PREVALENCE OF GASTROINTESTINAL PARASITES AMONG PRIMARY SCHOOL CHILDREN IN BOSSO LOCAL GOVERNMENT AREA, NIGER STATE, NIGERIA

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BY

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MAY, 2015

DECLARATION

I hereby declare that the work in this thesis titled "PREVALENCE OF GASTROINTESTINAL PARASITES AMONG PRIMARY SCHOOL CHILDREN IN BOSSO LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA" was carried out by me in the Department of Biological Sciences. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this work has been presented for another degree at any institution. I take exclusive responsibility for all errors and oversights in this project.

Danladi Passi AUDU _____ _____

Signature Date

CERTIFICATION

This thesis titled "PREVALENCE OF GASTROINTESTINAL PARASITES AMONG PRIMARY SCHOOL CHILDREN IN BOSSO LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA" by Danladi Passi AUDU meets the regulations governing the award of the degree of Master of science degree in Educational Biology of Ahmadu Bello University and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This project work is dedicated to the loving memory of my beloved mother, Late Nma Aisha Abdullahi (Gbmada abe) who could not live to reap the fruits of her efforts. May Almighty God (Allah) grant her an eternal resting abode in Jannatul Fildausi (Amen)

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ABSTRACT

This study was conducted between November, 2013 and March, 2014 to investigate the prevalence of gastrointestinal parasites among primary school children in Bosso Local Government Area of Niger State, Nigeria. Six hundred pupils from 10 Primary Schools in 10 political wards were enrolled for the investigation. A structured questionnaire was administered to obtain information on the risk factors. The formol ether concentration technique was used in the analysis of the stool samples. An overall prevalence of 45.2% was recorded. A total of 13 species of intestinal parasites were recorded in this study. This includes Hookworm, *Entamoeba histolytica*, *Ascaris lumbricoides*, *Strongyloides stercoralis*, *Schistosoma mansoni*, *Entamoeba coli*, *Enterobius vermicularis*, *Hymenolepis nana* and *Trichuris trichiura* with respective prevalence rates of 32.5%, 30.3%, 11.7%, 4.7%, 4.1%, 3.5%, 3.15%, and 1.9%. *Isospora belli*, *Giardia lamblia*, *Taenia* species and *Paragonimus* species were each recorded in 5 pupils (1.6%). The highest prevalence of 51.7% was recorded in Bosso central 2 ward, followed by Kodo primary school 50.0% while the least prevalence of 38% was recorded in Chanchaga primary school. There was no statistically significant difference between the prevalence rates in the ten schools. There were 44(16.2%) and 2(0.7%) cases of double and triple infections. The 5-7 years age group had the highest prevalence of (52.5%), followed by the 8-10 years age group (40.5%), and then the 11-13 years age group (38.0%). Sex-specific prevalence was higher in males (49.7%) than females (40.7%). There was statistically significant difference between the prevalence in males and females. Odds ratio of 1.44 showed association between the sex and the infection. Odds ratio greater than 1 showed significant associations between prevalence of the infection and risk factors such as use of stream water, (odds ratio1.51), pit latrine and bush, (odds ratio1.196 and 1.126 respectively). Lack

of de-worming of children, (odds ratio 1.15) and history of blood in stool, (odds ratio 1.76) showed association with the infection. The study showed that poor sanitary conditions, inadequate potable water supply, lack of personal hygiene education and lack of de-worming of children enhanced the spread of intestinal parasitic infection. The results suggest the need for mass public health education on personal hygiene practices in the communities, large scale de-worming campaigns in all primary schools in the area to be extended to the host communities. Children should be taught regular personal hands washing because they easily get contaminated in daily life and the pathogens are easily transferred to other surfaces.

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ABBREVIATIONS

NTD	-	Neglected tropical diseases,
IPIs	-	Intestinal parasitic infections,
e.g	-	for example,
sp.	-	species,
i.e	-	that is,
%	-	percentage,
et al	-	and others,
≤	-	less or equal to
>	-	Greater than
<	-	Less than
ns	-	Not significant
*	-	Significant
**	-	Highly significant
Df	-	degree of freedom,
CI	-	Confidence interval
N A	-	Not applicable.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of Study

Intestinal parasitic infections (IPIs) are widely distributed throughout the world. Mortality and morbidity rates of these infections are significant in developing countries. Infections are mainly transmitted via ingestion of water, soil or food contaminated by faeces containing the cysts of protozoans or eggs/larvae of helminths (Saki *et al*., 2012). Intestinal parasitic infection is one of the neglected tropical diseases (NTD) that thrive where there is poverty. Those mostly affected are the poorest populations, living in remote, rural areas, in urban slums or in conflict zones. Soil-transmitted helminth infections especially hookworm infection which causes childhood and maternal anaemia, results in the greatest disability, and the highest burden of neglected tropical diseases (Hotez *et al*., 2009).

These infections cause iron-deficiency anaemia, growth retardation in children, intestinal obstruction and some other physical and mental health problems (Evans and Stephenson, 1995). The helminths *Trichuris trichiura*, *Ascaris lumbricoides* and the hookworms as well as the protozoa such as *Entamoeba histolytica* cause infection in 800, 1,400, 1,200 and 48 million people worldwide (Houmsou *et al*., 2010).

Intestinal parasitic infections persist where inadequate sanitation, insufficient health care facilities and overcrowding exist. Ascariasis is a mirror of socioeconomic status, a reflection of environmental sanitary practices and an indicator of the awareness on health education. In the poor urban habitations, environmental factors promote the survival and transmission of intestinal parasites and alleviate the impact of these infections on the people (Crompton and Savioli, 1993).

In sub-Saharan Africa, intestinal helminth infections are common and of major health concerns because factors such as poverty, poor sanitation and malnutrition that predispose man to the infections prevails (Montressor *et al.*, 1998; Ijabone and Olangunju, 2006). In addition, the habit of playing on sand results in very widespread exposure to soil-transmitted parasites. Eating habits that involve the consumption of raw vegetables, fruits, crustaceans and meat increase the transmission of helminth infections (Montressor *et al.*, 2002).

People in the underdeveloped nations experience a cycle where malnutrition and infections lead to excess morbidity that can continue from generation to generation (Saki *et al*., 2012). The consumption of raw or lightly cooked vegetables, recycling of wastewater and sludge as a favourite strategy for the economical management of waste water and sludge, leads to contamination. Harvesting, handling, transport and storage also serve as some factors in the transmission of intestinal parasites (Absar *et al.*, 2010). The use of organic manure also causes greater risk for contamination of foods with eggs and oocysts of intestinal parasites during farm operations and dissemination during food processing operations.

In developing countries, intestinal parasitic infections are more debilitating to children and pregnant women. It reduces child survival rate by causing severe anaemia during pregnancy, which leads to low birth weight and increased infant and maternal mortality. In Africa, anaemia caused by hookworm infection can exacerbate the clinical course of Falciparum malaria especially in children and women (Hotez *et al*., 2009). Luka *et al.* (2000) observed that the higher prevalence of schistosomiasis and other helminth parasites in age group 10-12 years might be due to the fact that pupils in the age group spend more time in water either washing, fishing or playing. They

are often in contact with the soil and are fond of eating indiscriminately with unwashed hands. The disease burden associated with worm infection is enormous; school age children harbour heavy intestinal parasites and are most susceptible study group.

In the developing countries, the spread and increasing prevalence of parasitic infections may be attributed to favourable climatic factors for the development of the infective stages of common parasites. Population migration often caused by tribal, civil and religious crisis leads to refugee camps and asylums that are often marked with low and poor sanitary conditions, poor/inadequate living and environmental sanitation, poor vector control and lack of resources for chemotherapeutic intervention that could reduce the worm burden and reduce transmission potentials (Barnabas *et al.*, 2011).

It has also been observed that intestinal parasites can be acquired by eating food sold by food vendors. Food vendors are noted for selling food and drinks at moderate prices, thereby providing affordable balanced meals outside the home. However, some food vendors often operate near choked polluted environment with little or no access to clean water and often in close proximity to heaps of garbage that serve as a favourable environment for intestinal parasites transmission (Ayeh – kumi *et al.*, 2009; Suriptiatuti and Widiastuti , 2011; Omalu *et al.*, 2013). Invariably, street food forms most of the diets of pupils during school hours in both rural and urban areas.
Attempts to measure the morbidity of individual intestinal parasitic infections must be a continuous programme in different regions and among different societies in order to launch out proper control programmes.

Bosso Local Government Area of Niger State in Nigeria to the best of my knowledge still lack current baseline information on intestinal parasitic infections in primary school pupils.

Therefore there is need for continuous evaluation of prevalence of intestinal parasitic infections among school children.

1.2 Statement of Research Problem

Intestinal parasites are among the major contributors to the global disease burden but the non-acute nature of the infections has contributed to the perception of intestinal parasitic infections as being common but usually unimportant to the public health community (Absar *et al*., 2010). Inadequate sanitation and unhygienic living conditions lead to faecal contamination of the environment, lack of proper health education, insufficient and contaminated water supplies contribute to more infection by intestinal parasites in many localities (Cheesbrough, 2005). The consumption of street foods from food vendors and roadside hawkers of foods contaminated with eggs of intestinal parasites contribute to the transmission of infection. In Niger State, there is paucity of information on the distribution and transmission of intestinal parasitic infection in many Local Government Areas including Bosso.

1.3 Justification

Intestinal parasitic infections may remain asymptomatic and consequently carriers may act as on-going sources of infection within their community (Saki *et al*., 2012). School-age children are more susceptible to intestinal parasitic infections, because if the infections occur during a period of intense physical growth and rapid metabolism, it may result in increased nutritional needs which if not adequately met, growth may be impaired. During a period of intense learning, when children are infected, their

learning capabilities may significantly diminish, thereby leading to compromise in their learning abilities in formative years. In a setting of continuous exposure to contaminated soil and water, children generally lack awareness of the need for good personal hygiene and enjoy playing with soil and water which may be contaminated.

The distribution and prevalence of various species of intestinal parasites differ from region to region. Although several studies have been conducted on the distribution and prevalence of intestinal parasites in Nigeria, there are still several localities/communities for which epidemiological information has not been established (Obiukwu et al., 2008) This study was conducted in order to enrich baseline data on the occurrence of the gastro-intestinal parasites in school children in Bosso Local Government Area, Niger State.

1.4 Aim

To determine the prevalence of different species of gastrointestinal parasites among primary school children in Bosso Local Government Area of Niger State, Nigeria.

