PREVALENCE OF GEOHELMINTHIASIS AND INTESTINAL SCHISTOSOMIASIS IN PRIMARY SCHOOL PUPILS IN JABA LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA

BY

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN EDUCATIONAL BIOLOGY

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MARCH, 2015.

DECLARATION

I declare that the work in this thesis entitled, '*Prevalence of Geohelminthiasis and Intestinal Schistosomiasis in Primary School Pupils in Jaba Local Government Area of Kaduna State, Nigeria*' was carried out by me in the Department of Biological Sciences under the supervision of Prof. I. H. Nock and Dr. (Mrs.) S. A. Luka. The information derived from the 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.

Salome KENNEDY _____ Signature _____ Date

CERTIFICATION

This thesis entitled "**Prevalence of Geohelminthiasis and Intestinal Schistosomiasis in Primary School Pupils in Jaba Local Government Area of Kaduna State, Nigeria**" by Salome KENNEDY, meets the regulations governing the award of the degree of Master of Science of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to the Almighty God the creator of heaven and earth and to my father Rev. Daniel Maicibi and the entire GABJORA

ABSTRACT

This study was carried out from September to November 2013 in order to determine the prevalence and possible risk factors associated with Geohelminths and instestinal schistosomiasis among primary school pupils in Jaba Local Government of Kaduna State. A total of six hundred (600) pupils were randomly selected from twelve primary schools for the study. The stool samples were collected and analyzed using direct smear and formol-ether concentration technique. Out of the 600 pupils examined, 95(15.8%) were found infected with at least one or two soil transmitted helminths and schistosomes. Four different species of soil helminthes, and intestinal schistosome were identified from the stool samples. Parasites recorded was a single species of *Schistosoma mansoni* with 45(7.5%), *Strongyloides stercoralis* 2(2.3%), *Ascaris lumbricoides* 12(2.0%) and Hookworm 36(6.0%). The male pupils had the highest prevalence (17.8%) than the females (13.8%). Although difference was not significant (P>0.05). The age group 3-5years had the lowest prevalence of infection (7.9%) compared with other age groups, however, there was no significant difference in the prevalence among various age groups (P>0.05). The risk factors associated with the parasite infection were types of toilet used (OR=13.32), sources of water (OR=1.24), water contact activities (OR=1.30), parent occupation (OR=1.15) and personal hygiene (OR=1.02). The study showed that geohelminthiasis and schistosomiasis were independent of age and sex. Water contact activities of pupils showed that recreational (swimming) and occupation (fishing) habits tend to increase with the prevalences of infections. The source of water for drinking also exposed the subjects to infection while personal hygiene and parents occupation had less association with geohelminthiasis and schistosomiasis. The infection was associated with

sources of water and toilet used. Suggested efforts to control the parasite in pupils include regular de-worming exercises, adequate and proper information on public education and supply of portable drinking water.

TABLES OF CONTENTS

Content **Page**

Title page……iii

Declaration……iv

Certification……..v

Acknowledgements……..……..……vi

Dedication……....vii

Abstract……viii

Table of Contents…….....ix

List of Tables……..…….xii

List of Plates…….....xiii

List of Figures……..xiv

List of Appendices……..…….....xv

1.0 INTRODUCTION…….....1

1.1 Statement of the Research Problem……...4

1.2 Justification……..…….....5

1.3 Aim……...……..5

1.4 Objectives……...……5

1.5 Hypothesis……...……..……5

2.0 LITERATURE REVIEW……....7

2.1 Intestinal Parasites……...7

2.2 Distribution and Spread of Soil Helminthiasis and Schistosomiasis……..9

2.3 Prevalence of Geohelminthiasis and Intestinial Schistosomiasis in Nigeria…..17

2.4 Transmission and Pathogenesis…….20

2.4.1 Hookworm…….21

2.4.2 *Strongyloides stercoralis*……...25

2.4.3 *Ascaris lumbricoides* ……..…….....27

2.5 Epidemiology and Burden of Disease…….29

2.6 Sanitation and Hygiene……...31

3.0 MATERIALS AND METHODS……...33

3.1 Study Area…….....33

3.2 The Study Population…….33

3.3 Sample Size Estimation……..36

3.4 Ethical Clearance……37

3.5 Sample Collection……37

3.6 Laboratory Analysis of Faecal Samples……37

3.6.1 Direct smear method……..37

3.6.2 The formol-ether concentration technique……37

3.7 Identification of the Parasite……...38

3.8 Administration of Questionnaires…….38

3.9 Data Analysis……...39

4.0 **RESULTS……22**

4.1 **Identification and Prevelence of Geohelminthiasis and Schistosomiasis among Pupils……...40**

4.2 **Prevalence based on Age Distribution……..42**

4.3 **Prevalence of Infection in Relation to Sex……....42**

4.4 **Prevalence in Relation to Risk Factors……45**

5.0 DISCUSSION……..……....51

6.0 CONCLUSION AND RECOMMENDATIONS……..……54

6.1 Conclusion……....54

6.2 Recommendation……54

REFERENCES……56

APPENDICES……..66

LIST OF TABLES

Table		Page
Table 3.1	Jaba LGEA names of districts and number of schools per districts…….....	35
Table 4.1	Identification and prevelence of geohelminthiasis and schistosomiasis among pupils……	41
Table 4.2	Prevalence of parasite based on age distribution in selected primary schools in Jaba Local Government…….	43
Table 4.3	Prevalence of parasites based on sex of pupils.……	44
Table 4.4	Prevalence in relation to risk factors……..……	46

LIST OF PLATES

Plate		**Page**
Plate I:	*Schistosoma mansoni* egg…….…….	47
Plate II:	Hookworm egg…….	48
Plate III:	*Ascaris lumbricoides* egg……..	49
Plate IV	*Strongyloides stercoralis* …..…….…….	...50

LIST OF FIGURES

Figure **Page**

Figure I: Jaba L.G.A showing the districts and the primary schools……..34

LIST OF APPENDICES

Appendix **page**

Appendix 1: Questionnaire ……..…..68

CHAPTER ONE

1.0 INTRODUCTION

Geohelminths are soil transmitted parasites whose immature stages (eggs/larval) require a period of development or incubation in the soil before becoming infective. These are *Ascaris lumbroides,* Hookworm, *Trichuris trichiura,* and *Strongyloides stercoralis* (Cheesbrough, 2000). Intestinal helminth infections constitute significant public health problems in many developing countries. More than 3.5 billion people worldwide are currently infected with one or more species of intestinal helminths (Crompton, 1999). Children are at greatest risk of helminthiasis which are often associated with poor growth, reduced physical activity and impaired learning ability (Stephenson, *et al.,* 1994). An increasing number of studies of helminth epidemiology have shown that it is common for individuals to be infected with more than one species of helminth (Booth *et al.,* 1998; Fleming *et al.,* 2006).

Geohelminthiasis is the second largest leading cause of mortality in children above six years of age in Africa (Ogbe *et al.,* 2002). The infection is promoted by poor personal hygiene habits such as indiscriminate disposal of human and animal faeces. The habit permits contact of faeces and its accompanying microbial load including geohelminth eggs with soil. Other risk factors include lack of safe water source, overcrowding, poverty, geophagy, failure to wear foot wears and having pools of water/sewage around houses (Phiri *et al.,* 2002).

Schistosomiasis (also known as Bilharzia, Bilharziosis or snail fever) is a parasitic disease caused by several species of trematodes (platyhelminth infection or “flukes”), a parasitic worm of the genus *Schistosoma*. Snails serve as the intermediate host

between mammalian hosts. Individuals within developing countries who cannot afford proper water and sanitation facilities are often exposed to contaminated water containing the infected snails (CIA, 2007). Although it has a low mortality rate, schistosomiasis often is a chronic illness that can damage internal organs and, in children, impair growth and cognitive development. The urinary form of schistosomiasis is associated with increased risk for bladder cancer in adult. Schistosomiasis is the second most socio-economically devastating parasitic disease after malaria (Schistosomiasis Control Program 2007). This disease is most commonly found in Asia, Africa and South America, especially in areas where the water contains numerous freshwater snails, which may carry the parasite. The disease affects many people in developing countries, particularly children who may acquire the disease by swimming or playing in infected water (CIA, 2007).

