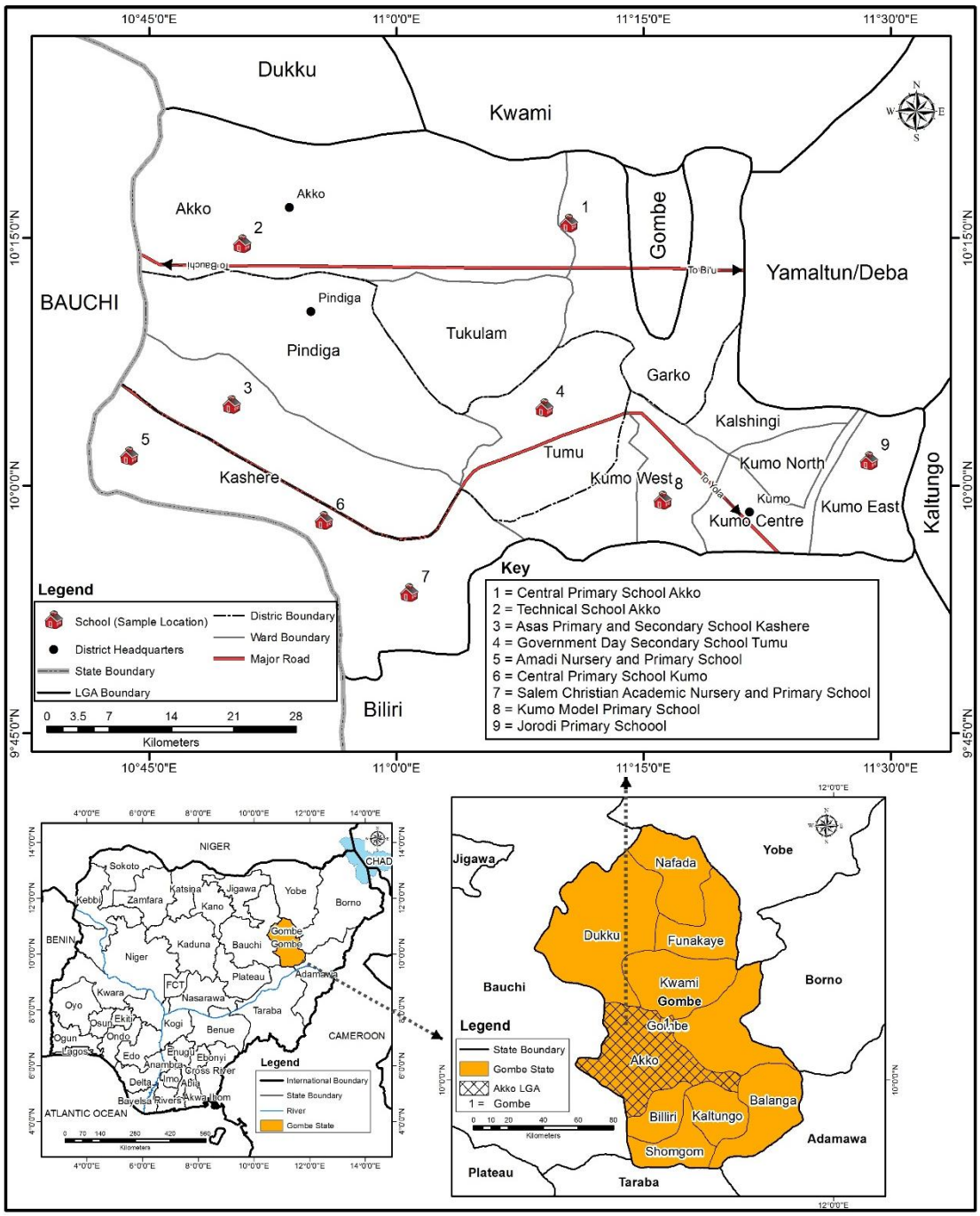


Figure 3.1: Map of Akko LGA showing districts and selected schools (Bottom right: Map of Nigeria; Bottom left: Map of Gombe State; Top: Map of Akko LGA)

Source: Adopted from the administrative map of Akko LGA

3.4 Administration of Questionnaire

Structured questionnaires were administered to the pupils. The questionnaire was designed to provide information on the pupils' background such as gender, age, sources of water, type of toilet, washing of hand before eating, swimming, fishing, hand washing after going to the toilet and use of soap in hand washing (Table 4.7).

3.5 Determination of Sample Size

Due to unavailability of data on the prevalence of intestinal protozoa and *Schistosoma mansoni* infections among primary school pupils in Akko local Government Area of Gombe State, the sample size for this study was obtained using the formula:

$[n = z^2pq/d^2]$ Naing *et al*. (2006)

Where: n= the desired sample size

z= the standard normal deviation, usually set at 1.96 (≈2.0)

p= the proportion in the target population having the particularinfections (when no estimate 50% is used; i.e. 0.5)

q= 1.0-p

d= degree of accuracy desired, usually set at 0.05

Therefore, $n= (1.96)^2(0.5)\ (0.5)/\ (0.05)^2 = 384$

For the purpose of this study a total of 450 pupils from all three districts (Kumo, Pindiga and Akko) were examined.