1.5 Objectives

1. To determine the prevalence of intestinal parasitic infections in pupils of selected schools in Bosso Local Government Area
2. To determine the age and sex-specific prevalence of intestinal parasitic infection in school children in Bosso Local Government Area.
3. To determine the significant association of some risk factors with the prevalence of intestinal parasitic infections in school children in Bosso Local Government Area.

1.6 Hypotheses

1. Intestinal parasitic infection is not prevalent in primary school children in Bosso Local Government Area.
2. The prevalence of intestinal parasitic infection is not associated with age and sex.
3. The risk factors analysed in this study are not associated with the prevalence of intestinal parasitic infection.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Parasite

A parasite is an organism that is entirely dependent on another organism, referred to as its host for all or part of its life cycle and metabolic requirements (Jordan and Verma, 2010, Arora and Arora, 2011). Gerald and Larry (2010) considered a parasite as an organism that resides on or within another living organism. i.e the host, in order to find the environment and nutrients required for its own growth and development. The term parasite can be applied to any infectious agent but, this includes protozoa and helminths excluding the viruses, bacteria and fungi (Arora and Arora, 2011). Parasites can be classified according to sizes into 2 types: micro parasite e.g. Protozoans and macro parasites e.g. Helminths.

Ectoparasites are parasites which live on the surface of the body e.g. the human louse (*pediculus humanu*). The infection by these parasites is known as infestation. Some ectoparasites serve as vectors transmitting pathogenic microorganisms.

Endoparasites are parasites that live within the body of the host. All protozoan and helminth parasites of man are endoparasites. The invasion by endoparasites is known as infection (Kathleen and Arthur, 2002, Arora and Arora, 2011); a condition in which pathogenic microorganisms penetrate the host defense, enter the tissues and multiply. When the cumulative effects of the infection damage or disrupt tissues and organs, disease result. A disease is defined as any deviation from health.

2.2 Types of Intestinal Parasites

Intestinal parasites can be classified into two, the protozoans and helminths. The protozoa intestinal parasites can be grouped into Amoebae, Sarcodina, Flagellates, Ciliates and Sporozoa (Arora and Arora, 2011).

Amoebae include *Entamoeba histolytica/dispar, E.hartmani, E.coli, Iodamoeba butschii and Endolima nana.* Flagellates of intestinal, oral and genital flagellates are *Giardia lamblia, Trichomonas vaginalis, T. tenax homini, and Dientamoeba fragilis*. Sporozoan consists of *Cryptosporidium parvum* and *Isospora belli* while *Balantidium coli* is the only ciliate that infects man.

The major intestinal helminths of humans can be grouped into intestinal nematodes, trematodes and cestodes (Kathleen and Arthur, 2002). Intestinal nematodes include *Trichuris trichiura* (whip worm), *Ascaris lumbricoides, Enterobius vermicularis* (pin worm), *Necator americanus* and *Ancylostoma duodenale* (hookworm) *Strongyloides stercoralis* (thread worm), *Trichinella spiralis* (trachina worm). Trematodes include *Schistosoma mansoni, S. haematobium* and *S. Japonicum.* Cestodes include *Taenia Saginata* (Beef tapeworm), *T. solium* (Pork tapeworm), *Diphyllobotrium latum* (fish tapeworm) and *Hymenolepis nana* (Dwarfworm).

2.3 Transmission of Intestinal Parasitic Infections

A parasite enters the human host through a proper route so that it can reach an appropriate site where it can continue its life cycle. Three (3) main routes of transmission through which the parasite enters the human body are explained by (Ochei and Kolhatkar, 2007).

2.3.1 Faecal-oral route

The commonest method of transmission of parasites is by ingestion of food or water contaminated with faeces containing the infective stage of the parasite as is the case in nematodes such as *Trichuris trichiura* and *Enterobius vermicularis*; and protozoans such as *Entamoeba histolytica* and *Giardia lamblia.* Ingestion of improperly cooked meat, fish or vegetables can expose an individual to the infective stage of the parasite (Ochei and Kolhatkar, 2007).

The larvae undergo encystment and lie in the muscles or tissues of the intermediate host. If not killed during cooking, they continue their life cycle when ingested by man e.g. *Taenia saginata* in beef, *Taenia solium* in pork and *Trichinella spiralis* in pork. Ingestion of the intermediate host harbouring the parasite e.g. infection can be transmitted by drinking water containing Cyclops, an intermediate host for *Dracunculus medinensis* (Ochei and Kolhatkar, 2007).

2.3.2 Penetration through the skin

The infective larvae of various parasites can enter the human body by penetration through the skin, reach the blood stream and then migrate to the site where they can mature and reproduce. The free swimming cercariae of schistosomes in water enter through the skin of a person coming in contact with that body of water. Infective (e.g. filariform) larvae of *Strongyloides* or hookworm can enter through the skin if in contact with soil polluted by faeces containing these larvae (Cheesbrough, 2005, Ochei and Kolhatkar, 2007).

2.3.3. By sexual contact

Parasites such as *Trichomonas vaginalis* can be transmitted from one person to another by sexual contact. Others are transmitted by oral- anal sex.

2.4 Geographic Distribution of Intestinal Parasites

The prevalence and profile of intestinal parasitic infections vary widely among continents and within countries or sub-regions. There are about 50 species of helminthes that parasitize humans (Valdenir *et al*., 2011). They are distributed in all areas of the world. Some worms are restricted to a given geographic region and many have a higher incidence in tropical areas. This knowledge must be tempered with the realization that jet-age travel, along with human migration are gradually changing the patterns of worm infections, especially of those species that do not require alternate hosts or special climatic conditions for development (Kathleen and Arthur, 2002). The yearly estimate of worldwide cases numbers in billions and these are not confined to developing countries. A conservative estimate places 50,000,000 helminth infections in North America. The primary targets are malnourished children (Kathleen and Arthur, 2002).

Entamoeba histoytica ranks third among parasites that cause death worldwide, being second to malaria as a protozoan parasite that causes death. It affects approximately 50 million people each year, causing an estimated 40- 100 thousand deaths annually (Olubunmi, 2013). It is commonly found in epidemic form in tropical and subtropical regions than in the temperate region. The more epidemic condition of this parasite is reported from Mexico, China, India, Philippines, South America and Thailand. Other areas with high prevalence in Asia include Bangladesh, Iraq, the republic of Korea and Vietnam (Jordan and Verma, 2010).

Giardia lamblia has high prevalence in the tropics and subtropics, where sanitation is poor. Travellers to Tropical Africa, Mexico, Russia, Southeast Asia and South Western America are at a high risk of acquiring giardiasis. *Giardia* infects about 200

million people worldwide and may produce symptoms in 500,000 individuals every year (Arora and Arora, 2011). *Balantidium coli* is worldwide in distribution because pigs are the animal reservoirs, human infections occur more frequently in areas where pigs are raised. Rodents and non-human primates may act as potential animal reservoirs.

Ascaris lumbricoides has worldwide distribution being specially prevalent in the tropics, such as India, China, Southeast Asia and Africa Arora and Arora (2011), South Eastern States of United States (Kathleen and Arthur, 2002). It is estimated that 1.47 billion people worldwide are infected by this parasite (Chiodini *et al.*, 2005). The highest prevalence is in malnourished people residing in developing countries, areas with modern water and waste treatment have a low incidence of the infection with this parasite. *Ancylostoma duodenale* ("old world" hookworm) is found in Europe, Africa, China, Japan, India and the pacific Islands. *Necator Americanus* ("new world" hookworm) is found in the Americas and the Caribbean and has recently been reported in Africa, Asia and the pacific (Kathleen and Arthur, 2002, Jordan and Verma, 2010). It is reported that about 25% of the world population are infected by the hookworm.

Diphyllobothrium Latum is found in Europe, Russia, Japan, Tropical Africa, North and South America but yet to be reported in India (Arora and Arora, 2011). Of the tapeworms that infect man, *Taenia saginata* has a worldwide distribution in countries where cattle are raised and beef is eaten. *Taenia solium* occurs Mainly in Southern Africa, China, India, Central America, Chile, Brazil, Papua New Guinea and Asia where human faeces reach the pigs and pork is eaten raw or undercooked. . *Taenia solium* is not as widely distributed as *T. saginata*. It is estimated that as many as 100

million people are infected with *T. Saginata* and *T. Solium* (Arora and Arora, 2011). *Hymenolepis nana* is the most common cause of cestode infection and is encountered worldwide. In temperate areas its incidence is higher in children. *Trichuris trichiura* is cosmopolitan in distribution but more common in the warm, moist regions of the world. It is also seen in India (Arora and Arora, 2011). About 1.3 billion are infected worldwide (Chiodini *et al*., 2005).

Enterobius vermicularis has a cosmopolitan distribution it is more common in temperate and cold climates than in warm climates because of less frequent bathing and infrequent changing of underclothing (Arora and Arora, 2011). It is the most prevalent nematode in the United State. Humans are the only known hosts and about 209 million people are infected worldwide. *Strongyloides stercoralis* is worldwide in distribution however it is more common in tropics and subtropics including those of Africa, South America and Asia including India. It has been estimated that there are 80-100 million cases of *Strongyloides* worldwide (Arora and Arora, 2011).

The geographical distribution of *Schistosoma* species shows that *Schistosoma haematobium* is distributed in 51 Eastern Mediterranean and African countries, India and Turkey. *S. mansoni* is distributed in 36 countries in Africa, 9 in America and 7 in the East Mediterranean. *S. japonicum* is distributed in China, Indonesia, Philippines and Thailand (Arora and Arora, 2011). *Schistosoma mansoni* is endemic in 52 countries. It is widespread in many African countries, Madagascar and parts of the Middle East, South America e.g. Brazil and West Indies. *Schistosoma mansoni* occurs with *S. haematobium* in 41 countries of Africa and eastern Mediterranean. Water development projects for water conservation, irrigation and hydroelectric power have contributed to the spread in mainland China, parts of Philippines and Western

Indonesia. *S. mekongi* is found in Lao people's Democratic Republic, Cambodia and Thailand in the Mekong River Basin. Prevalence rates are estimated at 15-50% with children up to 15 years being more commonly infected. *Schistosoma intercalatum* has a high prevalence rate but is limited in its distribution mainly to West Central Africa, i.e. Zaire, Gabon and Cameroon but has also been reported from Republic of Sao Tome.

2.5 Prevalence Studies of Intestinal Parasites in Different Parts of the World

Different researchers have reported prevalence of different intestinal parasites in different parts of the world varying from other continents to Africa.

In Pakistan, Shaikh *et al*. (2009), carried out a research on 3000 stool samples received from all age groups and both sexes on the prevalence of intestinal protozoan and helminth parasites and recorded *Giardia lamblia* in 36.19% in the study population, *Entamoeba histolytica* in 18.57%, *Hymenolepis nana* in 16.19%, *Ascaris lumbricoides* in 14.19%, *Trichuris trichiura* in 1.81% and *Taenia Saginata* in 1.05%.