The nutritional consequences of intestinal infections caused by geohelminths are substantial. For example ascariasis has been linked with decreased fat, protein and vitamins that are absorped by the parasite (O'lorcain and Holland, 2000). Iron deficiency anemia (Curtale *et al.,* 1993; Stoltzfus *et al.,* 2001) and in the case of severe infection, intestinal obstruction (De Silva *et al.,* 1997). Trichuriasis often occurs in tandem with ascariasis. It is estimated to cause morbidity in 87.133 million persons worldwide, heavy trichuriasis is associated with anemia, growth retardation, reduced cognition and development in children (Chan, 1997). The major health consequences of hookworm infection is anemia. Stolffus *et al*. (2001) in a study involving 3,595 school children reported that hookworm was responsible for 25% of all anemia cases and 35% was caused by iron deficiency among the 3,595 school children in the study. Intensity of infection is measured by the number of eggs per gram of faeces, generally by the kato-katz fecal thick smear technique. For *A.*

lumbricoides and *T. trichiura,* the most intense infections are found in children aged 5 – 15 years. A decline in intensity and frequency may indicate changes in exposure, acquired immunity or a combination of both which still remains controversial. In addition to clinical effects, severe and chronic infection, intestinal parasitic infection also has consequences on cognitive performance, and educational achievement of school children during their development. Studies conducted throughout the developing world have provided evidence that school children infected with intestinal parasites perform poorly in tests of cognitive function (Drake *et al.*, 2001).

The magnitude of the disease burden has spurred a global control programme, which includes universal targeting and periodic administration of anti-helminthic drugs to high risk groups. The implementation of these strategies requires a broader epidemiological perspective of the risk factors. Large scale environmental sanitation programmes are complex, making interventions, directly aimed at the transmission of geohelminths a challenge.

An increasing number of studies of helminthes epidemiology have shown that it is common for individuals to be infected with more than one species of helminthes (Booth *et al.,* 1998; Fleming *et al*., 2006). The global prevalence of soil transmitted helminth is high. Estimates indicate that approximately 1,472 million people have roundworm infection and 1,049 million people have whipworm infection (Crampton, 1999).

In Nigeria, a considerable amount of human and animals waste are discharged into the soil leading to the seeding of the soil with pathogenic organisms including geohelminth eggs and larvae. Infection may be direct or indirect through secondary

sources such as food, water, vegetables and fruits since most geohelminth infections are acquired through the faecal-oral route (Nock *et al.,* 2003).

Much has been reported on the prevalence of intestinal parasite infection in many parts of Nigeria with the prevalence ranging from 38% - 80% (Idris, 1988; Etim and Akpan, 1999; Olofintoye and Odaibo, 2006). Prevalence has been associated with various factors such as; contamination of environment with human and animal faeces (Akogun and Badaki, 1998), polluted water (Luka *et al.,* 2001), poor methods of refuse disposal and personal hygiene (WHO, 1987; Nwosu, 1999) and low socioeconomic status of the people (Akogun, 1995).

In Jaba Local Government Area of Kaduna State, there are several fadama areas and seasonal streams. In the dry season when the wells are dried, the main source of drinking water and for bathing are stagnant water from the streams, which are infested with snails such as *Bulinus spp* and *Biomphalaria spp* which are intermediate hosts of schistosome (Okuofu and Oniye, 1995). Pupils of primary school level of education are actively involved in water-related activities.

1.2 Statement of the Research Problem

Public schools (with over 3,900 pupils), lack adequate water supply and toiletary facilities such that the surroundings close to the playing ground are often used for defecation by the pupil. Thus pupils are exposed to the infective stages of geohelminthes and schistosome parasites and become infected as they visit streams and play on the ground respectively. There is no documented information on the prevalence of these study to the best of my knowledge that infections in pupils in Jaba LGA. Thus there is the need to provide useful information of the status of Geohelminthiasis and intestinal Schistosomiasis in the study area.

The prevalence of geohelminthiasis and schistosomiasis in Jaba L.G.A is not yet studied and therefore remain largely unknown.

1.3 Justification

Information on the general prevalence of geohelminthiasis and Schistosomiasis in the area is very scanty. This study will provide data to assess the extent by which these diseases are prevalent and their importance in the health and education of school pupil in the area.

1.4 Aims of the Study

To evaluate the prevalence and distribution of geohelminthiasis and schistosomiasis in school children in Jaba Local Government Area of Kaduna State.

1.5 Objectives of the Study

To determine the:

I Prevalence of geohelminthiasis and intestinal schistosomiasis among primary school pupils in Jaba Local Government Area.

II Prevalence of geohelminthiasis and intestinal schistosomiasis in relation to sex and age of school pupils in Jaba LGA.

III The risk factors associated with geohelminthiasis and intestinal schistosomiasis among primary school pupil in Jaba LGA.

1.6 Hypothesis of the Study

I The prevalence of geohelminthiasis and schistosomiasis are not significant among primary school in Jaba L.G.A.

II There are no significant relationship between age and sex and the prevalence of geohelminthiasis and schistosomiasis among primary school pupils.

III There is no significant association between the prevalence of intestinal schistosomiasis among primary school pupils and the risk factors.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Intestinal Parasites

According to World Health Organisation (WHO, 1994), intestinal parasites are those parasites that usually occur in the intestinal lumen of their host, mostly attached to the walls of the intestine. The eggs of intestinal helminthes can be found in the mummified feaces of humans dating back to thousands of years (Cox, 2002; Hotez, 2008), and we can recognize many of the characteristic clinical features of helminthes infections from the ancient writings of Hippocrates, Egyptian medical papyri, and the Bible (Cox, 2002, Hotez, 2008). These same helminthiasis markedly altered the course of modern history in the twentieth century (Cox, 2002, Hotez, 2008,), especially in China during the Cold War, when the Schistosome was known as "the blood-fluke that saved Formosa" (Kernan, 1959) because acute Schistosomiasis sickened Mao's Troops and aborted their amphibious assault of Taiwan (historically known as Formosa) just long enough for American ships to enter the Straits of Taiwan (Hotez, 2008).

There are two major phyla of helminthes. The nematodes (also known as roundworms) include the major intestinal worms (also known as soil-transmitted helminths) and the filarial worms that cause lymphatic filariasis (FL) and Onchocerciasis, whereas the platyhelminths (also known as flatworms) include the flukes (also known as trematodes), such as the schistosomes, and the tapeworms (also known as the cestodes), such as the pork tapeworm that causes cysticercosis. In 1947, Norman Stoll published a landmark paper entitled "This wormy world" in which he set out to estimate the number of people infected with helminthes worldwide (Stoll, 1999). Over the last 60 years, several estimates have confirmed Stoll's initial

observation that hundreds of millions of people harbor parasitic worms (De Silva *et al*, 2003, Ottesen, 2006). It is estimated that approximately one-third of almost three billion people that live on less than two US dollars per day in developing regions of sub-saharan Africa, Asia and the Americans are infected with one or more helminth (Hotez *et al.,* 2006, Hotez *et al.,* 2007). The most common helminthiasis are those caused by infection with Ascariasis, Trichuriasis, and Hookworm, followed by Schistosomiasis and lymphatic filariasis. This means that the inhibitants of thousand of rural, impoverished villages throughout the tropics and subtropics are often chronically infected with several different species of parasitic worms, (Hotez *et al.,* 2006, Hotez *et al.,* 2007).