3.6 Collection of Stool Samples

Two schools were randomly selected from each study district and in each school, 75 pupils were also randomly picked. Each pupil was given a labelled, clean 10-ml bottle bearing the serial number that was assigned to their questionnaire. Pupils were asked to collect their early morning stool between 7.00am and 10.00am (for maximum number of eggs) (WHO, 2000). Verbal description and specific instructions for handling

(avoiding contamination) of the stool specimen were given to all the pupils. The stool samples collected were preserved in 10% formalin in specimen bottles, kept in an insulated box and transported to the Parasitology Laboratory, Department of Biological Sciences, Ahmadu Bello University, Zaria for microscopic examination.

3.7 Laboratory Analysis of Stool Samples

Stool samples were analysed using formal ether concentration technique described by Allen and Ridley (1970) and modified by Fayer and Xio (2008) was used to concentrate parasite cysts and eggs.

3.7.1 Procedure

To 10ml of 10% formalin,1g of faeces was added in a test tube and the mixture stirred using an applicator stick until a homogeneous suspension was obtained.

The suspension was filtered into a centrifuge tube through gauze fitted to a funnel to remove particulate material, and 3mls of Diethyl ether was added to the suspension. The mouth of the centrifuge tube was stoppered and tube with contents shaken vigorously for 30 seconds. Thereafter, the mixture was centrifuged at 2000rpm for 2 minutes, after which an applicator stick was used to loosen the debris by passing the applicator stick between the inner wall of the tube and the debris.The supernatant was decanted and the tube placed in a rack to allow the fluid remaining on the sides of the tube to drain to the bottom. A little of the sediment along with the remnant of the supernatant was transferred to a slide using a pipette and covered with a cover slip. The preparation was examined microscopically for helminth eggs and cysts of protozoa. The parasites were identified using the morphology of the cysts and the eggs according to the Atlas of medical Helminthology and Protozoology by Chiodini *et al*. (2005). The Technical staff of the laboratory of Veterinary Parasitology and Helminthology, Department of

Veterinary Parasitology and Entomology, Faculty of Medicine Ahmadu Bello University Zaria assisted in the identification of the parasite cysts and eggs.

3.8 Data Analysis

Prevalences of intestinal protozoa and *Schistosoma mansoni* were calculated and expressed as percentages with respect to district, school, gender, age, type of school (private or public). Chi-square was used to test for significance of association between the prevalence of infection and district, gender, age, parents' occupation, and school type (private or public).

Odd's Ratio (OR) was used to determine the level of association between risk factors and infection. Significance was determined at $P< 0.05$ at 95% confidence interval (C.I).

CHAPTER FOUR

4.0 RESULTS

4.1 Overall Prevalence of Intestinal Protozoa and *Schistosoma mansoni* Infections in Relation to School

The eggs of *Schistosoma mansoni* (Plate I) and Cysts of intestinal protozoa (Plate II, Plate III, Plate IV) were recovered from the stool samples examined. Out of the total of 450 stool samples of school children, 56 (12.4%) were positive for intestinal protozoa and *Schistosoma mansoni* infections (Table 4.1).Central Primary School Bogo had the highest prevalence of15 (20%)while Standard Academy had the lowest prevalence of 3 (4.0%). There were no significant differencesin prevalence of infectionamong the schools (P>0.05).

4.2 Intestinal protozoa and *Schistosoma mansoni* Infections According to District

Table 4.2 shows that out of the 150 stool samples examined in each district, 19 (12.7 %) each from Kumo and Pindiga and 18 (12.0 %) from Gona were infected with intestinal protozoa cysts and *Schistosoma mansoni* eggs. However, there were no statistically significant differencesin infestation among the districts (P>0.05).

4.3 Prevalence of Intestinal Protozoa and *Schistosoma mansoni* Infections According to Age of Pupils

Infection occurred in all the age groups. The highest prevalence was recorded in age-group 8-10 years (16.2%); prevalence in age-group 5-7 years was 14.6%. The lowest prevalence (6.6 %) was recordedin pupils in age-group 11-13 years (6.6%). The differences in prevalence amongst age groups was highly significant (P<0.05). Odd's ratio value of 1.657 for 8-10 years showed an association between the age group and the infection (Table 4.3).



Plate I: *Schistosoma mansoni* egg at microscopic magnification of ×400 (i.e. eye-piece ×10, objective ×40). Note the characteristic lateral spine (LS).

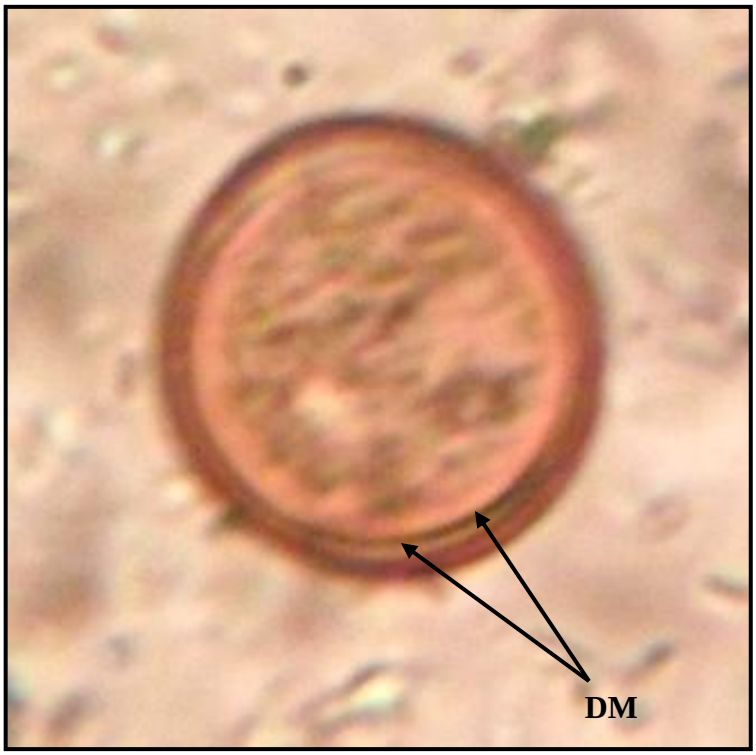


Plate II: *Entamoeba coli* cysts at microscopic magnification of ×400 (i.e. eye-piece ×10, objective ×40). Note the characteristic double membrane (DM).