A 10-year retrospective study on the prevalence of intestinal parasitic infections among food handlers in Khuzestan, Southwest of Iran, Saki *et al.* (2012) observed that 8.8% and 25.4% were infected with pathogenic and non-pathogenic parasite or eggs respectively. This demonstrates continuous protozoan and helminths contamination in different areas.

A simple random sample of children aged 1-5 years in an urban slum of Karachi, Pakistan in an attempt to study the prevalence of intestinal parasitic infection, Mehraj *et al*. (2008) recorded an overall prevalence of 52.8% with *Giardia lamblia* having the highest prevalence of (28.9%) followed by *Ascaris lumbricoides* (16.5%), *Blastocystis*

hominis (10.1%), *Iodoamoeba butschlii* (3.2%), *Entamoeba coli* (2.3%), *Endolimax nana*, (1.8%) and *Hymenolepis nana* (0.9%).

In Indonesia, Suriptiastuti and Widiastuti (2011) recorded a total prevalence of 83.9% in the finger nails of food vendors with *Ascaris lumbricoides* having 26.8%, *Giardia lamblia* having 17.89% and 36.2% mixed infections.

In Africa, investigations carried out by different researchers yielded the following results: Coulibaly *et al*. (2012) carried out a research on intestinal parasitic infection in school children in three different settings of Cote d` Ivore and reported prevalence of *Schistosoma mansoni* of 16%, 33% and 78% in the three selected areas. In more vigorous diagnostic approach, the respective prevalence increased to 33%, 53% and 92%. *Schistosoma haematobium* prevalent was 0.8%, 4%, and 65%. Prevalence and intensity of *Schistosoma* sp., soil-transmitted helminths and intestinal protozoan infections showed setting-specific patterns. Infection with two or more species concurrently were most common in the rural setting (84%), followed by the peri-urban (28%) and urban settings (18%).

A retrospective study was carried out by Mazigo *et al*. (2011) to determine the prevalence of intestinal parasitic infections among patients attending Bugando Medical Centre in Mwanza, North-western Tanzania, from January, 2008 to March, 2010, intestinal parasitic infections were recorded in 57.1% of the stool samples examined. Helminth eggs were observed in 36.6% of the samples with hookworm eggs recorded in 25.2% and *S.mansoni* in 5.6% of the samples. Protozoan parasites were recovered in 20.5% of the samples in which 13.6% had *Entamoeba histolytica* 6.9% *Giardia lamblia. Trichuris trichiura, Ascaris lumbricoides* and *Schistosoma mansoni* were detected in single infection in 16.4%, 5.8% and 1.5% of the infected

study subjects respectively. Polyparasitism was found in 56.7% of the total examined. Up to 5 parasites were detected in some individuals. *Trichuris trichiura, A*scaris *lumbricoides,* hookmorm and *Schistosoma mansoni* constituted 13.5%, 4.3% and 2.2% of the double infections, respectively. *Hymenolepis nana* and *Schistosoma mansoni* predominantly affected males. *Giardia* trophozoites and *H nana* were significantly higher in pre-school children than other age groups while higher proportion of teenagers were infected by *A. lumbricoides* and *S. mansoni,* Taeniasis was also dominant in teenagers.

A study to determine the prevalence of intestinal parasites associated with food vendors in Accra to assess the risk of consumers of street food recorded an overall prevalence of 21.6%. Helminth infection was 15.2% and protozoan infection 6.4% (Ayeh-kumi *et al*., 2009). Seven different parasites were identified-*Ascaris lumbricoides* (5.0%), *Strongyloides stercoralis* (4.4%), *Enterobius vermicularis* (4.1%), *Cryptosporidium parvum* (2.5%), *Giardia lamblia* (2.0%), *Ancylostoma duodenale* (2.0%), *Entamoeba histolytica/dispar* (2.0%).

Peter (2011) examined stool samples of individuals ranging from 11 months to 82 years residing in Porto Novo Municipality of Cape Verde, South Africa. The study was conducted between March and June in order to find out the distribution of intestinal parasitic infections. There were (36.06%) people infected with one or more intestinal parasites. Protozoan parasites encountered were *Entamoeba* coli (22.51%), *Entamoeba histolytica/dispar* (7.67%) and *Giardia lamblia* (5.90%) which were the most isolated intestinal parasites encountered. *Hymenolepis nana* (2.30%), *Ancylostoma duodenale* (1.28%) and *Trichuris trichiura* (0.51%) were isolated.

2.6 Prevalence of Intestinal Parasitic Infections in Nigeria

In Nigeria, various surveys have been carried out on the prevalence of intestinal parasite infections. Awolaju and Morenikeji (2008) in their investigation to determine the infection rate of intestinal parasites among 312 primary and post primary school children in five communities in Ilesa West Local Government Area, Osun States, Nigeria from January to July, 2005, recorded an overall prevalence of 48.8%. Out of which 39.10% were positive for *A. lumbricoides* and 9.29% were positive for *E. histolytica.*

Barnabas *et al*. (2011) conducted a research on the prevalence of *Schistosoma* and other intestinal helminth parasites among school children in Bida, Niger State, Nigeria and recorded a prevalence of 40.9%. *Ascaris lumbricoides* had a prevalence of 31.9%, *Schistosoma haematobium* 28.0% and hookworm 13.1%.

Damen *et al*. (2011) investigated the prevalence of intestinal parasitism among the Almajiris in Konduga Local Government Area, Borno State and recorded a prevalence of 80.9%. *Ascaris lumbricoides* had the highest prevalence of 19.1% while *Trichuris trichiura* had the least prevalence of 3.5%. Houmsou *et al*. (2010) in their investigation of primary school children in Makurdi, Benue State, Nigeria, reported 58.5% prevalence for various intestinal parasites with hookworm species accounting for 34.2%. *Ascaris lumbricoides* 16.1%, *Trichuris trichiura* 15.9%, *Enterobius vermicularis* 6.2%, *Strongyloides stercoralis* 1.7%, *Taenia* sp 3.9%, *Hymenolepis nana* 1.8%, *Schistosoma mansoni* 0.6%, *Entamoeba histolytica* 2.2%, *Entamoeba coli* 1.5% and *Giardia lamblia* 1.3%. Adefioye *et al*. (2011) studied the intestinal helminth infections among school children in Ilie, Osun State South West Nigeria and recorded an overall prevalence rate of 52%. Five species of intestinal helminthes were identified. *Ascaris lumbricoides* with a prevalence of 36.2% was the most common

followed by hookworm 10.5%, *Schistosoma mansoni* 4%, *Strongyloides stercoralis* 0.7% and *Hymenolepis nana* 0.7%.

In a study conducted by Ahmed *et al*. (2003) on intestinal parasites in relation to growth and academic performance of students in Katsina State, Nigeria, an overall prevalence of 30.8% was recorded. Hookworm had a prevalence of 13.5%, *Hymenolepis nana* 1.8%; *Schistosoma mansoni*, 1.4%; *Ascaris lumbricoides*, 0.8%; *Trichuris trichiura*, 0.3%; *Enterobius vermicularis*, 0.3%; *Entamoeba coli*, 10.7% and *Isospora* sp, 0.1%.

Adebote *et al*. (2004) carried out studies on helminth infections in 80 pre-school children in three villages in Zaria, Nigeria and recorded a prevalence of 67.5%. The specific parasite prevalence for *Ascaris lumbricoides* was 55%, *Strongyloides stercoralis* was 25%, hookworm was 15%, *Schistosoma haematobium* was 10%, u*Enterobius vermicularis* was 2.5% and *Schistosoma mansoni* was 1.25%.

Adabara *et al*. (2011) investigated the prevalence of intestinal helminthes among primary school children of Bosso town Niger State, North Central Nigeria and recorded the prevalence of 46% in which *Ascaris lumbricoides* was 16.6% *Strongyloides stercoralis* was 14.4%, hookworm 0.09%, *Trichuris trichiura* 0.06%. Egbuobi *et al*. (2013) investigated intestinal parasitic infection among pupils in Umuezeaga autonomous community, Akokwo in Ideato North Local Government Area, Imo State Nigeria. They reported a prevalence of 64.1% for intestinal parasites,66.0% were positive for hookworm, 60.0% for *Ascaris lumbricoides*, 28.5% for *E. histolytica*, 18.5% for *G.lamblia*, 13.2% for *T.trichiura* and 1.5% for *Strongyloides* stercoralis, 53% of the samples recorded mixed infections. From the

fore-going, it could be inferred that intestinal parasitic infection is a worldwide problem particularly in developing countries.

2.7 Pathogenicity of Intestinal Parasites

Many species of intestinal parasites are known to cause a number of health problems in man which may have immediate and long-term effects on their hosts. These are divided into protozoans and helminthes infections. Protozoan intestinal parasites cause dysentery and diarrhoea.

Entamoeba histolytica causes amoebic dysentery, abscesses in liver, lungs and brain and non-dysentric infection. In amoebic dysentery, *Entamoeba histolytica* secrets a tissue dissolving enzyme that destroys the epithelial lining of the colon and causes its necrosis and forms the abscesses which later become flask shaped bleeding ulcers. The cavity of these ulcers is generally filled with mucous, bacteria, amoeba and cell debris. The abscesses pour their contents into the lumen of the intestine. The ulcers vary greatly in number and size in severe cases almost the entire colon is undermined. The ulceration of colon may produce severe dysentery.

In amoebic dysentery, the stools are acidic and contain pure blood and mucous, in which swarms of amoeba and blood corpuscles are usually present. The patient feels discomforted due to the rectal straining and intense gripping pains with the passage of blood and mucous stools every few minutes (Jordan and Verma, 2010).

Sometimes *Entamoeba histolytica* may be drawn into the portal circulation and carried to the liver. In liver the parasites settle, attack liver tissue and form abscesses. The patient has pain in liver region, fever and high leucocyte number, a condition referred to as mass amoebic hepatitis. Lung abscesses are fairly frequent; these are usually caused by direct extension from a liver abscess through the diaphragm. The

lung abscesses usually rapture into a bronchial tube and discharge brown mucoid materials which is coughed out with the sputum. Sometimes the parasites also forms abscesses in the brain (Jordan and Verma, 2010).