School-aged children (including adolescents) and pre-school children tend to harbor the greatest number of intestinal worms as a result of which they experience growth stunting and diminished physical fitness as well as impaired memory and cognition (Crompton and Neshein, 2002). These adverse health consequences combine to impair childhood educational performance, reduce school attendance (Miguel and Kremer, 2003), and account for the observation that hookworm (and presumably other diseases caused by parasitic worms) reduces entire wage-earning capacity (Bleakley and Hoyt, 2007). Hookworm infection and schistosomiasis are important diseases during pregnancy, that cause neonatal prematurity, reduced neonatal birth weight, and increased maternal morbidity and mortality (Christian *et al.,* 2004). Among some adult populations living in impoverished areas of developing countries, Hookworm and schistosomiasis, are also major determinants of reduced worker productivity (Hotez, 2008, Perera *et al.,* 2007, Hotez and Ferris, 2006). Such chronic, disabling, and often disfiguring effects of helminthes translate into enormous poverty-promoting

effects and represent a major reason why poor people remain mired in a downward cycle of destitution (Hotez and Ferris, 2006).

The global mortality that results from human helminth infections have both direct and indirect effects on malaria and HIV/AIDS in developing countries. In sub- Saharan Africa and elsewhere, helminthiasis are frequently coendemic with malaria (Hotez *et al.,* 2006, Druilhe *et al*., 2005, Brooker *et al.*, 2008) and HIV/AIDS (Borkow and Bentwich, 2006, Hotez *et al.,* 2006, Gallagher et al, 2005). It is not uncommom for an individual to be co-infected with the malaria-causing parasite and one or more parasitic worm (Brooker *et al.,* 2008), or HIV and one or more parasitic worms (Kjetland *et al.,* 2006, Gallegher *et al*, 2005). Such co infections have additive effects, such as severe anemia (Brooker *et al.,* 2006), and synergistic effects, such as increased transmission of the malaria- causing parasite, HIV, and/or increased susceptibility to infection with these pathogens as well as cause an exacerbated progression of these two killer diseases (Hotez *et al.,* 2006, Druilhe *et al* 2005, Gallagher *et al.*, 2005). Geohelminths and Schistosomiasis have a global distribution. They are estimated to infect 3.5billion people, most of whom are children residing in developing countries (WHO 2000).

2.2 Distribution and Spread of Soil Helminthiasis and Schistosomiasis.

The distribution of parasitic infections is determined by several factors, such as environment, food- habit, cultural tradition, social status, economic situations and others. Each parasite has its own natural and social habitat, and favourable environment is a prerequisite for its transmission. For example, Soil-transmitted helminthes (STHs) or geohelminthes are highly prevalent in poor agricultural societies, where human faeces are used as a fertilizer (Crompton, 1999; Horton, 2003).

Fish-transmitted flukes are prevalent among raw-fish-eating communities along river basins and seaside areas (Chai *et al*., 2005), and schistosomiasis is transmitted to people residing along endemic rivers or water reservoirs. In a word, the prevalence of a parasitic infection is a consequence of both natural and cultural factors, but its control is a product of social consent and change of behavior. Of the world's 218 countries, *Ascaris* is known to be distributed in 153 countries; no data are available on its distribution in the remainder. In 1947, globally 650 million people were estimated to be infected with *Ascaris*, but this rise to 1,472 million in 1990 (Crompton, 1999).

Moreover, these estimates suggest that the overall prevalence of ascariasis has remained almost unchanged over the last 50 years. Most of the infected are believed to live in Asia, Africa, and Central or South America. However, in Asia, *Ascaris* has been almost completely eradicated from Japan, the Republic of Korea, and Taiwan. China is currently showing a rapid decrease of its prevalence in urban and developed areas (Tang, 2002). Therefore, the estimates in Asia need to be revised. More than one billion of the world's populations, including at least 400 million school children, are chronically infected with *Ascaris lumbricoides*, *Trichuris trichiura*, Hookworms, *Enterobius vermicularis* and *Taenia sp*. (Adeyeba and Akinlabi, 2002; Braide, 2004).Schistosomiasis or bilharzia is prevalent in 76 countries and territories in tropical and subtropical regions and is estimated to infect over 200 million people worldwide, causing significant morbidity (Chitsulo *et al*., 2000, Steinmann *et al*., 2006). The disease is caused by infection with trematodes of the *Schistosoma* genus. There are three major species which infect humans: *Schistosoma haematobium* causing urogenital (formerly known as urinary) schistosomiasis, and *Schistosoma mansoni* and *Schistosoma japonicum* (the latter in Asia) that causes intestinal schistosomiasis. The geographical distribution of schistosomiasis is dependent on the

presence of suitable intermediate snail hosts in the aquatic environment in the tropics and subtropics, amongst other factors. Prevalence rates of intestinal parasites have been reported from all over the world. Savioli *et al.* (1992) reported that intestinal nematodes infect many of the world's children. Wiselka and Nicholson (1992) diagnosed 22 cases of schistosomiasis in Leicester during a 5-year period. The survey identified eleven (11) cases of *Schistosoma haematobium* infection and three (3) of *Schistosoma mansoni* infection. The *Schistosoma* type in the remaining eight (8) cases was uncertain.

Ferreira *et al.*, (1994) conducted a research on the prevalence of infection by intestinal parasites in an urban slum in Sao Paulo, Brazil, stool specimens from a random house-hold based samples of 407 dwellers of all age groups were used for the study. Intestinal parasites were detected in 45.7% of the specimens. The most prevalent parasites detected were *Ascaris lumbricoides* (23.8%) and *Trichuris trichiura* (17.2%); 17 individuals (4.2%) harboured *Giardia lamblia* and six (1.5%) harboured *Entamoeba histolytica.* Simultaneous infection by *Ascaris lumbricoides* and *Trichuris trichuira* (including mixed infection) were highest among childen of 2-12 year.

Awasthi *et al.*, (2003), conducted a survey on the prevalence of malnutrirtion and intestinal parasites in pre-school slum children in Lucknow, India. 1061 children between the ages of 1.5-3.5 were examined. Parasites were detected in 17.5% of the children. 124(68.1%) children had *A.lumbricoides* and 60 (32.9%) had *Giardia lamblia.* Malnutrition and low haemoglobin levels were also prevalent.

A retrospective survey of laboratory records of 8,590 stool samples examined for intestinal parasites from Local Hong Kong residents showed changes in the pattern of infestations, particularly at the age of acquiring first infection and the peak occurrence for the different intestinal parasites in comparison with the data obtained 12 years

earlier (Kam, 1992). *Clonorchis sinensis* was the most prevalent, found in 453(5.3%) subjects, followed by *T.trichiurea* in 192(2.2%), Hookworm in 35(0.4%), *A. lumbricoides* in 26(0.3%), *E. histolytica* in 23(0.3%) and *Strongyloides stercoralis* in only 3(0.03%). Another 486 samples collected from Vietnamese migrants during the same period showed a different pattern: *Trichuris trichiura* 142(29.2%), *C.sinensis* 5(1.0%), *A. lumbricoides* 3(0.6%) and *E. vermicularis* 1(0.2%).

Curtale *et al*. (1995) conducted a research on intestinal helminthes and xerophthalmia in Nepal. Their study reported on 25 cases of xerophthalmia among children of 6-12 months of age. The study found that, xerophthalmia cases had a significantly higher prevalence and intensity of infection, as expressed by the presence and number of *Ascaris lumbricoides* eggs per gram of faeces of any of the cases. Their study therefore demonstrate the importance of *Ascaris lumbricoides* as a risk factor for ocular signs of vitamin A deficiency. Reduction of prevalence and intensity of *Ascaris lumbricoides* infection, may reduce the incidence of xerophthalmia in the community with its potential sequels of blindness, morbidity and mortality.

An epidemiological study of intestinal nematodes with 1,292 children ranging from birth through 11 years old, living in South- East Madagascar was conducted by Kightlinger *et al*. (1994). Faecal examination revealed prevalence of 78% for *Ascaris lumbricoides*, 38% for *Trihuris trichiura*, 16% for Hookworm and 0.4% for *Schistosoma mansoni*. The distribution was over-dispersed for all the 3 nematodes. The age profile showed a rapid acquisition of *A.lumbricoides* during infancy, increasing to 100% prevalence by the age of 10.