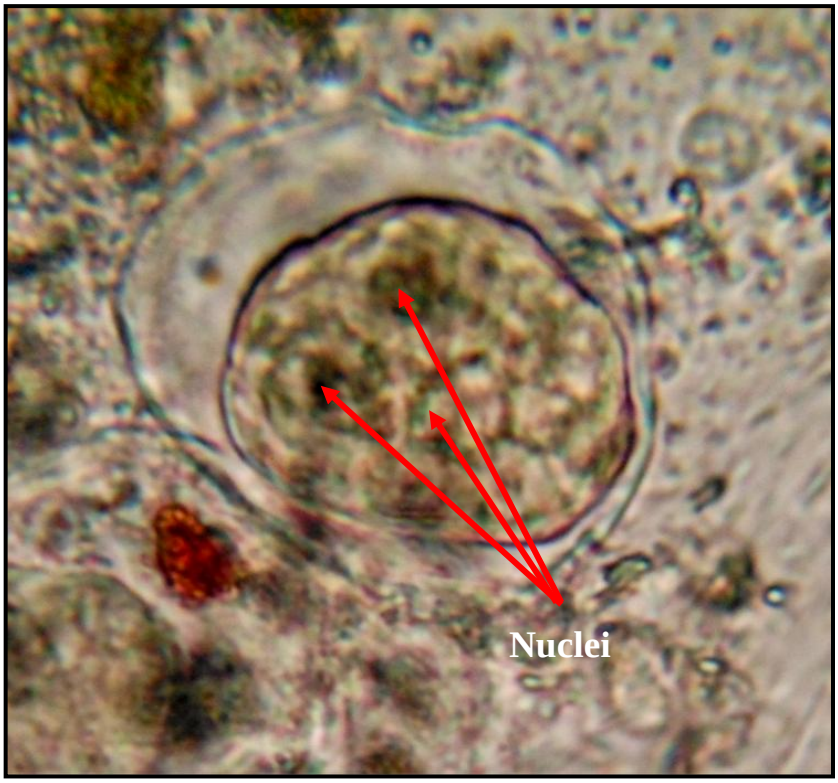


Plate III: *Entamoeba histolytica* cyst at microscopic magnification of × 400 (i.e. eye-piece ×10, objective × 40). Note the characteristic three nuclei.

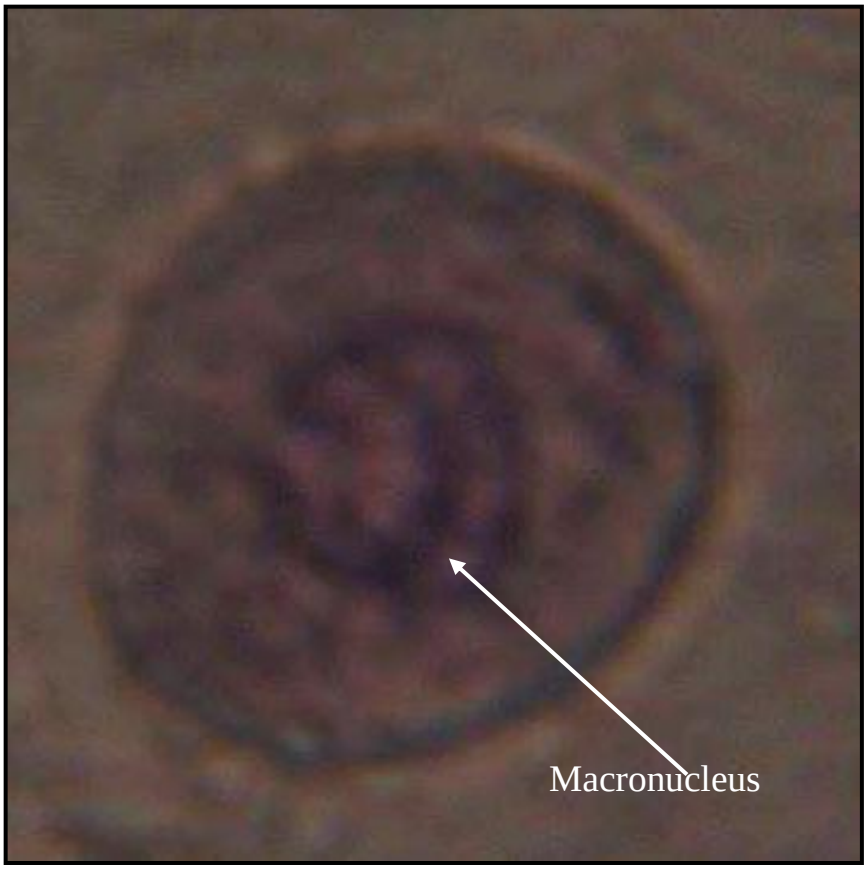


Plate IV: *Balantidium coli* cysts at microscopic magnification of ×400 (i.e. eye-piece ×10, objective ×40). Note the macro nucleus