In non-dysentric infections, amoebiasis is usually thought of as the cause of dysentery with blood and mucous-containing stools or of liver abscesses, these conditions are actually the exception rather than rule and some workers have reported that as many as 90% of dysentery cases in temperate climates are apparently symptomless. Even in the tropics dysentry is exceptional. Although about 10% of the general population is infected with *Entamoeba histolytica*, most of them are carriers or passers. The symptoms commonly associated with chronic amoebiasis are abdominal pain, nausea and bowel irregularity, with headaches, fatigability and nervousness in minority of cases (Jordan and Verma, 2010).

Giardiasis is also known as traveller's diarrhoea. Its infection ranges from being asymptomatic to acute diarrhoea. The pathogenesis of the disease is dose-dependent, clinical symptoms are more common in young children than adult. Acute infection is accompanied by clinical signs such as nausea, loss of appetite and an upper gastro-intestinal discomfort, such as bloating, flatulence, cramps, anoxia, and frothy, greasy foul-smelling diarrhoea or constipation. Chronic infection rarely developed, but patients have prolonged and severe infections (Olubunmi, 2013).

Isospora belli is the causative organism of human coccidiosis or isosporiosis or traveller's diarrhoea. The clinical symptoms are transient gastro-enteritis. Diarrhoea of varying severity accompanied with crampy abdominal pain (abdominal colic) has been documented. High eosinophilia is also recorded. It is a self-limiting disease in healthy individuals, lasting about 2 weeks. However, it is severe, long lasting and life

threatening in AIDs patients. Protracted non-bloody diarrhoea, fever, headache and malaria are characterized by malabsorption, weight loss and anorexia. Death may occur (Olubunmi, 2013).

Intestinal helminthes are known to cause short and long-term parasitic infections in human. The diseases include ascariasis, trichuriasis, enterobiasis, strongyloidiasis ancylostomiasis and necatoriasis. Others include cestodes and trematodes disease, taeniasis, hymenolepiasis, schistosomiasis and *Diphyllobotrium latum* infection.

Ascariasis is caused by *Ascaris lumbricoides*. Adult Ascaris as many as 500 to 5000 may be present in a single host and they may cause abdominal discomforts and colic pains accompanied with diarrhoea, vomiting and a slight rise in temperature (Jordan and Verma, 2010).

They may block the intestine and appendix. The wandering habit of the parasites in the gut may cause them to enter the bile or pancreatic ducts and interfere with digestion, or they may injure the intestine and cause peritonitis. At times they wander into the nose. They produce toxins which irritate the mucous membrane of the gut, or prevent digestion of proteins by the host by destroying trypsin, or they may cause general nervousness, delirium or convulsions (Cheesbrough, 2005, Jordan and Verma, 2010).

In children where infection is more common, they dull the mental capacity and stunt growth. Their juveniles cause inflammation and haemorrhage in the lungs which results in pneumonia which may prove fatal (Kathleen and Arthur, 2002, Jordan and Verma, 2010).

The hookworms are the most dangerous parasitic nematodes because they hold onto the intestinal villi and suck blood and body fluids of the host by their muscular

pharynx, they also cut holes in the intestinal mucosa and leave bleeding wounds. It causes severe anaemia in children where incidence of infection is very great they retard the physical and mental growth. Some toxins secreted by the glands in the head regions of worms cause stomach-ache, food fermentation, diarrhoea, constipation, dyspnea, palpitation of heart, eosinophilia, ill health and the patient may finally collapse.

During penetration of larvae in the skin, local irritation is caused resulting into inflammation of the surrounding tissues these may result into tiny sores. The migratory larvae in lungs may cause haemorrhage and bronchial pneumonites. The disease caused by the two hookworms *Ancylostoma duodenale* and *Necator americanus* is called ancylostomiasis (Jordan and Verma, 2010) and necatoriasis (Olubunmi, 2013) respectively.

Strongyloidiasis is an infection caused by the nematode *Strongyloides stercoralis.* Local inflammatory reactions of the intestinal mucosa may occur. Autoinfection may result in the distribution of larvae throughout the body affecting various organs. Massive invasion of the lungs by migrating worms may result in dyspnea, cough, broncho-pneumonia, hemoptysis (Kathleen and Arthur, 2002, Olubunmi, 2013).

Eosinophilia, invasion of the peri-anal skin by filariform larvae undertaking cutaneous larval migration during autoinfection causes rashes and pruritic lesions that extend from the anal area to the thighs and sometimes the abdomen.

The larvae are known as larva currens or racing larva as they undergo rapid movements (Olubunmi, 2013). The clinical symptoms of the disease are anaemia, constipation, cough, diarrhoea, nausea osmophilic pneumonitis. Secondary bacterial infections are generally associated with strongyloidiasis as migrating worms carry adhering bacteria from the intestinal lumen and the soil, local infection or sepses are

associated with larval migration. The impact of the filariform larvae depends on the organs impacted by the parasite during migration. Intestinal manifestation of strongyloidiasis entails diarrhoea, constipation, weight loss and pruritus in acute cases, chronic infection is associated with malabsorption and paralytic ileums (Jordan and Verma, 2010, Olubunmi, 2013).

Enteriobiasis caused by *Enterobius vermicularis*, causes uncontrollable itching sensation. Scratching may lead to anal lesion and perineal pruritus, which may be secondarily infected. The extra–intestinal invasions by the parasite have been recorded by haemotogenous spread to different organs such as the liver, spleen and lungs. Ectopic invasion resulting in ectopic enterobiosis occurs in women via the vagina aberrant infection. Erratic adult worms penetrating the gut wall produce extra intestinal lesions. Complications are generally associated with extra intestinal infections in pretoneum, kidney, liver and lungs. Heavy infections cause insomnia, nightmares, weight loss, convulsion, mucosal ulceration, submucosal abscesses, mild eosinophilic and lymphocytic infiltration and granuloma are associated with extra intestinal lesions (Kathleen and Arthur, 2002, Olubunmi 2013).

Trichuriasis is caused by *Trichuris trichiura* commonly known as whipworm. It is associated with mechanical damage to the intestinal mucosa and allergic reactions by the host. Mucosal inflammation of the gut epithelium, eosinophilic infiltration and minor blood loss may occur. Pathogenesis of trichuriasis is influenced by certain factors such as worm burden, minor infection, heavy infection, length of infection, age and overall health status of the host. Rectal prolapse, rectal bleeding leading to anaemia and abdominal cramps may be caused by *Trichuris* infection. Prolonged massive infection may lead to iron-deficiency, and anaemia due to blood loss in the

colon. Clinical manifestations of trichuriasis include diarrhoea, iron-deficiency anaemia and weight loss (Kathleen and Arthur, 2002, Jordan and Verma, 2010, Olubunmi, 2013).

Taeniasis is a disease caused by species of tapeworm belonging to the genus Taenia, which include mainly *Taenia solium* (pork tapeworm) and *Taenia saginata* (Beef tapeworm). Man acquires the infection by eating raw or under-cooked pork or beef that contains the cysticerci. The cysticerci develop into adult tapeworms in the intestine of man. Taeniasis is characterized by abdominal discomforts like pain, indigestion, vomiting, and constipation, loss of appetite, diarrhoea and nervous disorder like nervousness, insomnia, nausea and epileptic fits. Its infection may cause eosinophilia up to 13 percent and obstruction in the passage of alimentary canal (Kathleen and Arthur, 2002, Jordan and Verma, 2010). Taeniasis is comparatively less dangerous than cysticercosis caused by the infection of bladder worm or cysticerci larvae. Sometimes, it has been observed that if somehow man ingests onchospheres with contaminated food and drink or due to antiperistaltic movements of the intestine, bladder worm will enter through the intestinal circulation in different parts of the body. After reaching the vital organs like liver, eyes and brain, the cysticerci get encysted and cause serious, even fatal diseases. Encystment in eyes may cause blindness and in brain it causes epilepsy (Cheesbrough, 2005, Jordan and Verma, 2010).

Hymenolepiasis is caused by *Hymenolepis nana* or dwarf tapeworm. It has no symptoms even with a heavy worm burden. Clinical symptoms may include diarrhoea, irritability and restlessness. In children, nervous complications may include

vertigo and epileptic convulsion (seizures) serious complications are known to occur in immuno-compromised patients (Olubunmi, 2013).

Schistosomiasis is also known as “snail fever”. In sub-saharan Africa, the pathogenic effects of schistosome infection on the definitive hosts depend on several factors such as the species and strain of the worm, the worm burden, the geographic region and the human demographic factors especially the age and nutritional status of the individual. As rapid re-infection occurs in many endemic areas, previous exposure to infection affects the degree of pathologic manifestation. Clinical symptoms of schistosomiasis include fever, diarrhoea, abdominal pain, weight loss, eosinophilia, hepatomegaly and haematuria in the case of urinary schistosomiasis (Jordan and Verma, 2010).

In children, it causes anaemia, stunting and reduced ability to learn. The incubation period of schistosomiasis corresponds with parasite penetration and maturation. It is characterized by dermatitis of the skin and infiltrative changes of the lung during parasite migration.

The production, passage and release of schistosome eggs produce serious clinical and pathologic effects. Fever, abdominal pain, liver tenderness, urticaria and general malaise are experienced with schistosomiasis. Anaemia is common and mucous occur in stool of patients, with *S. mansoni* and *S. japonicum*, Haematuria at the end of micturation and possibly dysuria are commonly associated with *S. haematobium*.

Schistosome eggs deposited, trapped and embedded in tissues can cause serious lesions, leading to granuloma and fibrotic formations, cellular infiltration of lymphocytes, eosinophils, macrophages and fibroblast lead to mechanical obstruction, the degree of fibrosis is variable and cumulative over many years except in heavy infections. Mechanical obstruction of blood vessels may lead to portal hypertension

causing collateral circulation. In liver, the eggs also cause massive fibrosis, which is referred to as symmer's pipe stem fibrosis, leading to hepatomegaly.

Hepato-splenomegaly and hepatomegaly caused by congestion and increased size of the spleen and liver respectively result from lesions and blockage of the portal circulation (Kathleen and Arthur, 2002, Cheesbrough, 2005, Olubunmi, 2013).

Hepatosplenic involvement accumulated over years vertigo of moderate schistosomiasis infection is the commonest cause of morbidity in schistosomiasis. Instances of eggs of *S. Japonicum* were been observed in the brain and spinal cord, causing epilepsy. Seizures are common in the Philippines and pulmonary involvement via the heart to the lungs (Olubunmi, 2013).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

The study was conducted in Bosso Local Government Area of Niger State between November, 2013 and March, 2014.