With the exception of *Stronglyoides stercoralis*, helminthes do not replicate within the human host. This fundamental aspect of helminth biology establishes a set of

transmission dynamics quite different than those for viruses, bacteria, fungi, and protozoans. For example, prevalence, which is the proportion of persons in a defined population at a given time point infected with the helminth (Fletcher and Fletcher, 2005) is seldom used as the only measure to assess the epidemiological situation for that helminth infection, because morbidity is associated with the number of worms infecting the host (i.e. the worm burden) rather than the absence or presence of infection. Prevalence is commonly combined with worm burden (also referred to as the "intensity of infection"), which is commonly measured by the number of eggs per gram (EPGs) of feces for intestinal helminthes and schistosomes (Anderson, 1982). Based on EPGs and their association with morbidity, individuals are classified into categories of light, moderate, and heavy infection by the WHO (Montresor, *et al.*, 1998). Furthermore, in the case of soil-transmitted helminth, the WHO recommends use of both prevalence and intensity of infection to classify communities into transmission categories- category I (high), category II (medium), and category III (low). These transmission categories are assigned according to both the number of heavily infected people in the community (greater or less than 10%) and the prevalence of infection (greater or less than 50%). For example, a community with greater than 50% prevalence but less than 10% heavy infection would be considered a category II transmission community. The WHO uses this information in algorithms to determine the type of mass treatment a community should undertake.

Round worm infection (*Ascaris lumbricoides*), a soil transmitted helminthes is reported to infect at least one fourth of the world (Crompton, 1999). Annual morbidity associated with parasite has been estimated by the WHO at 60,000 with another 250million people said to be at risk for acquiring the infection (Monstresor *et al.*, 1998) Both domestic and wild animals are common reservoirs for *Ascaris*

lumbricoides. The quality is due in part to be resilient nature of the eggs which are capable of surviving a wide range of hot and cold temperature chemicals, chemical disinfectants and other extreme conditions (Neva and Brown, 1999). The eggs of *Ascaris* are one of the most resilient of the helminth eggs and can remain infective for years embedded in the soil (Gilgen and Mascie, 2000, Crompton, 1999). Wiselka and Nicloson (1992) diagnosed 2 cases of Schostomiasis in Leicester during a five years period. The survey identified eleven cases of *Schistosoma haematobium* infection and of *Schistosoma mansoni* infection. The Schistosoma types in the remaining eight cases were uncertain. Kabateria *et al*. (1996) studied *schistosoma mansoni* infection in 451 people living in three villages along Albert Kibale district of western Uganda. Four hundred and nine (90.7%) were found to be infected with *S.mansoni* with geometric egg count of 561.3 eggs per gram (epg) of feces. Males were found to have a significantly higher mean egg counts (608.3 epg) than females (415.6 epg) other common parasites observed were *Ascaris lumbricoides*, *Trichuris trichura* and hookworm. Snail infection rate by *S. mansoni* among the 115 *Biomphalaria sudanica* and the 56 *Biomphalaria stanleyi* were 5.2% and 3.6% respectively.

A diagnosis of 6122 children from 27 schools in the former White Nile province of Sudan was carried by Ahmed *et al.,* (1995). The prevalence rates were marked differences in the level of endemicity between provinces and also between schools within each province. School specific prevalence and intensities of infection were positively correlated for both *S. mansoni* and *S. haematobium*. Prevalence and intensities of infection were generally similar in male and female subjects and in different age groups. Observations in small related aspects of transmission revealed that transmission of both *S. mansoni* and *S. haematobium* was highly focal and also seasonal.

There was a recent tendency showing a wider generation including children and larger number of women suffering from Cysticercosis in 1994-2010, 22 patients were Japanese (56.4%) 11 patients were from Asian countries including China (n= 6) Korea, Cambodia, Nepal, India and the Philippines, and 2 others were from Latin America (Brazil and Peru). The nationality was not provided for the remaining 4 cases.

Strongyloides stercoralis is a thread worm, a nematode parasite that causes strongyloidiasis (Fardet *et al.,* 2006). There are an estimated 100 million to 200 million people infected with stercoralis residing in 70 different countries (Bianchil *et al.,* 2006). The true prevalence of an *S. stercoralis* infection is underestimated because majority of the cases are sub-clinical (Rose, 2008). There are 53 species of the organism and the most common infection is due to *S. stercoralis* species. Species such as *S. fuelleborni* and *S. kelly*, are frequently found in human living in Africa and Papua new Guinea (Rose, 2008). There is high prevalence of *S. Stercoralis* in Brazil, Central America, and Australia. It is also endemic in Africa, South and Southeast Asia, South America, rural parts of Italy, Papua new Guinea, and the specific Islands such as Fiji, (2006). Endemic areas in the United States of America are Kentucky, West Virginia and Eastern Tennessee (Cabina. *et al.,* 2006). A recent study illustrated that 38 % of southern Asia immigrants residing in Washington DC, were infected with *S. Stercoralis* the infective stage of the worm is the larvae (Rose, 2008).

Despite considerable advances in chemotherapy and control, hookworms rank amongst the most widespread of soil-transmitted intestinal helminth parasites and affect a significant proportion of the world population (approximately 900 million people) mainly in the tropics and sub-tropics (Bundy *et al*., 1991). Adult hookworms

attach to the mucosa of the small intestine, feed on blood. And is an important cause of anaemia in school-aged and adult populations in the tropics (Olsen *et al*., 1998). *Necator americanus* and *Ancylostoma duodenale*, the 2 major species of human hookworms are sympatric over much of their distribution and people are often simultaneously infected with both species in endemic areas. Despite significant differences in their life histories, the 2 species have traditionally been considered to be identical for treatment and control strategies (Hoagland and Schad, 1978). Failure to consider these differences is probably responsible for reports of failed drug treatments and rapid reinfection rates following anthelmintic treatment. 1996) although, there are established morphological differences between the adult worms. The adult stages are rarely available for routine parasitological examination (Yoshida *et al*., 1974a,b; Pawloski *et al.,* 1991).

Thus, species identification has traditionally been done by using subtle morphological characteristics to differentiate the infective, third-stage filariform (L3) larvae, reared from eggs in coprocultures (WHO, 1981; Pawloski *et al.,* 1991). Although, previous reports from some parts of Nigeria have shown that *N. americanus* is the ubiquitous and dominant hookworm species (Fisk, 1939; Cowper and Woodward, 1961; Oyerinde, 1978; Adenusi, 1997) and that infections with *A. duodenale* represent only a small proportion of the local hookworm infections, over the years however, the epidemiological situation may not be the same as previously reported.