Table 4.1: Overall prevalence of Intestinal Protozoa and *Schistosoma mansoni* Infections According to Schools (n = 75 per school)

School	**Number Positive**	**%**	χ^2	**Df**	**P value**
All Saints	7	9.3	10.932	5	0.053ns
Central Kumo	12	16.0			
Standard Academy	3	4.0			
Central Bogo	15	20.0			
Asas	8	10.7			
Central Kashere	11	14.7			
Total	**56**	**12.4**			

Key:

ns = Not significant; n= Number Examined

Table 4.2: Intestinal Protozoa and *Schistosoma mansoni* Infections According toDistrict (n = 150 per District)

District	**Number Positive**	**%**	χ^2	**Df**	**P value**
Kumo	19	12.7	0.041	2	0.980ns
Akko	18	12.0			
Pindiga	19	12.7			
Total	**56**	**12.4**			

Key:

ns = Not significant; n= Number Examined

Table 4.3: Prevalence of Intestinal Protozoa and *Schistosoma mansoni* Infections According to Age of Pupils

Age	Number Examined	Number Positive	%	χ^2	Df	P-value	Odd's Ratio	Confidence Interval
5-7 years	144	21	14.6	7.434	2	0.024*	1.322	0.739-2.364
8-10 years	154	25	16.2				1.657	0.939-2.922
11-13 years	152	10	6.6				0.386	0.186-0.788
Total	**450**	**56**	**12.4**					

Key:

* = Significant; ns = Not significant

4.4 Gender-related Prevalence of Intestinal Protozoa and *Schistosoma mansoni* Infections in Primary School Pupils

Out of the 257 stool samples examined from male pupils and 193 from female pupils, 36 (14.0 %) and 20 (10.4 %) respectively, contained cysts/eggs of the parasites. Intestinal protozoa and *Schistosoma mansoni* infectionstherefore, showed higherprevalence of infectionin male than in female pupils. The differencesin the infestation between males and females were not significant (P>0.05).The value of Odd's ratio (1.409) showed an association between gender and infections (Table 4.4).

4.5 Intestinal Protozoa and *Schistosoma mansoni* Infections based on Occupation of Pupils' Parents

Table 4.5 shows that out of four(4) occupation types of the pupils' parents/guardians, the highest prevalence was observed in pupils whose parents were involved in fishing (27%), followed by farming(17.8%), then trading (14.7%). The lowest prevalence was in pupils whose parents/guardians were civil servants (6.8%). There were highly significant differencesin prevalencesof infection with the types of occupation of pupils' parents (P<0.05).

4.6 Intestinal Protozoa and *Schistosoma mansoni* Infections According to the Type of School

Out of the total of 450 stool samples examined,225 stools each from private and public school pupils, 18 (8%) and 38 (16.9%) respectively, contained protozoan cysts and *S. mansoni* eggs. the difference in infestation between both sets of schools was highly statistically significant (P<0.005).Odd's ratio of 0.428 shows no association between types of school and infections (Table 4.6).

Table 4.4: Gender-related Prevalence of Intestinal Protozoa and *Schistosoma mansoni* Infections in Primary School Pupils

Gender	**Number Examined**	**Number Positive**	**%**	χ^2	**Df**	**P-value**	**Odd's Ratio**	**Confidence Interval**
Male	257	36	14.0	1.344	1	0.246ns	1.409	0.788-2.521
Female	193	20	10.4					
Total	**450**	**56**	**12.4**					

Key:

ns = Not significant

Table 4.5: Intestinal Protozoa and *Schistosoma mansoni* Infections based on Occupation of Pupils' Parents

Occupation	Number Examined	Number Positive	%	χ^2	Df	P-value	Odd's Ratio	Confident interval
Civil Servant	205	14	6.8	14.621	3	0.002**	0.354	0.187 – 0.669
Farming	73	13	17.8				1.683	0.854 – 3.317
Trading	143	21	14.7				1.338	0.748 – 2.393
Fishing	29	8	27.6				2.960	1.243 – 7.052
Total	**450**	**56**	**12.4**					

Key:

** = Highly significant

Table 4.6: Intestinal Protozoa and *Schistosoma mansoni* Infections According to the Type of School

School Type	Number Examined	Number Positive	%	χ^2	Df	P-value	Odd's Ratio	Confidence Interval
Private	225	18	8.0	8.158	1	0.004**	0.428	0.236 - 0.776
Public	225	38	16.9					
Total	**450**	**56**	**12.4**					

Key:

** = Highly significant

4.7 Risk Factors Associated with Intestinal Protozoa and *Schistosoma mansoni* Infections

The responses elicited by the questionnaire, and the statistical analysis showed the association between some risk factors with the epidemiological variables and the infections. The prevalence of infections with respect to source of water were23.3%; 16.9%; and 9.0% for Stream, Well and Borehole respectively; the differences were statistically significant (P<0.05). An Odd's ratio value of 2.522 was obtained for respondents that used Stream or Rivers water showed a strong association between water source and the infections. Among the 102 pupils that swim, 26.5% had intestinal protozoa and *S. mansoni* infections;an Odd's ratio value of 3.96 showed a statistically significant association between water contact activities and the infections. Also there was significant relationship between walking barefoot and the infections;the Odd's ratio value obtained was 2.941 forwalking barefootoccasionally. There was highly significant relationship between the type of toilet and prevalence of infections; Odd's ratio of 18.959 was obtained for the use of pit-latrine. Non-washing of hands had asignificant associationwith infection in all the districts. Odd's ratio 2.488 of washing of hands without soap showed a relationship between non-washing of hands and the infections (Table 4.7).