Bosso Local Government Area lies on latitude 09°27′30″N to 09°47′30″N and longitude 06°15′0″E to 06°40′0″E. It has a land mass of 1 606.1 square kilometers (1 606.1 Sq Km), with a total human population of 147, 359 people (NPC, 2006). The area consists of two districts, Bosso and Maikunkele. There are 10 political wards in the area; Beji, Bosso central I, Bosso central 2, Chanchaga, Garatu, Kampala, Kodo, Maikunkele, Maitumbi and Shatta. It is located in the Niger east senatorial zone of Niger State.

The climate of Bosso Local Government Area is a true reflection of the climate of the middle belt rainfall starts from April and lasts till October. It has a mean annual temperature of 30.20°C and rainfall of 1, 334mm (Omalu et al., 2013).

There are many streams that serve as major sources of water supply to the populace in both rainy and dry season in the rural areas. In addition, there are boreholes sunk at various locations to compliment water supply especially during dry seasons. Those living in the cities depend on epileptic pipe-borne, solar boreholes and wells as their domestic water supplies. The inhabitants of the area are predominantly farmers, herdsmen, business and civil servants. Since farming forms the major occupation of the populace, they depend on the streams for their source of drinking water supply and for dry season farming by irrigation.

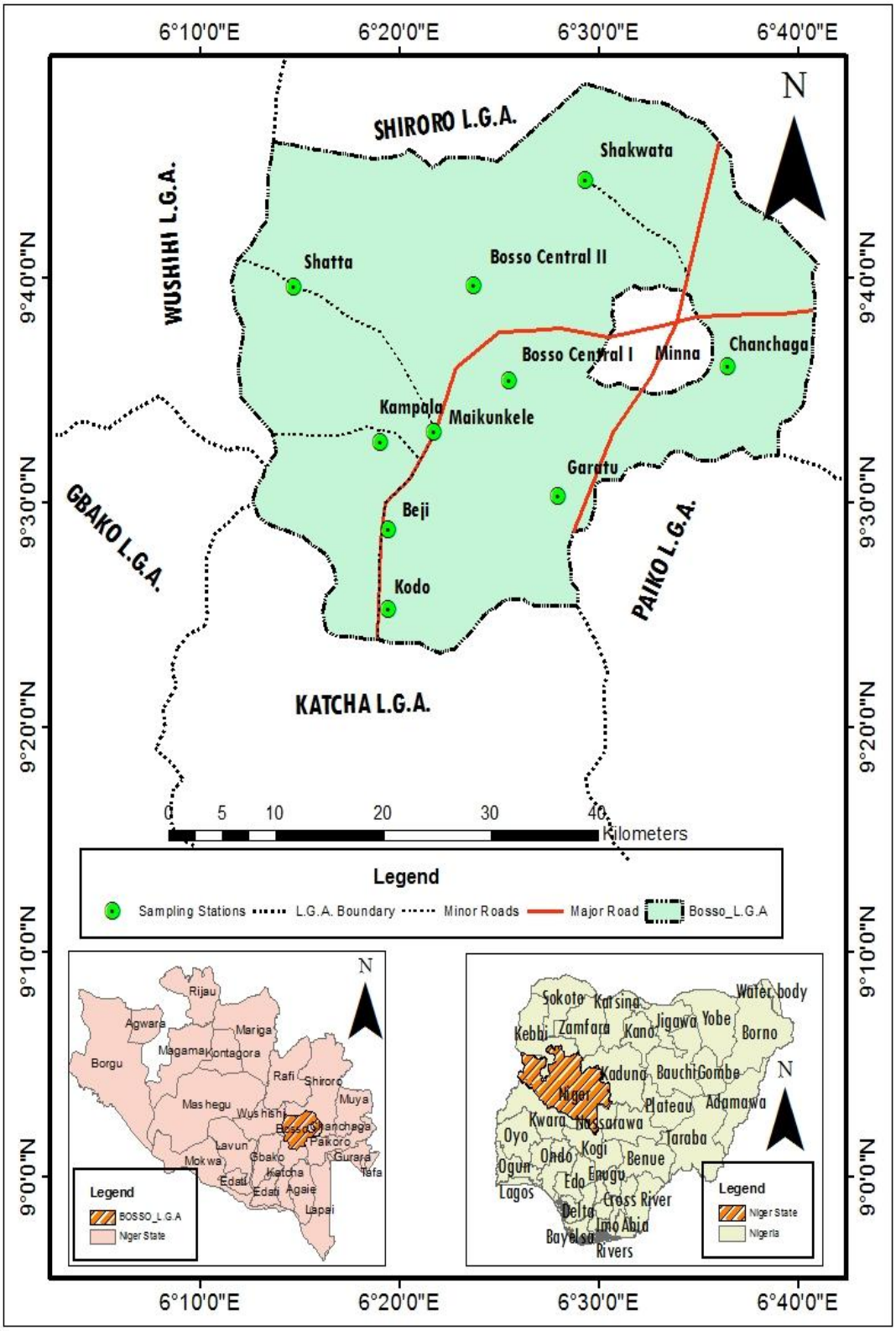


Figure 1: Map of Bosso Local Government Area.
Source: Modified From Administrative Map of Niger State

3.2 Study Population

The study population comprised of 600 primary school pupils. 60 pupils were selected at random from 10 primary schools in 10 wards. The enrolled pupils were within the ages of 5-13 years. A simple ballot system was used for the selection of the schools and the pupils.

3.3 Sample Size

A total sample size of pupils was estimated using the standard formula of

Sarmukaddam and Garad (2006), $\boldsymbol{N = \frac{Z^2 pq}{D^2}}$

To calculate the sample size using the equation above,

Where; N=sample size,

Z= standard normal distribution at 95% confidence interval=1.96,

p= prevalence rate of 52% recorded by Adefioye *et al* (2011). q=1-p = (1-0.52) =0.48, D= the allowable error, which is taken as 5% =0.05

$$\text{Substituting the values in the formula; } N = \frac{1.96^2 \times 0.52 \times 0.48}{0.0025}$$

$$= \frac{0.95886336}{0.0025} = 383.55 \quad N = 384$$

This was the minimum sample size that was to be taken.

3.4 Sample Collection

The faecal samples were collected from 600 pupils, 60 pupils from each selected primary school. Prior to collection of samples, written consent of the Local Government Education Secretary, Headmasters, School-based Management Committee, Parents and the Pupils were obtained after being briefed on the importance of the study.

The samples were collected from Beji, Bosso central I, Bosso central 2, Chanchaga, Garatu, Kampala, Kodo, Maikunkele, Shakwata and Shatta Primary Schools. The faecal samples collected were preserved in 10% formalin and transported to the Helminthology Laboratory in the Department of Veterinary Parasitology and

Entomology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria for analysis.

3.4 Administration of Questionnaires

A structured questionnaire was administered to obtain information on demographic data and risk factors of acquiring gastrointestinal parasites. Information such as name of school, sex, age, parents' occupation, source of drinking water, water contact activities, type of latrine, administration of de-worming tablets, and history of blood in the stool were obtained.

3.5 Sample Analyses

The samples were analyzed for the cysts, eggs and larvae of parasites using Formol-ether concentration techniques as described by Cheesbrough (2005). About 1g of faeces was placed into 4ml of 10% formalin solution with a rod or applicator stick in a screw cap bottle or tube. Another 3-4ml of 10% formalin solution was added the bottle was capped and mixed well by shaking or use of glass rod to mix the contents. The emulsified faeces were sieved using cotton gauze and the suspension collected into a beaker or centrifuge tubes. About 3-4ml of diethyl ether was added to the suspension in the centrifuge tube, capped with glass stopper and was shaken for 1minute. With a tissue or piece of cloth wrapped around the top of the tube, the stopper was loosen (considerable pressure might be built up inside the tube) it was centrifuged immediately at 3000 revolution per minute. A stick or the stem of a plastic bulb pipette was used to loosen the layer of faecal debris from the side of the tube and the tube inverted to discard the ether, faecal debris and 10% formalin solution leaving behind only the sediment. The tube was returned to its upright position and allowed the fluid from the side of the tube to drain to the bottom.

The bottom of the tube was tapped to re-suspend and mix the sediment. A few drops of the sediment were transferred to a slide using a pipette and covered with a cover slip. The preparation was examined microscopically using ×10 objective with the condenser iris closed sufficiently to give good contrast. The ×40 objective was used to examine cysts. Lugol's iodine solution was added under the cover slip to assist in the identification of cysts. The eggs and larvae were photomicrographed using digital camera on a Heerburg Olympus Microscope (Model No. M40 -1- 02438).

Identification of the parasites was done using the morphology of the cysts, eggs and larvae using Atlas of Medical Helminthology and Protozoology (Chiodini *et al*., 2005), Medical Parasitology (Arora and Arora, 2011). The Technical staff of the laboratory of Veterinary Parasitology and Helminthology, Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine Ahmadu Bello University Zaria assisted in the identification of the parasites.

3.6 Data Analysis

The data was analysed using the Statistical Package for Social Sciences (SPSS) Version 21.0. The prevalence of different intestinal parasites were calculated and expressed in percentages. Odds ratio (OR) was used to determine the association between the risk factors and prevalence of infection. When Odds ratio (OR) is less than one (< 1), it means that there is no association between the risk factors and the prevalence of the infection. But when Odds ratio (OR) is greater than one (> 1), it means that there is association between the risk factors and the prevalence of the infection. If the lower limit of 95% confidence interval (CI) is (< 1) then the association is not significant but if the lower limit of 95% confidence interval (CI) is (> 1) then the association is significant.

CHAPTER FOUR

4.0 RESULTS

4.1 Prevalence of gastrointestinal parasites per primary schools

A total of 600 pupils were examined, out of which 271 pupils representing 45.2% of the study population were found to be infected with gastrointestinal parasites in Bosso Local Government Area of Niger State, Nigeria (Table 4.1).

Prevalence studies per school showed that Bosso Central 2 primary school had the highest prevalence of 31(51.7%), followed by Kodo 30(50.0%), Bosso central 1 and Shakwata 29(48.3%) each, Maikunkele 28(46.7%), Beji 27(45.0%), Garatu and Kampala 25(41.7%), Shatta 24(40.0%) and Chanchaga had the least prevalence with 23(38.3%). These differences among the Schools were however not significant ($P< 0.05$).

4.2 Species-Specific Prevalence

Thirteen species of parasites were identified during the study (Appendix II), Hookworm was recorded in 103 pupils representing 32.5% of the study population, followed by *Entamoeba histolytica* 96(30.3%), *Ascaris lumbricoides* 37(11.7%), *Strongyloides stercoralis* 15(4.7%), *Schistosoma mansoni* 13(4.1%), *Entamoeba coli* 11(3.5%), *Enterobius vermicularis* 10(3.2%), *Hymenolepis nana*, and *Trichuris trichiura*, 6(1.9%) each and *Isospora belli*, *Giardia lamblia*, *Taenia* sp. and *Paragonimus* sp. each recorded 5(1.6%) respectively (Table 4.2).