2.3 Prevalence of Geohelminthiasis and Intestinial Schistosomiasis in Nigeria

Parasitic worms are among the most common causes of chronic infection in humans (Awasthi *et al.,* 2003). Infection thrives and persists in communities in need of better housing, clean water, proper sanitation, better access to health care, education and

increased personal earnings (Crompton, 1999). This is typical of most rural communities and urban slums in Nigeria. Children growing up in these communities can be infected soon after weaning, and to be infected and re-infected constantly for the rest of their lives (Awasthi *et al*., 2003). Helminth infection is a major cause of disease burden among children in developing countries (World Bank, 1993), especially in sub-Saharan Africa. This high infestation mirrors severe shortage in health care, education, transport, and chronic poverty (Crompton, 1999). Following improvements in child survival, and the constant increase in the proportion of children living beyond the age of five in many developing countries, attention is now focused on the health of school age children (Bundy and Guyatt, 1995). At the same time, the increase in the level of school attendance in recent years in many developing countries has facilitated the delivery of school-based nutrition and health services, providing an excellent cost-effective opportunity for educational, economic and developmental gains (Del Rosso and Marek, 1996). In many developing countries, children only receive primary school education, and this is the age when they are more frequently and more severely infected by helminths. These infections could thwart the efforts of a country to provide basic school education (PCD 1997); especially in a country like Nigeria where only 70% of school-aged children are enrolled in primary schools (Ola and Oyeledun, 1999). There is a growing body of evidence that school-based health services such as treatment of schistosomiasis and intestinal nematode infections can be delivered at low cost (World Bank 1993; PCD 1997) and can contribute to improving children's general well-being, growth (Stephenson *et al* 1989; Stoltzfus *et al.*, 1998), nutritional status (Stephenson *et al.*, 1993; Beasley *et al.*, 2000), cognitive ability (Drake and Bundy 2001), and school attendance (Simeon *et al*., 1995). In a comparative study of intestinal helminthes

conducted in two communities along the Benue River in Adamawa state of Nigeria by Akogun and Badaki (1998). Out of 350 stool samples collected and examined for parasites, intestinal infections were found to be more frequent in Jambutu community (52.1%) and Bajabure (38.5%) while urinary schistosomiasis was more prevalent in Bajaloure (22.9%) than Jambutu (12.5%). The species-specific prevalence was *A. lumbricoides* 18.8%, *T. trichiura* 14.9%, *E. histolytica* 18.8% and *S. haematobium* 18.8%. Galadima and Olatunde (1985), showed that out of 208 children examined for intestinal parasitic infections in Samaru-Zaria, 90(43.3%) were infected. The identity and prevalence of the parasites encountered were hookworm 5.8%, *S. mansoni* 4.89%, *S. haematobium* 0.5%, *H. nana*, *T. solium* and *T. saginata* 4.3% each, *T. trichura* and *A lumbricoides* 3.8% each , *E. vermicularis* 3.4 % and *S. stercoralis* 2.4%, others found are *E. histolytica* 6.7% *E. coli* 15.4% and *G. lamblia* 7.2%. The prevalence of hookworm infection in Samaru-Zaria was studies by (Galadima *et al.,* 1986). They reported a prevalence rate of 91.3% for *Necator americanus* and 8.7% for *Ancylostoma duodenale*. A survey was carried out on 400 pupils in five local government areas of Katsina State by Idris (2001). The average range of the pupils was between 5 and 19 years. Pupils infected with at least one species of intestinal parasite were 1,404 (35.1%). Infection rate of helminthes and protozoan species detected were *Ancylostoma duodenale,* 622(15.55%), *Ascaris lumbricoides,* 28(0.70%), *Hymenolepis nana,* 16.5(4.13 %), *Enterobius vermicularis,* 153(3.85%), *Trichuris trichiura,* 34(0.85%), *Strongyloides stercoralis,* 16(0.4%) *S.mansoni,* 382(4.03%), and *Entamoeba histolytica,* 4(0.10%). The infection rate was found to be influenced by sex ($p< 0.05$).

Prevalence of intestinal helminthiasis among rural and urban school children in the rain forest zone of south-western Nigeria was studied by Nwosu and Ogunrinade

(1999). In their study, 225 children were examined, 180(80%) were infected of which 126(97.7 %) were rural and 54(56.3%) were school parasites encountered were, Hookworm (90.7%), *A. lumbricoides* (86.1%), *T. trichiura* (97.1%), *S. stercoralis* (7.0%), *S. mansoni* (2.3%) and *H. nana* (2.3%).

Another studies carried out by Luka *et al.* (2001) on Schistosomiasis among school children in Lere LG of Kaduna State, 1159 children of school age (7-20 years) were examined with the prevalence of *Schistosoma haematobium* was 142(12.3%) of the urine samples. The prevalence varied within primary schools under study, ranging infrom 4.4% in Maigamo to 31.0% in Mariri. In males, the prevalence was 105(16.9%) and in female 36(6.9%). Etim *et al.*, (2002) also obtained prevalence values of 53.2, 31.0, 27.0 and 5.5% for *Ascaris sp.*, *Ancylostoma sp.*, *Trichuris sp.*, and *Schistosoma mansoni* respectively, from primary school children aged 5- 13 years in Calabar, Nigeria. Ahmed, et al., (2003) reported that 30.8% of students in Katsina were infected with at least one intestinal helminthes. Also, prevalence of intestinal helminthes in some patients in Zaria has been reported to be 1.67% for *Strongyloids stercoralis* only and 62.7% of other helminthes (Abdullahi and Abdulazeez, 2000).

2.4 Transmission and Pathogenesis

Intestinal parasitic infections are mainly acquired by ingestion, inhalation or penetration of the skin by the infective forms (Ananthakrishan *et al.*, 1997) and transmission has been associated with habits of people (Kabatereine *et al.*, 1996). For instance, contact between the larvae of hookworm in contaminated soil and skin lead to penetration resultant larval migration (Hira and Patel, 1984). Larva pulmonary migration generally as asymptomatic, however, symptomatic pulmonary disease may

occur with fever, cough, chest pain, hemoptysis, dysnea and wheezing due to loffler's syndrome, the effects of the larval tissue migration, airway reactivity or bronchospasm, infections bacterial complications from parasitic migration and associated aspiration and rarely chronic eosinophilic pneumonia, transdiaphragmatic penetration, or symptoms of supper airway obstruction, Clinical evaluation shows pulmonary opacities on chest radiograph, peripheral blood eosinophilia and larvae in respiratory or gastric secretions (Sarinas and Chitkara 1997). Schistosoma includes two hosts a definitive host (i.e human) where the parasite undergoes sexual reproduction and a single intermediate small host where there are a number of asexual reproductive stages (Cruikshank, 1936). After the eggs of humans dwelling parasite are emitted in the feces and into the water, the ripe miracidium searches for a suitable freshwater snail (*Biomphalaria glabrata, Biomphalaria straminea, Biomphalaria tenagophila or Biomphalaria sudanica* (Amin and Omer, 1972) to act as intermediate and penetrate it. following this, the parasite develops via a so-called mother sporocyst and daughter-sporocyst generates to the cercaria.

2.4.1 Hookworm

The two major species of hookworm known to infect humans are *Necator americanus* and *Ancylostoma duodenale.* Eggs of both species are identical and morphological identification can be done on the basis of the adult morphology (Katz *et a*l., 1989; Pawloski *et al.,* 1991), or by the study of the larval stages cultured from eggs by the Harada-mori method (Pawloski *et al*., 1991). They are colourless with a thin shell which appears as a black line around the ovum. They are oval in shape, measuring about 65 x 40 μm. The eggs contain an ovum which appears unsegmented. In faeces more than 12 hours old, larvae may be seen inside the egg. Heavy infection with hookworm can create serious health problems for newborns, children, pregnant

women and persons who are malnourished. (Haburchak, 2006). The hookworm eggs are transmitted by improper disposal of faeces or urine and agency of insect host (Adenusi and Ogunyomi, 2003). Thus the infection is endemic in areas where sanitation are poor, Knowledge of the disease and its prevention is minimal, where health education is often nonexistent especially in warm humid areas of the tropics and subtropics (Schad, 1991). Contamination of soil through direct defecation or deposition of faeces on the ground, in other words poor sanitation, exposure of skin to infected soil for instance working barefooted and the use of human faeces for fertilizers. When the eggs hatches, the infective thread-like larvae penetrate human skin (foot) and migrate to the small intestine, where they mature (Albonico *et al.*, 2004). Despite considerable advances in chemotherapy and control, hookworm rank amongst the most widely spread of soil-transmitted helminthes parasite and affect a significant proportion of the world population (Olsen, *et al.*, 2006).