4.8 Infection of Pupils with Protozoan Cysts and *S. mansoni*Eggs According to School

Table 4.8 shows that out of the 450 stool samples examined from all the six schools, *E. histolytica* cysts were the most prevalent (5.1 %) and *S. mansoni* eggs had the lowest prevalence (1.6%). *Entamoeba coli*showed the highest prevalence (8.0 %) in Central primary school Bogo among all the parasites cysts and eggs recovered, the lowest prevalence of infection among the parasites (1.3 %) was shown by *E. coli* in Standard Academy, and by *B. coli*in All Saints and Asas primary schools. There were

Table 4.7:Risk factors associated with intestinal Protozoa and *Schistosoma mansoni*

Risk Factors	No. Examined	No. Positive	%	χ^2	Df	P value	Odd's Ratio	C.I
Source of Water								
Stream	60	14	23.3	11.452	2	0.003**	2.522	1.279 – 4.970
Well	89	15	16.9				1.582	0.832 – 3.010
Borehole	301	27	9.0				0.408	0.231 – 0.718
Do you swim								
Yes	102	27	26.5	23.815	1	0.000**	3.96	2.214 - 7.082
No	319	29	8.3					
Do you fish								
Yes	34	8	23.5	4.148	1	0.042*	2.359	1.011 - 5.506
No	416	48	11.5					
Bathing and Washing in Rivers/Streams								
Yes	143	28	19.6	9.796	1	0.002**	2.426	1.376 - 4.277
No	307	28	9.1					
Walking bare foot								
Always	4	0	0.0	1.296	2	0.523ns	-	-
Occasionally	429	55	12.8				2.941	0.387 – 22.354
Not at all	17	1	5.9				0.430	0.056 – 3.303
Trimming of finger nails								
Always	152	13	8.6	3.191	1	0.074ns	1.803	0.938 – 3.467
Occasionally	298	43	14.4					
Type of toilet used								
Pit Latrine	261	44	16.9	18.593	2	0.000**	18.959	4.535 – 9.260
Water Closet	175	8	4.6				0.299	0.136 – 0.657
Bush	13	4	30.8				3.752	1.128 – 12.488
Washing of hands before eating								
No	30	17	56.7	57.691	1	0.000**	0.010	0.004 – 0.023
Yes	420	39	9.3					
Washing of hands after using the toilet								
No	221	47	21.3	31.024	1	0.000**	6.603	3.149 – 13.844
Yes	229	9	3.9					
Use of soap in hand washing								
No	338	50	14.8	6.874	1	0.009**	2.488	1.032 – 6.002
Yes	112	6	5.4					

Key: * = Significant; ** = Highly significant; ns = Not significant; n= Number Examined

Table 4.8: Infection of Pupils with Protozoan Cysts and *S. mansoni* Eggs According to School

School	Number Examined	*E. histolytica* (%)	*E. coli* (%)	*B. coli* (%)	*S. mansoni* (%)
All Saints	75	3 (4.0)	3 (4.0)	1 (1.3)	0 (0.0)
Central Kumo	75	5 (6.7)	2 (2.7)	3 (4.0)	4 (5.3)
Standard Academy	75	2 (2.7)	1 (1.3)	0 (0.0)	0 (0.0)
Central Bogo	75	4 (5.3)	6 (8.0)	3 (4.0)	3 (4.0)
Asas	75	4 (5.3)	3 (4.0)	1 (1.3)	0 (0.0)
Central Kashere	75	5 (6.7)	4 (5.3)	4 (5.3)	0 (0.0)
Total	**450**	**23 (5.1)**	**19 (4.2)**	**12 (2.7)**	**7 (1.6)**
	χ^2	1.879	4.891	6.164	14.657
	Df	5	5	5	5
	P value	0.866ns	0.429ns	0.291ns	0.012*

Key: * = Significant; ** = Highly significant; ns = Not significant; n= Number Examined

no significant differences (P>0.05) in the prevalence of infection with the protozoan parasite cysts (*E. histolytica*, *E. coli* and *B. coli*), among the six schools but there was a significant difference (P<0.05) in the prevalence of *S. mansoni*infection among the schools.

4.9 Infection of Pupils with Protozoan Cysts and *S. mansoni* Eggs According to Age

Out of the 144 stool samples examined from pupils in age group 5-7 years, the highest prevalence (8.3%) was obtained for *E. histolytica* and the lowest (1.4 %) for *B. coli.* In age group 8-10 years, 154 stool samples were examined and *E. histolytica*had the highest prevalence of infection (5.2%) and *S. mansoni* the lowest (3.2 %). Out of the 152 stool samples examined in age group 11-13 years, the highest prevalence of infection among the parasites (2.0 %) was shown by *E. histolytica*, *E. coli* and *B. coli* while*Schistosoma mansoni*had a lower prevalence of 1.3 %. There was a significant difference in the prevalence of *E. histolytica*infection among the age groups (P<0.05), but there were no significant differences in the prevalence of infection with the *E. coli, B. coli* and *S. mansoni* within the various age groups (P>0.05) (Table 4.9).