Table.4.1: Prevalence of Intestinal Parasites in Ten primary Schools in Bosso Local Government Area, Niger State

School	Number Examined per School	Positive (%)	Chi-square	Df	P value
Beji	60	27 (45.0)	4.502	9	0.875n.s
Bosso Central 1	60	29 (48.3)			
Bosso Central 2	60	31 (51.7)			
Chanchaga	60	23 (38.3)			
Garatu	60	25 (41.7)			
Kampala	60	25 (41.7)			
Kodo	60	30 (50.0)			
Maikunkele	60	28 (46.7)			
Shakwata	60	29 (48.3)			
Shatta	60	24 (40.0)			
Total	**600**	**271 (45.2)**			

n.s = not significant

Table 4.2: Species-specific prevalence of gastrointestinal parasites in primary school children in Bosso Local Government Area, Niger State

Schools (n=60)	Number Positive (%)													Total
	Hookworm	***Strongyloides stercoralis***	***Isospora belli***	***Entamoeba histolytica***	***Entamoeba coli***	***Schistosoma mansoni***	***Ascaris lumbricoides***	***Giardia lamblia***	***Hymenolepis nana***	***Enterobius vermicularis***	***Trichuris trichiura***	***Taenia sp.***	***Paragoni-mus sp.***	
Beji	9 (2.84)	2 (0.63)	0 (0.0)	9 (2.84)	0 (0.0)	0 (0.0)	3 (0.95)	1 (0.32)	1 (0.32)	4 (1.26)	3 (0.95)	0 (0.0)	0 (0.0)	32 (10.09)
Bosso Central 1	5 (1.58)	3 (0.95)	0 (0.0)	13 (4.10)	2 (0.63)	6 (1.89)	4 (1.26)	0 (0.0)	1 (0.32)	1 (0.32)	0 (0.0)	0 (0.0)	0 (0.0)	35 (11.04)
Bosso Central 2	14 (4.42)	4 (1.26)	0 (0.0)	9 (2.84)	2 (0.63)	4 (1.26)	2 (0.63)	2 (0.63)	2 (0.63)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	39 (12.30)
Chanchaga	10 (3.16)	1 (0.32)	0 (0.0)	4 (1.26)	2 (0.63)	2 (0.63)	4 (1.26)	2 (0.63)	1 (0.32)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	26 (8.20)
Garatu	9 (2.84)	0 (0.0)	0 (0.0)	8 (2.52)	0 (0.0)	0 (0.0)	4 (1.26)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.32)	0 (0.0)	5 (1.58)	27 (8.52)
Kampala	8 (2.52)	0 (0.0)	0 (0.0)	14 (4.42)	1 (0.32)	0 (0.0)	2 (0.63)	0 (0.0)	0 (0.0)	2 (0.63)	1 (0.32)	1 (0.32)	0 (0.0)	29 (9.15)
Kodo	13 (4.10)	0 (0.0)	0 (0.0)	12 (3.79)	3 (0.95)	0 (0.0)	5 (1.58)	0 (0.0)	0 (0.0)	1 (0.32)	1 (0.32)	0 (0.0)	0 (0.0)	35 (11.04)
Maikunkele	10 (3.16)	2 (0.63)	3 (0.95)	11 (3.47)	0 (0.0)	0 (0.0)	2 (0.63)	0 (0.0)	1 (0.32)	1 (0.32)	0 (0.0)	4 (1.26)	0 (0.0)	34 (10.73)
Shakwata	15 (4.73)	2 (0.63)	2 (0.63)	7 (2.21)	1 (0.32)	1 (0.32)	7 (2.20)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	35 (11.04)
Shatta	10 (3.16)	1 (0.32)	0 (0.0)	9 (2.84)	0 (0.0)	0 (0.0)	4 (1.26)	0 (0.0)	0 (0.0)	1 (0.32)	0 (0.0)	0 (0.0)	0 (0.0)	25 (7.89)
Total 600	**103 (32.5)**	**15 (4.73)**	5 (1.58)	**96 (30.28)**	**11 (3.47)**	**13 (4.10)**	**37 (11.67)**	5 (1.58)	**6 (1.89)**	**10 (3.15)**	**6 (1.89)**	**5 (1.58)**	5 (1.58)	**317 (100.0)**
Chisquare 3600	**9.388**	**11.282**	**21.176**	**9.97**	**10.094**	**31.529**	**6.366**	**13.109**	**7.407**	**14.237**	**14.108**	**29.244**	**45.378**	
Df	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	
P value	**0.402n.s**	**0.257n.s**	**0.012***	**0.353n.s**	**0.343n.s**	**0.000****	**0.703n.s**	**0.158n.s**	**0.595n.s**	**0.114n.s**	**0.119n.s**	**0.001****	**0.000****	

ANOVA	**P value**			
Parasites	0.000**	*	-	significant (P≤0.05)
Schools	0.000**	**	-	highly significant (P≤0.01)
Parasites x Schools	NA	n.s	-	non-significant

Hookworm, *Entamoeba histolytica*, and *Ascaris lumbricoides* were the common infections in all the sampled schools in the area. However hookworm infection was highest in Shakwata primary school 15(4.73%) followed by Bosso Central 2 primary school 14(4.42%) and lowest in Bosso Central 1 primary school with 5(1.58%). *Entamoeba histolytica* was highest in Kampala primary school 14(4.42%), followed by Bosso Central 1 primary school 13(4.10%) and lowest in Chanchaga primary school with 4(1.26%). *Strongyloides stercoralis* was highest in Bosso Central 2 primary school 4(1.26%) followed by Bosso Central 1 primary school 3(0.95%) and lowest in Shatta primary school with 1(0.32%) but absent in Garatu, Kampala and Kodo primary schools.

Isospora belli was recorded only in 2 primary schools, Maikunkele 3(0.95%) and Shakwata 2(0.63). *Entamoeba coli* was recorded in mixed infections in Kodo primary school 3(0.95%), Bosso Central 1, Bosso Central 2 and Chanchaga primary schools 2(0.63), Kampala and Shakwata primary schools 1(0.32) but absent in Beji, Garatu, Maikunkele and Shatta primary schools.

Ascaris lumbricoides was recorded in all schools but highest in Shakwata primary school 7(2.20%) followed by Kodo primary school 5(1.58%) and lowest in Bosso Central 2, Kampala and Maikunkele primary schools with 2(0.63%) each. *Giardia lamblia* was recorded in 3 primary schools Bosso Central 2 and Chanchaga 2(0.63%) each and Beji primary schools 1(0.32%).

Schistosoma mansoni was recorded in 4 primary schools which included Bosso Central 1 primary school 6(1.89%), Bosso Central 2 primary school 4(1.26%), Chanchaga primary school 2(0.63%) and Shakwata primary school 1(0.32%). *Hymenolepis nana* was recorded in 5 primary schools, Bosso Central 2 primary school 2(0.63%), Beji,

Bosso Central 1, Chanchaga and Maikunkele primary schools 1(0.32%) each. *Enterobius vermicularis* was recorded in Beji 4(1.26%), Kampala 2(0.63%), Bosso Central 1, Kodo, Maikunkele and Shatta primary schools with 1(0.32%) each but absent in Bosso Central 2, Chanchaga, Garatu and Shakwata primary schools. *Trichuris trichiura* was recorded in Beji primary school 3(0.95%), Garatu, Kampala, and Kodo primary schools 1(0.32%) but absent in Bosso Central 1 and 2, Chanchaga, Maikunkele, Shakwata and Shatta primary schools. *Taenia* sp. was only recorded in Maikunkele 4(1.26%) and Kampala primary schools 1(0.32 *Paragonimus* sp. was recorded only in Garatu primary school 5(1.58%), (Table 4.2).

Some parasites were recorded in single infection while some were recorded in double and triple infections. There were 44(16.26%) and 2(0.74%) multiple cases of double and triple infections, (Table 4.3).

4.3 Prevalence of Intestinal Parasites in Relation to Age of Pupils

Age-specific prevalence of parasites showed that class 1 and 2 pupils who are in the 5-7 age group had the highest prevalence of 105(52.5%), Class 3 and 4 (age group 8-10 years) had 90 pupils infected out of 200 with 45.0% prevalence and 5 and 6 (age group 11-13 years) had the least with 76 pupils infected out of 200 and prevalence rate of 38.0%. There was statistically significant association between prevalence of infection and age groups. P= 0.014**.** Odds ratio value of 1.56 for 5-7years showed associations between the age group and the infection (Table 4.4). Regression of age on prevalence showed that prevalence of infection reduced with increase in age (r = -0.9998).

Table 4.3: Single, Double and Triple Intestinal Parasitic Infections in Primary Schools in Bosso Local Government Area of Niger State.

Single infection	Number infected	Percentage
Ascaris lumbricoides	28	10.33%
Entamoeba histolytica	66	24.35%
Enterobius vermicularis	8	2.95%
Giardia lamblia	3	1.11%
Hookworm	81	29.89%
Hymenolepis nana	4	1.48%
Isospora belli	5	1.85%
Paragonimus sp.	4	1.48%
Schistosoma mansoni	9	3.32%
Strongyloides stercoralis	9	3.32%
Taenia sp.	2	0.74%
Trichuris trichiura	6	2.21%
Total	225	83.03%
Double infections		
Ascaris lumbricoides/ Entamoeba histolytica	3	1.11%
*A. lumbricoides/*Hookworm	4	1.48%
A. lumbricoides/Entamoeba coli	1	0.37%
A.lumbricoides/Schistosoma mansoni	1	0.37%
E. histolytica/E. coli	8	2.95%
E. histolytica/ Hookworm	11	4.06%
E.histolytica/Enterobius vermicularis	1	0.37%
E.histolytica/ Giardia lamblia	1	0.37%
E.histolytica/Strongyloides stercoralis	3	1.11%
E. histolytica/Taenia sp.	1	0.37%
*E.coli/*Hookworm	2	0.74%
Hookworm/*Paragonimus* sp.	1	0.37%
Hookworm/S.*mansoni*	3	1.11%
Hookworm/S.*stercoralis*	2	0.74%
Hookworm/*Taenia* sp.	2	0.74%
Total	44	16.26%
Triple infections		
E.histolytica/G.lamblia/H. nana	1	0.37%
E.histolytica/E.vermicularis/S.stercoralis	1	0.37%
Total	2	0.74%

Table 4.4: Age-specific prevalence of intestinal Parasites among primary school children in Bosso Local Government Area, Niger State

Class(Age)	No. Examined	Status		Odds ratio	C.I.
		Positive (%)	Negative (%)		
One/Two(5-7 years)	200	105(52.5)	95 (47.5)	1.558	1.107 – 2.192*
Three/Four(8-10years)	200	90 (45.0)	110 (55.0)	0.990	0.704 – 1.392
Five/Six(11-13years)	200	76 (38.0)	124 (62.0)	0.644	0.456 – 0.911
Total	**600**	**271 (45.2)**	**329 (54.8)**		

* Statistically significant

4.4 Prevalence of Intestinal Parasites in Relation to Sex

The prevalence of the parasites in the 600 pupils was higher in males compared to the females. From a total of 300 male and 300 female pupils enrolled for the screening, 149(49.7%) males and 122(40.7%) females were positive for one parasite or the other. There was statistically significant association between the sexes and prevalence rate. Odd ratio of 1.4 shows an association between sex and the infection (Table 4.5).