Hookworm disease**,** also called ancylostomiasis, or uncinariasis, a parasitic infestation of humans, dogs, or cats caused by bloodsucking worms living in the small intestine sometimes associated with secondary anemia (Capello *et al*., 1993). Several species of hookworm can cause the disease (Carroll and Grove, 1986). *Necator americanus*, which ranges in size from 5 to 11 millimetres (0.2 to 0.4 inch), is responsible for about 90 percent of human hookworm infections that occur in tropical and subtropical regions of the world (Castro *et al.*, 1990). *Ancylostoma duodenale*, 8 to 13 millimetres long, is found on all continents but is most prevalent in warm regions (Schad *et al*., 1997). *A. braziliense*, from 8 to 11 millimetres long, is normally parasitic in dogs and cats; man, however, is sometimes infected by this species in the southern United States, South America, and Asia (Singh *et al*., 1991). *A. ceylanicum*, normally parasitic in dogs, is sometimes found in man in South America and Asia. *A.*

duodenale, possesses four hooklike teeth in its adult stage, and *N. americanus* has plates in its mouth rather than teeth (Pritchar *et al.*, 1990).

Both species of hookworm have similar life cycles. The adult worm attaches itself to the mucosal tissue lining the small intestine, where the female may produce several thousand eggs a day, which are passed in the faeces (Pawlowski *et al.*, 1991). If the fecal matter reaches suitable soil, the eggs are hatched, and the infective, threadlike larvae may penetrate human skin, usually that of the foot, by way of the sweat glands and hair follicles (Kappus, *et al.*, 1991). They then invade the lymph and blood vessels, reach the lungs, and pass up the respiratory tree to reach the mouth, where they are swallowed and sent to the small intestine; there they mature and start a new reproductive cycle. The intestinal parasites are reputedly long-lived, with a lifetime that may span some 10 years (Kappus, *et al.*, 1991).

The symptoms of hookworm disease ordinarily begin with ground itch, an itchy skin irritation caused by the larvae when they penetrate the skin and marked by papules and vesicles that are often located between the toes (Hillyer *et al.*, 1990). In passing through the lungs, the larvae may produce coughing and fever. In the intestine, the mature worm sustains its life by bloodsucking, and persistent feeding by many worms over many years results in secondary anemia (Hillyer *et al.*, 1990).

In heavy infestations (which may involve more than 500 larvae), the general symptoms include pallor of the skin and mucous membranes, fluid retention in the face and extremities, constipation alternating with diarrhea, abdominal tenderness, increased appetite for bulky or strange substances (*e.g.*, clay), delayed puberty and stunted growth, fatigue, dullness, and apathy (Gilles, 1996). Hookworm infestation tends to be constantly widespread in tropical and subtropical regions of the world;

moisture, warmth, loose soil, promiscuous defecation, and absence of shoes are the chief factors responsible for infection (Gilles, 1996). One single oral dose of tetrachlorethylene on an empty stomach will remove about 90 percent of the *Necator.* Bephenium hydroxynaphthoate is especially effective against *Ancylostoma.*Iron supplements and a diet high in protein will speed recovery. Immediate prognosis is good, but the likelihood of reinfection constitutes a major health problem (Genta and Woods, 1991). Periodic mass treatment of the population has been used in some hookworm control programs. The prevention of hookworm disease consists of ensuring the sanitary disposal of human excreta (Genta and Woods, 1991).

Estimates of the number of people in the world infected with blood-sucking hookworms range from 800 million to 1.25 billion people (WHO, 1997), with at least 1.6 million suffering from significant anemia and 65,000 deaths annually. Forty-four million pregnant women are infected with hookworms, increasing their risk of iron deficiency anemia and related adverse effects on fetal growth, prematurity, and below normal birth weight (Pritchar, *et al.,* 1990). Despite these staggering statistics, there is reason for hope, since hookworms are readily eradicated by albendazole, mebendazole and other anthelmintics. Spectacular results reported by the WHO (1998) in Zanzibar, where over 99% of children harbor hookworms, prove that regular deworming increases their weight and height, improves iron stores, and reduces iron deficiency anemia, preventing the loss of 250 ml of blood per child per year at a cost of only 15 U.S. cents. By the year 2,000 intestinal helminth control programs should be implemented in at least 50% of endemic countries (Pritchar, 1990).

In 1990, hookworms were the most common human intestinal helminths identified by state diagnostic laboratories in the southern United States and Puerto Rico. Next to malaria, hookworm disease has probably attracted the attention of more physicians in the tropics than any other parasitic disease (Pritchar *et al*., 1990). Yet, despite progress in its eradication and control, it remains a major problem in many developing countries, causing considerable debility and poverty. It is not a disease which the radiologist will find easy to diagnose (Pritchar *et al*., 1990).

Probably the earliest reference to hookworm disease goes back to the papyrus papers of ancient Egypt (1600 B.C.), where it was described as a derangement characterized by anemia. Avicenna, a Persian physician of the 11th century, discovered the worm in several of his patients and related it to their disease. During the 19th century, the relationship between hookworms and anemia was established, and the disease became a focus of special concern in 1880 when it caused several fatal epidemics among miners in France and Germany. In 1897, it was established that the skin was the principal avenue of infection and the life cycle of the hookworm was clarified (Carroll *et al*., 1986).

In 1899, Stiles discovered that the "progressive pernicious anemia" seen in the southern United States was caused by *Ancylostoma duodenale*, and at the same time he defined two distinct species of hookworm capable of infecting man: *Uncinaria (Ancylostoma) duodenale* (the Old World hookworm) and *Uncinaria (Necator) americanus* (the New World hookworm). This newly found American species undoubtedly originated in Africa and was brought to the Americas during the slave trade (Carroll *et al*., 1986).

2.4.2 *Strongyloides Stercoralis*

Strongyloides stercoralis is the human parasitic roundworm that causes strongyloidiasis. It is commonly known as threadworm. However in the UK and Australia, however, the term *threadworm* can also refer to nematodes of the genus *Enterobius*, otherwise known as pinworms (Vanderkooi, 2000).

Strongyloides stercoralis nematode can parasitize humans. The adult parasitic stage lives in tunnels in the mucosa of the small intestine. The genus *Strongyloides* contains 53 species (Speare, 1989) and *S. stercoralis* is the type species. *S. stercoralis* has been reported in other mammals, including cats and dogs (Skerratt, 1995). However, it seems that the species in dogs is typically not *S. stercoralis*, but the related species *S. canis*. Non-human primates are more commonly infected with *S. fuelleborni* and *S. cebus*, although *S. stercoralis* has been reported in captive primates. Other species of *Strongyloides*, naturally parasitic in humans, but with restricted distributions, are *S. fuelleborni* in central Africa and *S. kellyi* in Papua New Guinea (Speare, 1989)

S. stercoralis has a very low prevalence in societies where fecal contamination of soil or water is rare. Hence, it is a very rare infection in developed economies. In developing countries, it is less prevalent in urban areas than in rural areas (where sanitation standards are poor). *S. stercoralis* can be found in areas with tropical and subtropical climates (Segarra-Newman, 2007).

The infective form of the worm is the larva which lives in the soil which has been contaminated by feaces of an infected worm. If a person comes in contact with the soil, the larvae may burrow through the person s skin to the lungs and then the gut where they become adult worms and produce eggs they hatch and develop into the infective larvae. *Strongyloides stercoralis* are actively motile except in formal preparations when they mobilized larvae can be identified by their forms. They are

large, measuring 200-300 μm x 15 μm and are unsheathed. They can be distinguished from hookworm larvae by their shorter buccal cavity.

In some African countries (e.g., Zaire), *S. fuelleborni* was more common than *S. stercoralis* in parasite surveys from the 1970s, but current status is unknown. In Papua New Guinea, *S. stercoralis* is endemic, but prevalence is low. However, in some areas, another species, *S. kellyi* (Dorris *et al*., 2002), is a very common parasite of children in the New Guinea Highlands and Western Province (Dorris *et al*., 2002). Knowledge of the geographic distribution of strongyloidiasis is of significance to travelers who may acquire the parasite during their stays in endemic areas (Dorris *et al*., 2002).

Because strongyloidiasis is transmittable by textiles, such as bedclothes and clothing, care must be taken never to use hotel bed sheets in endemic areas. Personal sleeping bags and using plastic slippers when showering are very important when travelling in tropical regions (Skerratt, 1995).