4.10 Pupils with Mixed Infections According to School

Table 4.10 Shows mixed infections with *E. histolytica* and *E. coli*(0.44%)*; E. histolytica* and *B. coli* (0.22%); and *E. coli* and *B. coli* (0.22%). The total prevalence of mixed infections in the schools was low (0.22 %) and the differences in infection among the schools was not significant (P>0.05).

Table 4.9: Infection of Pupils with Protozoan Cysts and *S. mansoni* Eggs According to Age

Age group	Number Examined	*E. histolytica* (%)	*E. coli* (%)	*B. coli* (%)	*S. mansoni* (%)
5 - 7 years	144	12 (8.3)	9 (6.3)	2 (1.4)	0 (0.0)
8 - 10 years	154	8 (5.2)	7 (4.5)	7 (4.5)	5 (3.2)
11 - 13 years	152	3 (2.0)	3 (2.0)	3 (2.0)	2 (1.3)
Total	**450**	**23 (5.1)**	**19 (4.2)**	**12 (2.7)**	**7 (1.6)**
	χ^2	6.17	3.404	3.281	5.209
	Df	2	2	2	2
	P value	0.046*	0.182ns	0.194ns	0.074ns

Key:

* = Significant; ** = Highly significant; ns = Not significant; n= Number Examined

Table 4.10: Pupils with Mixed Infections According to School

School	Number Examined	*E. histolytica* and *E. co*li (%)	*E. histolytica* and *B. coli* (%)	*B. coli* and *E. coli* (%)
All Saints	75	0	0	0
Central Kumo	75	1 (1.33)	1 (1.33)	0
Standard Academy	75	0	0	0
Central Bogo	75	1 (1.33)	0	0
Asas	75	0	0	0
Central Kashere	75	0	0	1 (1.33)
Total	**450**	**2 (0.44)**	**1 (0.22)**	**1 (0.22)**

CHAPTER FIVE

5.0 DISCUSSION

The results of the present study established the occurrence of three species of intestinal protozoa, and *Schistosoma mansoni* infections among six primary school pupils in three districts of Akko Local Government Area, Gombe State. The prevalence of infection obtained (12.4%) was lower than what has been reported in studies conducted in other parts of North-Eastern Nigeria. In a similar studies conducted by Biu and Dauda (2008) and Biu *et al*. (2012) in Maiduguri, Borno State, prevalences of 72 % and 60 % of enteric protozoan and gastrointestinal heminthes ova respectively, were reported. The possible explanation for the discrepancy between the result of the present and those of previous such studies in Borno State might be due to the differences in sampling techniques, quality of drinking water, sample size, and variation in the environmental and climatic conditions of the different study localities. These observations, with which I concur, were made by Aina (2002).

*Schistosoma mansoni*eggs in this studyhad a lower prevalence (1.6 %) than the intestinal protozoan cysts (12.0 %).This might be due tothe fact that there are very few water contact activities in surrounding streams, which may harbour the snailintermediate host of *S. mansoni*. Okpala *et al*. (2004)obtained a higher prevalence of 3.33 % of *S. mansoni* in Plateau State, when they examined primary school pupils.

Among the cysts of protozoan parasites found in this study *E. histolytica*had the highest prevalence (5.1 %) which might be due to the fact that primary school children eat food and would drink water indiscriminately while in school, and which could be contaminated with the cyst. The prevalence of intestinal protozoa infestation observed

in the present study may be attributed to unhealthy environmental condition, lack of safe drinking water and defaecation in the open, which were all noted in the course of this study. Mohammed *et al*. (2015) noted that such infections were also common among primary school children in Boso Local Government Area, Niger State.

The lower prevalence in children aged 5-7 years may be due to greater parental care, preventing them from wandering far away from home. The higher prevalence in age group 8-10 years may be attributed to their exploratory nature, and their tendency to be daring and restless. The considerable decrease in the prevalence of intestinal protozoa and *S. mansoni* infections in age group 11-13 years observed may be attributed to the fact that as a child gets older, he/she is more conscious of his/her surroundings and may not always be involved in playing in dirty environments (Idris, 1988).

Furthermore, theresults of the present study revealed a higher prevalence among public school pupils compared to private school pupils. This disparity in prevalence was likely due to the fact that children in private schools are given more attention than those in public schools and because the school environment is cleaner. In addition, they are likely to have better toilet facilities than their counterparts in public schools. This finding agrees with those of Biu *et al*. (2012)and Alhassan *et al*. (2013) who remarked that public schools in northern Nigeria were known to have poor sanitary conditions with pupils defaecating around the school.

Although more male pupils than their female counterparts were infected, the prevalence of infection was not statistically significant probably because the pupils that were enrolled for this study had the same or similar socio-economic background. Both male and female children might have similar habits and would therefore be almost equally

exposed to infective stages. Ogunlowo (2006) also made a similar observation and deduction.

The prevalence of infectionby *S. mansoni* in different districts and individual schools was not uniform despite the similarity in the local topography and the climatic conditions. This outcome can be attributed to varying distances of the communities to the ponds and streams, which harbor the infected snail intermediate host.

Parents' occupation appeared to have a relationship with parasite prevalence. For instance, children of fishermen had the highest prevalence, whereas the children of civil servants had lowest prevalence. The difference between the prevalence of infection was statistically significant. This finding agrees with that of Akogun (1989) who noted that people of low socio–economic status have the tendency to have parasitic infections. Which is also in contrast with the finding of Habbari *et al*. (1999) who noted that prevalence of intestinal parasites is not always influenced by profession of the parents but the behaviour of their children. It is also possible that the pupils would drink water or eat contaminated food both at home and in school inpresence or absence of their parents.