4.5 Responses of Pupils to Questionnaires

The responses of the pupils to the questionnaire and the results of statistical analysis, showed some associations between the various epidemiological variables and the infection (Table 4.6).

Prevalence of intestinal parasitic infections according to water source showed that the prevalence was higher in the pupils who used streams as their source of drinking water and least in those that used either borehole or pipe-borne water as source of drinking water.

Out of a total of 70 pupils who indicated that, they use streams, 38(54.3%) tested positive for intestinal parasites, 80 respondents that use well water had 42(52.5%) positive cases. Out of 339 respondents that use borehole, 114(42.5%) positive cases were recorded and from 111 respondents for pipe-borne water 47(42.3%) had positive cases. The results did not show significant difference ($P<0.05$). An odds ratio of 1.514 obtained for respondents that use Streams showed association between the water source and the disease.

Prevalence of intestinal parasitic infections according to type of toilet showed that individuals that use pit latrine had higher prevalence than those that use open field defaecation. Those that responded they use pit latrine had 134(47.5%) positive cases out of 282 respondents, and 103(47.0%) out of 219 for refuse dump and open field defaecation.

Table 4.5: Sex-specific prevalence of intestinal parasitic infection among primary school children in Bosso Local Government Area, Niger State

Sex	No. Examined	Status		Odds ratio	C.I.
		Positive (%)	Negative (%)		
Male	300	149 (49.7)	151 (50.3)	1.440	1.042 – 1.988*
Female	300	122 (40.7)	178 (59.3)		
Total	**600**	**271 (45.2)**	**329 (54.8)**		

* Statistically significant

Table 4.6: Responses of Pupils to Questionnaires

Other risk factors	No. Examined	Status		Odds Ratio	C.I
		Positive (%)	Negative (%)		
Water Source					
Tap	111	47 (42.3)	64 (57.7)	0.869	0.573 - 1.318
Others	489	224 (45.8)	265 (54.2)		
Borehole	339	144 (42.5)	195 (57.5)	0.779	0.563 - 1.078
Others	261	127 (48.7)	134 (51.3)		
Well	80	42 (52.5)	38 (47.5)	0.819	0.663 - 1.717
Others	520	299 (57.5)	221 (42.5)		
Stream	70	38 (54.3)	32 (45.7)	1.514	0.918 - 2.497
Others	530	233 (44.0)	297 (56.0)		
Total	**600**	**271 (45.2)**	**329 (54.8)**		
Toilet Type					
Pit Latrine	282	134 (47.5)	148 (52.5)	1.196	0.867 - 1.651
Others	318	137 (43.1)	181 (56.9)		
Water Closet	99	34 (34.3)	65 (65.7)	0.583	0.371 - 0.914
Others	501	237 (47.3)	264 (54.7)		
Refuse dump/open field defaecation	219	103 (47.0)	116 (53.0)	1.126	0.806 - 1.572
Others	381	168 (44.1)	213 (55.9)		
Total	**600**	**271 (45.2)**	**329 (54.8)**		
De-worming					
Not at all	439	201 (45.8)	238 (54.2)	1.151	0.799 - 1.658
Others	161	70 (43.5)	91 (56.5)		
Yearly	90	39 (43.3)	51 (56.7)	0.924	0.588 - 1.451
Others	510	231 (45.3)	279 (54.7)		
3 - 6 months	71	30 (42.3)	41 (57.7)	0.874	0.530 - 1.443
Others	529	241 (45.6)	288 (54.4)		
Total	**600**	**271 (45.2)**	**329 (54.8)**		
Water Contact Activities					
Yes	277	18 (6.5)	259 (93.5)		
No	323	0 (0.0)	323 (100.0)		
Total	**600**	**18 (3.0)**	**582 (97.0)**		
History of Blood in stool					
Yes	237	127 (53.6)	110 (46.4)	1.756	1.261 - 2.444*
No	363	144 (39.7)	219 (60.3)		
Total	**600**	**271 (45.2)**	**329 (54.8)**		

* Statistically significant

Those that use water system had 99 respondents with 34(34.3%) positive cases. Odds ratio values of 1.196 and 1.126 for pit latrine and refuse dump/open field defaecation showed statistically significant association between toilet type and the infection.

The prevalence in pupils that said they had never taken any anthelminthics was 45.8%, compared to 44.4% and 42.3% in pupils that took anthelminthics yearly and at 3-6monthly interval respectively. The pupils that indicated not taken anthelminthics at all had Odds ratio of 1.151 which showed association between the variable and the infection.

Among the 277 pupils that said they used to go for swimming and fishing, 18(6.5%) had *S. mansoni* and paragonimus infections, 13(4.7%) had *S. mansoni* infection, 5(1.9%) had *Pargonimus* sp infection.

In the 237 pupils that responded positively to the question on the history of bloody stool, 127(53.6%) had intestinal parasites (*Entamoeba histolytica*, Hookworm, *Schistosoma mansoni*, *strongyloides stercolaris* and *Trichuris trichiura*). There was statistically significant association between this factor and the infection with lower confidence interval of 1.261, Odds ratio of 1.756 shows association between history of bloody stool and the infection (Table 4.6).

CHAPTER FIVE

5.0 DISCUSSION

In this study, an overall prevalence of 45.2% was obtained. The prevalence was low compared to findings by Luka *et al*. (2000) with 56.8% in Lere, Kaduna State, Houmsou *et al*. (2010) with 58.5% in Markudi, Damen *et al*. (2011) with 80.9% in Konduga, Borno state, Adefioye *et al*. (2011) with 52% in Ilie Osun State, Egbuobi *et al*. (2013) with 64.1% in Akokwo Imo State. But the finding was similar to the finding of Nasiru *et a*l. (2011) with 46% in Bosso town, which form part of the study area in Bosso Local Government Area of Niger State. However the result of this finding was higher than that obtained by Ahmed *et al*. (2003) with 30.8% in Katsina, Damen *et al*. (2010) with 30.2% in Doi village Plateau State. The high prevalence of intestinal parasites in schools in Bosso Local Government Area could be due to favourable climate for the survival of the parasites. The prevalence was higher in Bosso Central 2 ward. This outcome might be due to improper management of organic refuse and inadequate supply of clean water. Poor drainages and use of dumping sites for defaecation might have contributed to this high prevalence. Generally there was improper management of toilet facilities in many schools and some did not even have one. Unavailability of potable water in some schools might drive pupils into other unhygienic sources, thereby exposing them to risk factors.

The difference in prevalence of intestinal parasite infections from one school to another was not significant. This might be due to the same level of exposure to infected soils in the communities where the schools are located. It shows that the levels of hygiene in the schools might be the same.

Prevalence of each parasite encountered from the schools showed that hookworm recorded the highest prevalence in all the schools. It was followed by *E. histolytica*, *A.*

lumbricoides, and the least were *H. nana*, *I. belli*, *G. lamblia*, *Taenia* sp. and *Paragonimus* sp. High hookworm prevalence of infection was also observed by other workers, Ahmed *et al*. (2003) in Katsina, Egbuobi *et al.* (2013) in Akokwo Imo State, Damen *et al*. (2010) in Doi village Plateau State, Luka *et al*. (2000) in Lere, Kaduna State, Houmsou *et al*. (2010) in Makurdi, Benue State, Obiukwu *et al*. (2008) in Mbaukwu, Anambra State, and Coulibaly *et al*. (2012) in different settings of Cote d' Ivore. The high prevalence of hookworm recorded in this study may be due to favourable climatic conditions for the development of the infective stage and rate of exposure to risk factors.

Prevalence of *Entamoeba histolytica* and *Ascaris lumbricoides* could be due to lack of proper sanitation. Lack of clean drinking water, Poor standards of public and personal hygiene and inadequate health education promote the spread of such parasites. Some of the parasites have high fecundity rate which may last long and in many places where sanitation and safe garbage disposal are non-existence, the environment becomes thoroughly contaminated and infection is difficult to avoid (Crompton and Savioli, 1993).

The pupils between age group of 5-7 years were observed to have the highest prevalence rate. It was followed by pupils between the age group of 8-10 years. Those pupils in age group of 11-13 years had least prevalence. This may be due to their level of exposure to the risk factors. There is association between the age and the disease. Children of age group 5-7 years are more engaged in playing in contaminated soil activities due to regular playing with soil. They are known for maintaining poor personal hygiene as this plays a role in intestinal parasitic infections. As the children grow there is better awareness in hand washing and other personal hygiene measures which reduce the chances of the children from getting infected. Similar observations

were made by Kalu *et al*. (2013) in Mbaitoli in Imo State, Nigeria, Damen *et al*. (2010) in Doi village Plateau State, Obiukwu *et al.* (2008) in Mbaukwu in Anambra State.

Sex-related prevalence shows that male pupils were more infected compared to the females. The reason may be due to the fact that males are more engaged in extracurricular activities such as recreational activities and games. The lower prevalence in females may be due to cultural practices, which require females to be indoors most of the time while males take part in many outdoor activities. Uneke *et al*. (2006) and Kalu *et al*. (2013) made similar observations in South East Nigeria.

The pupils that used streams and wells as sources of water supply had higher prevalence compared to those that use borehole and pipe-borne-water. There was significant association between the infection and use of streams as sources of drinking water. This might be because humans and domestic/wild animals use these (stream) as sources of drinking water especially during the dry season in local communities. A situation that could lead to contamination with faeces and subsequent infection of exposed individuals. The high prevalence of 52.5% in pupils that used wells as water sources may be because shallow wells may be prone to contaminations. Also some wells in the towns are dug close to pit latrine and poor sanitation around the well enhances transmission. Lower prevalence was recorded among those using pipe-borne and borehole water as their sources of drinking water. This shows that these sources are safe. However, during the process of fetching water, the water containers or handle of the borehole engine and tap may be contaminated (Absar *et al*., 2010).