An unusual feature of *S. stercoralis* is autoinfection. Only one other species in the *Strongyloides* genus, *S. felis*, has this trait. Autoinfection is the development of L1 into small infective larvae in the gut of the host. These autoinfective larvae penetrate the wall of the lower ileum or colon or the skin of the perianal region, enter the circulation again, travel to the lungs, and then to the small intestine, thus repeating the cycle. Autoinfection makes strongyloidiasis due to *S. stercoralis* an infection with several unusual features (Speare, 1989).

2.4.3 *Ascaris lumbricoides*

Ascaris lumbricoides is characterized by its great size. Males are 2–4 mm in diameter and 15–31 cm long. The males' posterior end is curved ventrally and has a bluntly pointed tail. Females are 3–6 mm wide and 20–49 cm long. The vulva is located in the anterior end and accounts for about a one third of its body length. Uteri may contain up to 27 million eggs at a time with 200,000 being laid per day. Fertilized eggs are oval to round in shape and are 45-75 micrometers long and 35-50 micrometers wide with a thick outer shell. Unfertilized eggs measure 88-94 micrometers long and 44 micrometers wide (Roberts *et al.*, 2009).

This is the largest of human intestinal parasitic nematodes. Mature male and female can grow from 15-50cm and 20-35cm in length respectively. Both usually inhabit the jejunum where they feed on the semi digested food present in the host (Neva and Brown, 1994). They also secrete antitrypsin and thus capable for adequate competition with the host system for ingested proteins. They resist the normal peristaltic movement of the gut by assuming an S- shaped configuration pressing their outer cuticle against the columnar epithelium of the host. This allows them to move against peristalsis (Katz *et al.*, 1989). The mature female lays approximately 200,000 eggs per day which then passes out in the feces in an unembryonated form. (Thein-Hleing, 1993; Crompton, 1994). Under favorable conditions such as adequate moisture and shade the eggs become embryonated to form second stage larva in which they remain until they are subsequently ingested (Thein -Hleing, 1993; Crompton, 1994).

Ingested eggs hatch in the duodenum to release the larva, which penetrate the intestinal wall to reach the venules from where the larvae are carried passively to the liver via portal circulation. The larvae subsequently migrate to the heart through the inferior vena cava and are carried to the lungs by the pulmonary space and undergo

their second and third molt. Next, third stage larvae break out of alveolar space and migrate up the trachea into the pharynx where they are swallowed. After arriving at the small intestine, they undergo one more molt before they are transformed into mature worms. The mature forms made and lay more eggs (Neva and Brown, 1994). The fertilized eggs of Ascaris are yellow brown and the shell is covered by an uneven albuminous coat. They are oval or round in shape and measure 60x40µm. They contain a central granular mass which is the unsegmented ovum. The unfertilized eggs are darker in colour and have a more granular albuminous granular covering than fertilized eggs. They are more elongated than fertilized eggs measuring about 90x45 µm. The process takes approximately 3 months. (Thein-Hleing, 1993) Adult worms have a lifespan of 1-2years. Adult females can generate eggs for up to 1year (Thein-Hleing, 1993; O' Lorcain and Holland, 2000).

More than 2 billion people are affected by this infection (Murray, 2005). In the United States there is a reported prevalence of 0.8% of the total population as of 1987. *Ascaris lumbricoides* eggs are extremely resistant to strong chemicals, desiccation, and low temperatures. The eggs can remain viable in the soil for several months or even years (Roberts *et al*., 2009). Eggs of *A. lumbricoides* have been identified in archeological coprolites in the Americas, Europe, Africa, the Middle East, and New Zealand, the oldest ones being more than 24,000 years old (Dridelle, 2010).

Prevention is by improved sanitation, which includes improving access to toilets and proper disposal of faeces (Hagel and Giusti, 2010). Handwashing with soap appears protective. In areas where more than 20% of the population is affected, treating everyone at regular intervals is recommended (Dold and Holland, 2011). Reoccurring infections are, however, common there is no vaccine. Treatments recommended by

the World Health Organization are medications which includes the following drugs; albendazo, mebendazole, levamisole or pyrantelpamoate. Other effective agents include tribendimidine and nitazoxanide (Hagel and Giusti, 2010).

2.5 Epidemiology and Burden of Disease

Soil-transmitted helminthes infections are widely distributed throughout the tropics and subtropics. Climate is an important determinant of transmission of these infections as proposed by Crompton, Pierce and Miller (2010), with adequate moisture and warm temperature essential for larval development in the soil. Equally important determinants are poverty and inadequate water supplies and sanitation. In such conditions, soil transmitted helminth species are commonly co endemic (Christian *et al*., 2004). There is evidence that individuals with many helminth infections have even heavier infections with soil transmitted helminths. Because morbidity from these infections and the rate of transmission are directly related to the number of worms harboured in the host, intensity of infection is the main epidemiological index used to describe soil-transmitted helminth infection (Wani *et al*., 2007). Marsh 2002 explained the intensity of infection is measured by the number of eggs per gram of faeces, generally by the Kato-Katz faecal thick-smear technique. For *A lumbricoides* and *T trichiura*, the most intense infections are in children aged 5–15 years, with a decline in intensity and frequency in adulthood. Although heavy hookworm infections also occur in childhood, frequency and intensity commonly remain high in adulthood, even in elderly people (Hotez *et al*., 2004 and Hotez *et al*., 2007).

Several works have been carried out in Nigeria over the years in different parts of the country on the prevalence of intestinal helminthes and its associated diseases among

many groups of people. Ahmed, *et al*., (2003) reported that 30.8% of students in Katsina were infected with at least one intestinal helminthes. Also, prevalence of intestinal helminthes in some patients in Zaria has been reported to be 1.67% for *Strongyloids stercoralis* only and 62.7% of other helminthes (Abdullahi and Abdulazeez, 2000). The high percentage of children with severe infection with STH is clinically important because problems associated with this infection are proportional to the worm burden. Other complications of soil-transmitted helminthiasis, such as intestinal obstruction in severe ascariasis, or dysentery and rectal prolapsed in severe *trichuriasis*, have been reported in Southern Nigeria by Nwosu (2010), in Ibadan by Ayanwale *et al* (1982) and Bauchi in 2012 by Akogun.

In 2013 Auta, *et al.,* examined 283 school children in Gwagwada, Kaduna State for the study of which 190 (67.1%) were positive for at least one of the intestinal parasites encountered. The prevalence of intestinal helminthes found were *Ascaris lumbricoides* (30.7%), Taenia species (23.0%), *Schistosoma mansoni* (11.7%), Hookworm (6.4%), *Trichuris trichiura* (4.9%), *Enterobius vermicularis* (4.6%), *Strongyloides stercoralis* (4.2%) and *Hymenolepis nana* (3.9%). The prevalence of the helminth by sex revealed higher prevalence among males (67.7%) than females (66.4%). The prevalence of intestinal helminthes in relation to contact with water bodies showed that all the school children examined were equally exposed to intestinal helminth whether they had contact with water bodies or not as eachzs3 category had a prevalence of 67% and, in relation to the age of the school children, the highest prevalence of 75.0% was observed in the age group 13-15 years while the lowest prevalence of 44.4% was found in the age group > 16 years. The surveys provide basis for development of control programmes at national, state and local levels.