The data obtained in this study confirmed that hand-washing before eating and after going to the toilet significantly reduced the risk infection, in all the districts of acquiring surveyed. This agrees with the findings of Curtis(1978) and Obadiah *et al.*(2011), who reported that the hands of pupils were contaminated with dirt, especially with faecal matter. Such hands can potentially be a vehicle in the transmission of parasitic infections. The contamination of hands by parasite cysts/eggs reflects the poor hygiene habits of the pupils, which is often associated with indiscriminate disposal of human

faeces and poor animal husbandry, most especially in the environs. These observations were made by Aina (2002) and Michael *et al*. (2012).

Source of drinking water, and water contact activities such as swimming, fishing, bathing and washing in rivers/stream, trimming of finger nails and washing of hands without soap were also found to be significantly associated with infection by intestinal protozoa and *S. mansoni*. This is an indication that children who lived near water bodies had a higher prevalence of infestation with *S. mansoni* than those who lived further away. Tadesse and Mulat (2014) in Ethiopia and Okpala *et al*. (2004) in Jos also made a similar observation that swimming and fishing were significant risk factors of *Schistosoma mansoni* infection.

Mixed infections involving *E. histolytica* and *E. coli*; *E. histolytica* and *B. coli*; *Balantidium coli* and *E. coli*, that were obtained in this study have also been reported by Adebote *et al*. (2002); Mengistu *et al*. (2007); Alhassan *et al*. (2013) and Wosu and Onyeabor (2014) who remarked that such infections were common.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

i. Intestinal protozoa and *Schistosoma mansoni* infections occur among pupils of some primary schools in Akko Local Government Area, Gombe State, Nigeria (12.4%). Hence, the first hypothesis,which says that there are no intestinal protozoa and *Schistosoma mansoni* infections among pupils ofthe six primary schools in Akko Local Government Area, Gombe State is rejected.

ii. Infections by intestinal protozoa and *S. mansoni* occur in all the age groups, the highest prevalence being in pupils that are 8-10 years old, while pupils of 11-13 years have the lowest prevalence. Also, infections are higher among the male pupils than their female counterparts. This finding is contrary to the second hypothesis; therefore, the null hypothesis that the prevalence of intestinal protozoa and *S. mansoni* infections are not influenced by age and gender is rejected.

iii. Risk factors in the study area identified include: The use of stream water for domestic purposes, hand washing without soap, walking barefoot, and indiscriminate defaecation. There is a significant association between the prevalence of infection and some risk factors, therefore, the third hypothesis,which says that there is no significant association between the prevalence of intestinal protozoan and *S. mansoni* infections and the risk factors among the primary school pupils is partially rejected.

iv. The Prevalence of mixed infections are as follows: *E. histolytica* and *E. coli* (0.44 %); *E. histolytica* and *B. coli* (0.22%); *E. coli* and *B. coli* (0.22 %). Hence, the fourth hypothesis which says that there are no significant incidences of the mixed infections among pupils of the six primary schools in Akko Local Government Area, GombeState, is accepted.

6.2 Recommendations

Based on the results of the study, the following recommendations are hereby made:

i. Further studies should be conducted in the area and other local government areas of the state to unravel the prevalence of other intestinal parasites and their risk factors

ii. Public enlightenment on the need for good personal hygiene practices, especially washing of hands after defaecating,and before and after eating.

iii. Pupils should be discouraged from defaecating in open fields/bush, instead, well-kept pit-latrines should be constructed for them. This is because Pupils defaecating in the bush had the highest prevalence of infection in the study area, compared to those whoused toilets.

iv. Pupils should be discouraged from bathing and swimming in rivers and streams.