The pupils that use pit latrines and open field defaecation in their homes had higher prevalence and odds ratio values showed association between the disease and the toilet system. Similar observations were made among those that use open field defaecation toilet system by Uneke *et al*. (2006). This could be due to poor sanitation which might

encourage flies and cockroaches to spread cysts and eggs of intestinal parasites (Absar *et al*., 2010).

Erosion may wash away the faecal contaminant into the village water source in open field defaecation toilet system during rainy season. These practices could also enhance the transmission of cysts and eggs of parasites.

The pupils that indicated not taking de-worming tablets were more infected than those that took it and those that took dewormers yearly were more infected compared to those that took within 6 and 3 months intervals with Odds ratio of 1.151, 0.924 and 0.874 respectively. This shows association between the infection and use of anthelminthics. Positive cases recorded in those that were de-wormed may be due to re-infection after treatment. Damen *et al*. (2010) made such observations in Doi village in Plateau State, Nigeria. Chemotherapy is the best way of reducing the worm burden but there was a conflict of results in Northern Bangladesh where chemotherapeutic intervention was found not to have significant long-term impact. Improved living standards, environmental sanitation, agricultural and industrial hygiene can contribute to the success of the use of chemotherapy (Absar *et al*., 2010).

Those that indicated hand washing before and after eating still had high prevalence. This outcome may be due to improper washing of hands (soaking of hands) especially when they are hungry or exposure to other risk factors. It has been reported that the hands readily become contaminated after defaecation even with the use of tissue paper. The human hands act as a common denominator in the transmission of intestinal parasites regardless of route of transmission (Absar *et al*., 2010). Hands can act as conduits to transfer parasites from surfaces in or outside the home, currency, food and animals (pets or wild).

Out of the total number of 277 pupils that responded for swimming and fishing, 18(06.5%) positive cases was recorded in them. The low prevalence of *Schistosoma mansoni* in Bosso Central 1, Bosso Central 2, Chanchaga and Shakwata primary schools may either be due to irrigation farming practiced by the people of the area or the water bodies they might have visited during their recreational activities. *Paragonimus* sp. infection was recorded in 5 individuals in Garatu primary school with a prevalence of 1.8%. It might be that the infected pupils ingested raw sea food, undercooked, salted crabs or crayfish infected with metacercariae brought from the Southern part of Nigeria, since Garatu is a yam business centre which attracts yam dealers from all parts of Nigeria. Infection could also have been due to contamination of cooking utensils or hands with metacercariae from the fresh water crab during food preparation. There were some positive cases of *Schistosoma mansoni* and *Paragonimus* sp. infections among those that indicated going for swimming and fishing which shows an association between water contact activities and prevalence of the infections. Luka *et al*. (2001) made similar observations in Lere, Kaduna State. However Odds ratio could not be calculated for water contact activities because no single positive case out of 323 pupils was recorded among those that responded not participating in water contact activities.

The pupils that responded positively to the question on history of bloody stool had 127(53.6%) positive cases of infections with Odds ratio of 1.756. This Odds ratio value of 1.756 showed association between the factor and the rate of infection. This means that intestinal parasites such as *Entamoeba histolytica*, Hookworm, *Schistosoma mansoni*, *Strongyloides stercolaris* and *Trichuris trichiura* may be responsible for the observed blood in the stool.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

1. This study on prevalence of gastrointestinal parasites among primary school children recorded a prevalence of 45.2% in Bosso Local Government Area of Niger State.
2. The prevalence was highest in age group of 5-7 years with 105(52.5%) and lowest in age group of 10-13 years with 76(38.0%). Odds ratio of 1.56 showed association between age and the infection. The prevalence was also higher in male pupils 49.7% compared to female pupils 40.7%. Odds ratio of 1.44 also showed association between sex and the infection.
3. Poor sanitation, inadequate potable water supply, low level of personal hygiene education and lack of de-worming were observed as the major risk factors that enhances the transmission of the disease.

6.2 Recommendations

1. The Health Services Unit of the Local Government should embark on mass public health education to improve the level of hygiene in the area.
2. There should be large-scale de-worming campaigns in all the primary school children in the area to be extended to the host communities.

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APPENDIX I:

QUESTIONNAIRE

A Research questionnaire designed to obtain information on the prevalence of gastrointestinal parasites in primary school children in Bosso Local Government Area Niger State, Nigeria

The questionnaire is meant only for the purpose of this research therefore, all information regarding this questionnaire will be highly confidential.

Please answer the following questions: Tick the appropriate option where applicable.

Name of School: _____

S/No: _____

Name of Pupil: _____ Age: _____ Sex: _____

Residence Area: _____

Father's Occupation: _____

Mother's Occupation: _____

Source of drinking water supply

a. Pipe-borne ☐ b. Well ☐ c. stream ☐ d. Borehole ☐

Type of latrine/toilet

a. Water closet ☐ b. Pit latrine ☐ c. Refuse dump/ others ☐

How often do you take de-worming tablets?

a. 3 Months/ 6 months intervals ☐ b. Yearly ☐ d. Not at all ☐

Do you always wash your hand before and after eating? a. Yes ☐ b. No ☐

Do you go to fishing/swimming. a. Yes ☐ b. No ☐

History of bloody stools, a. Yes ☐ b. No ☐

APPENDIX II PLATES

Intestinal parasites isolated in the study.



Plate I. *Ascaris lumbricoides* egg x400 (The egg developed into larva after storage).



Plate II. *Entamoeba histolytica* cyst x400



Plate III. *Enterobius vermicularis* egg x400



Plate IV. *Hymenolepis nana* egg x400



Plate V. *Trichuris trichiura* egg x400



Plate VI. *Taenia* sp. egg x400



Plate VII. *Strongyloides steroralis* larva x400



Plate VIII. *Schistosoma mansoni* egg x400

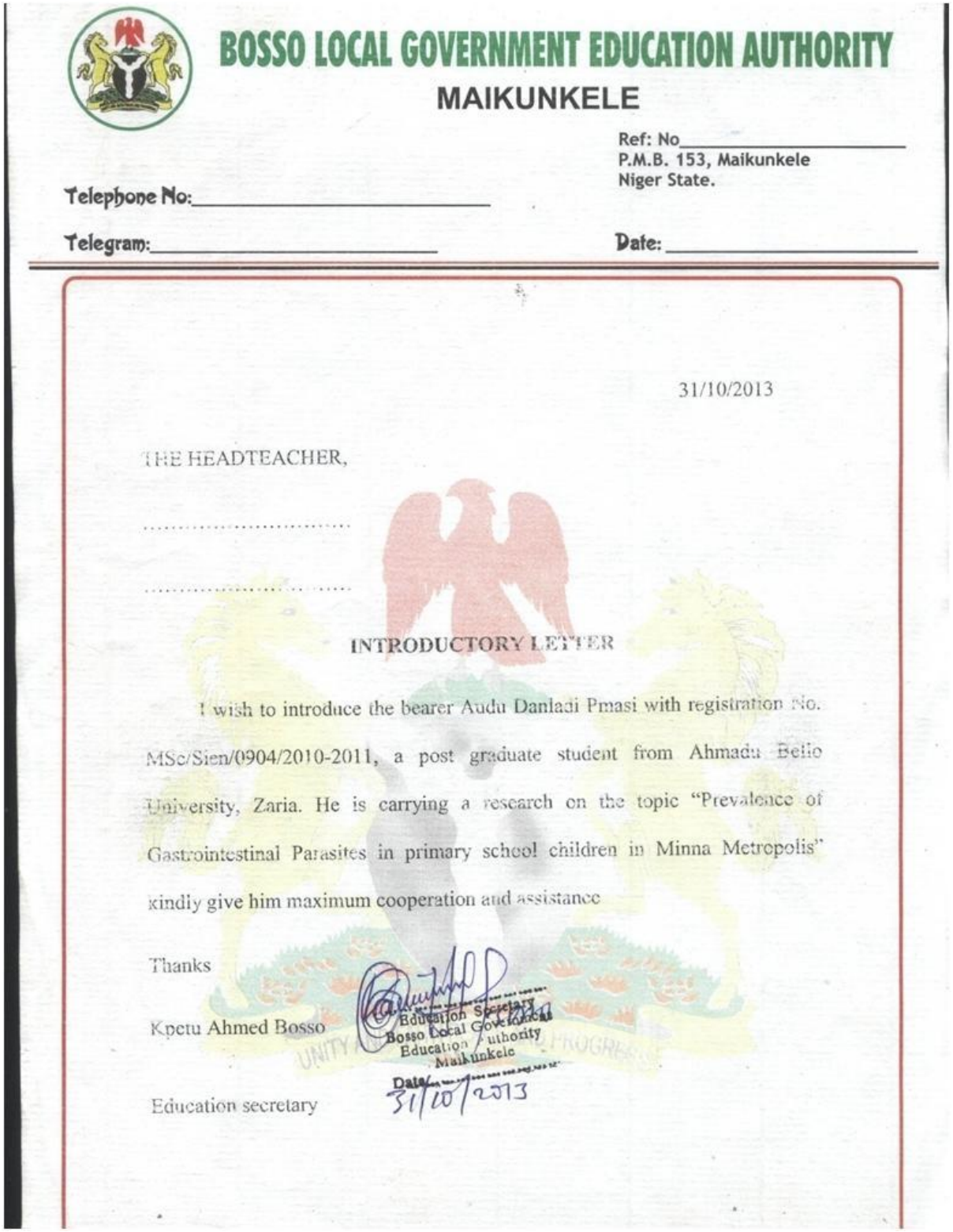


Plate IX. *Paragonimus* sp. egg x400



Plate X. Hookworm egg x400

APPENDIX III: LETTER OF APPROVAL



BOSSO LOCAL GOVERNMENT EDUCATION AUTHORITY

MAIKUNKELE

Ref: No_____
P.M.B. 153, Maikunkele
Niger State.

Telephone No:_____

Telegram:_____ Date:_____

31/10/2013

THE HEADTEACHER,

.....

.....

INTRODUCTORY LETTER

I wish to introduce the bearer Audu Danladi Pmasi with registration No. MSc/Sien/0904/2010-2011, a post graduate student from Ahmadu Bello University, Zaria. He is carrying a research on the topic "Prevalence of Gastrointestinal Parasites in primary school children in Minna Metropolis" kindly give him maximum cooperation and assistance

Thanks

Kpetu Ahmed Bosso

Education Secretary
Bosso Local Government
Education Authority
Maikunkele

Date 31/10/2013

Education secretary