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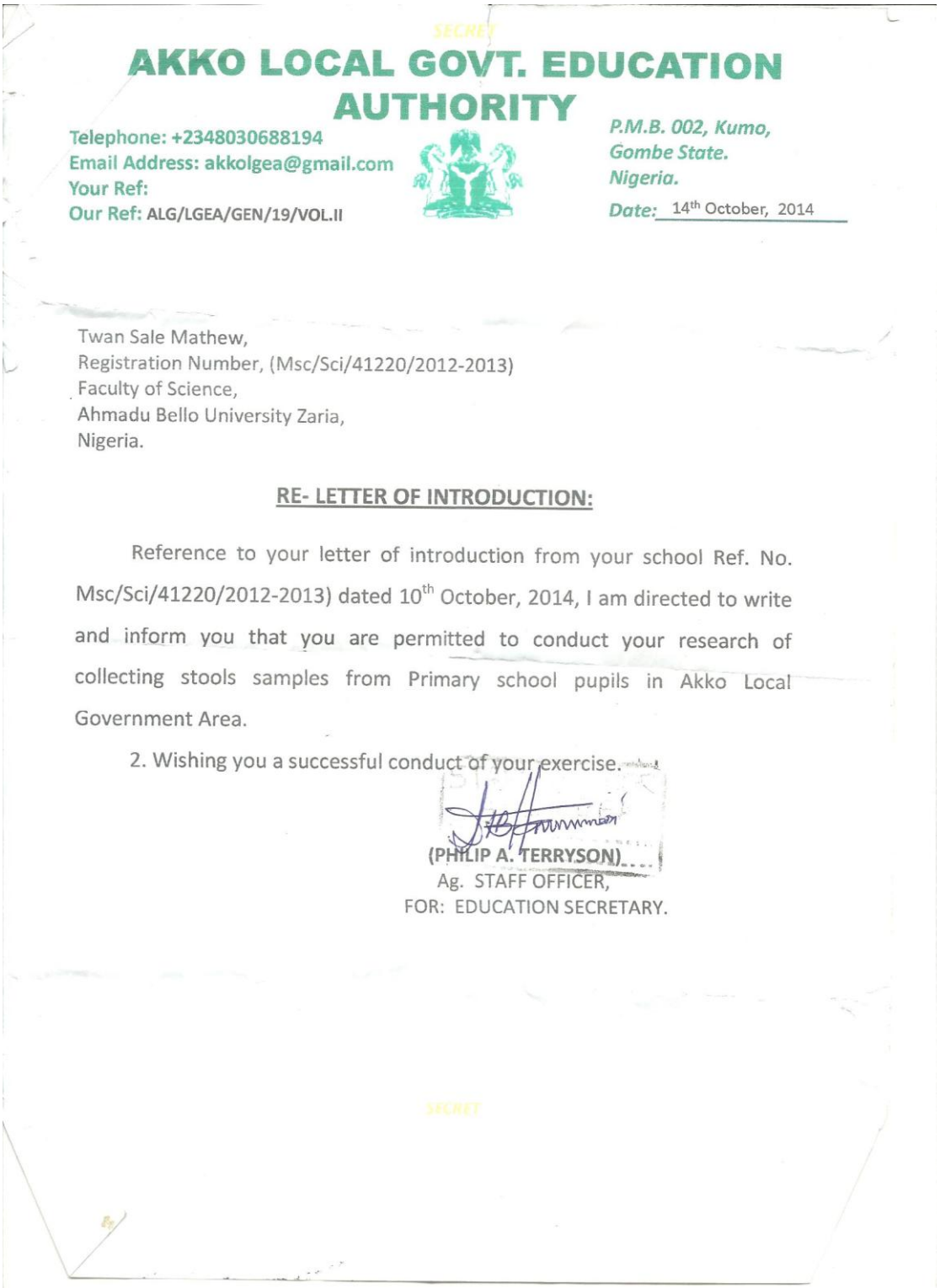
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Appendix I: Ethical Clearance and Permission to Carry out the Study



SECRET

AKKO LOCAL GOVT. EDUCATION AUTHORITY

Telephone: +2348030688194
Email Address: akkolgea@gmail.com
Your Ref:
Our Ref: ALG/LGEA/GEN/19/VOL.II

P.M.B. 002, Kumo,
Gombe State.
Nigeria.
Date: 14th October, 2014

Twan Sale Mathew,
Registration Number, (Msc/Sci/41220/2012-2013)
Faculty of Science,
Ahmadu Bello University Zaria,
Nigeria.

RE- LETTER OF INTRODUCTION:

Reference to your letter of introduction from your school Ref. No. Msc/Sci/41220/2012-2013) dated 10th October, 2014, I am directed to write and inform you that you are permitted to conduct your research of collecting stools samples from Primary school pupils in Akko Local Government Area.

2. Wishing you a successful conduct of your exercise.

(PHILIP A. TERRYSON)
Ag. STAFF OFFICER,
FOR: EDUCATION SECRETARY.

SECRET

APPENDIX II: QUESTIONNAIRE

QUESTIONNAIRE ON THE PREVALENCE OF PROTOZOAN AND *SCHISTOSOMA MANSONI*

Dear Pupil,

I am an M.Sc student of Ahmadu Bello University, Zaria. This is a Postgraduate research thesis on the topic: Prevalence of Intestinal Protozoa and *Schistosoma mansoni* infections among some Primary School pupils in Akko, Gombe State, Nigeria. Kindly fill the Questionnaire as honest as you can. Every information you give will be treated with confidentiality and used for the purpose of this research work only.

Thank you for your cooperation.

TWAN, Sale Mathew.

Code----------

Section A: Socio-Demographic Data

1. Date of Birth:
2. Sex: Male [ ] Female [ ]
3. Parents/Guardian Occupation: (a) Farming [ ], (b) Fishing [ ], (c) Trading [ ] (d) Civil-servant [ ], (e) others:----------
4. Type of school (a) Private [ ] (b) Public [ ]
5. Location of school----------/District----------
6. Location of Home----------/District----------

Section B: Factors associated with intestinal parasite and *S. mansoni*

1. Source of water (a) Stream [ ] (b) Well [ ] (c) Bore-hole [ ]
2. Do you Swim? (a) Yes [ ] (b) No [ ]
3. Do you fish? (a) Yes [ ] (b) No [ ]
4. Do you bath or Wash in Rivers/ streams? (a) Yes [ ] (b) No [ ]
5. Do you walk with bare foot? (a) Always [ ](b) Occasionally [ ]
6. Do you trim your finger nails? (a) Always [ ] (b) Occasionally [ ]
7. Type of toilet. (a) Pit latrine [ ] (b) Water closet [ ] (c) Bush [ ]
8. Do you wash your hands after using the toilet? (a) Yes [ ] (b) No [ ]
9. Do you wash your hands after using the toilet? (a) Yes [ ] (b) No [ ]
10. Use of Soap in hand washing. (a) Yes [ ] (b) No [ ]