2.6 Sanitation and Hygiene

Undoubtedly improved sanitation and hygiene are essential for the long-term control of parasitic diseases. The availability of latrine facilities is associated with lower helminth and protozoan intensities. However, the impact of introducing sanitation on infection levels may only be evident after decades (Esrey *et al*., 1991) and may not be completely effective. For example, in one study, hookworm prevalence declined by only 4% after the introduction of latrines (Huttly, 1990). Despite associations between hookworm infection and use of footwear to protect from exposure to infective larvae, there is debate as to whether promotion of footwear is an effective control strategy (Albonico *et al*., 2004). Furthermore, the impact of footwear on interrupting hookworm transmission has probably been overestimated, given that *N. amerianus* infective larvae penetrate all aspects of the skin and *A. duodenale* larvae are orally infective. The long time required for improved sanitation and behavior change to occur necessitates a need for a quick acting, medium-term measure to control helminth infections, namely chemotherapy (Albonico *et al*., 2004).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

Jaba Local Government Area is located in southern part of Kaduna State between latitude 9º 20′ 0″ N and 9º 35′ 0″ N longitude 7º 55′ 0″ E and 8º 10′ 0″ E with approximate land mass of 640 square kilometers, bounded in the north and west by Kachia and Kagarko Local Government Area of Kaduna State, to the East by Zango Kataf and Jama'a Local Government Area and bordered with Nasarawa State from the southern part of Nigeria. The LGA Headquarter is at Kwoi. The inhabitants are Jaba people by tribe. The major occupation of the people is farming and hunting. The temperature is between 34°C to 37°C with two distinct seasons. The raining season starts from April to October while dry season is from November to March. The popula tion of Jaba Local Government according to the 2006 National Census is 155,973 (NPC, 2006) In these communities, portable water supply is inadequate and major parts still depend largely on natural sources of water, the stream, river, lakes, ponds and there is poor sanitory condition of the area.

3.2 The Study Population

Table 3.1 shows the population which comprises primary school pupils between the ages 5-12 years. Twelve primary schools were randomly selected for the study. One school from each (six) district based on stratified random sampling was selected but in Ankung, Fai and Samban that has the highest number of school, two schools were selected. A total of six hundred pupils, 50 from each school were selected for the study between September and November, 2013.

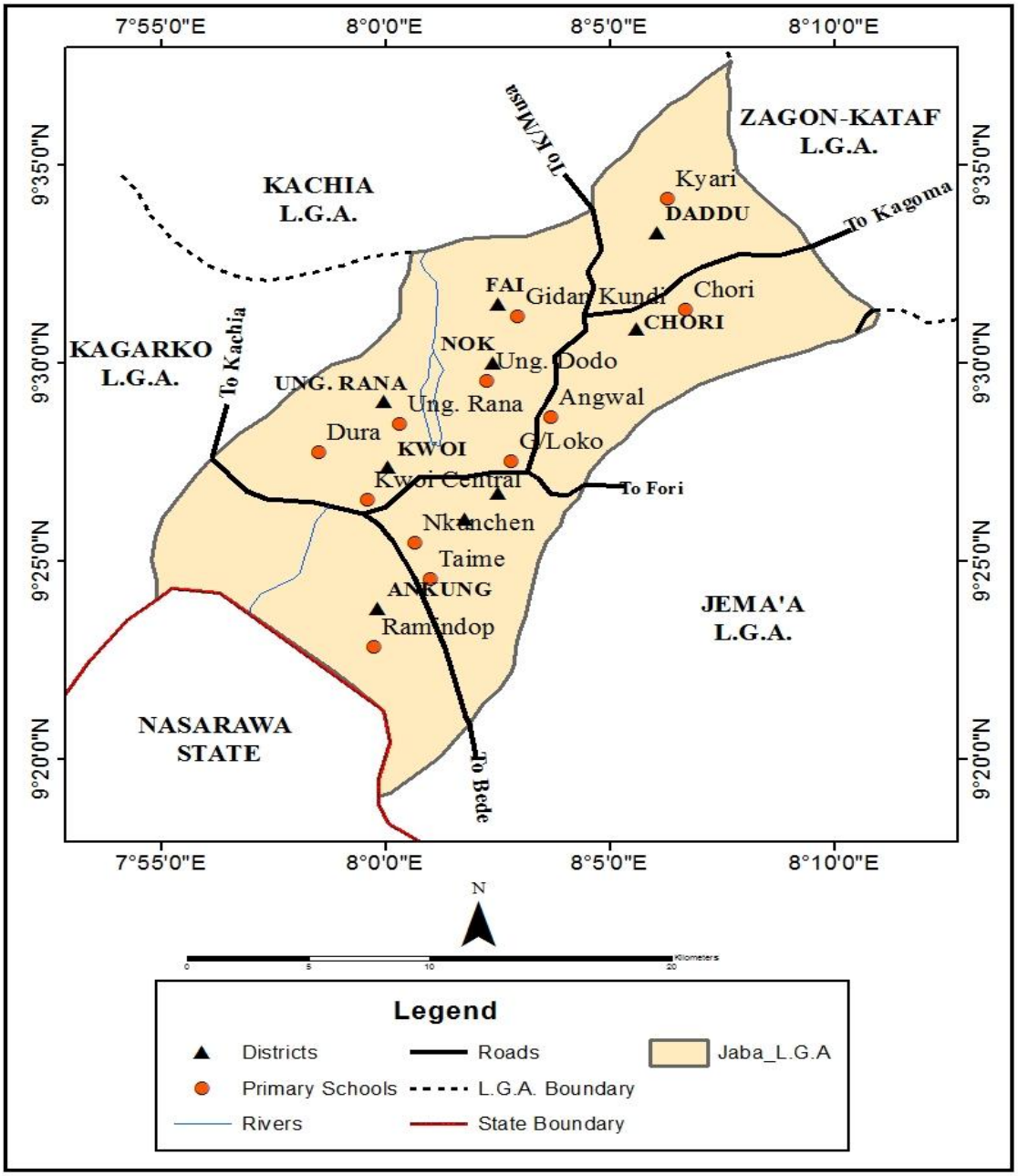


Fig 1: Map of Jaba L.G.A (Adapted) showing the districts and the primary schools.

Source: Jaba L.G. Council

Table 3.1 Jaba Local Government Education Authority. Name of district and number of School per district.

S/NO	DISTRICT	NO. OF SCHOOLS
1	Ankung	15
2	Chori	9
3	Daddu	10
4	Fai	13
5	Hakwain	10
6	Kwoi	11
7	Nok	7
8	Ungwan Rana	10
9	Sambang	15
	TOTAL	**100**

3.3 Sample Size Estimation

A projected prevalence of 3.3% based on the previous study by Ahmed (2004) was used to determine the sample size from the formula below. The total sample size from each district was estimated using the standard formula of Handerson and Sundaresan; $N=Z^2PQ/D^2$ (UNDP/World Bank/WHO, 2001).

Where;

N = the number of samples that were collected

Z = the normal deviation (1.96 for an alpha of 0.05) corresponding to a confidence interval of 95%

P = the proportion of symptomatic and asymptomatic people that were expected to harbour geohelminths. (3.3%, 0.033)

Q = 1-P. (1- 0.033) = 0.877

D^2 = is the precision of the estimates, which is taken as 5% (0.05)

Substituting the values in the formula;

$$N = \frac{(1.96)^2 \times 0.033 \times 0.877}{(0.05)^2}$$

$$N = \frac{0.11117975}{0.0025}$$

$$N = 44.4719$$

$$N = 45$$

The minimum sample size is 45 per school but was increased to 50 per school to give a round figure.

3.4 Clearance form

Samples were collected from selected school pupil with the informed consent of the council authorities, community leaders, parents, school heads, teachers and the pupils themselves.

3.5 Sample Collection

The name, age and sex of each pupil were obtained from the class register provided by each class teacher. Each pupil was given a wide- mouth screw capped sample bottle bearing serial number that was assigned to the pupils name in the record book. The pupils were instructed on how to collect their stool sample into the containers between 7 and 10 am.

3.6 Laboratory Analysis of Faecal Samples

The faecal samples were preserved in 10% formalin before taking to the laboratory for analyses. Fecal analysis was achieved by using both direct smear method and formol-ether concentration technique (Nmorsi, *et al.*, 2009).

3.6.1 Direct smear method

A drop of normal saline was placed on a clean slide with the aid of a clean dropper. A small quantity (1g) of the faeces was mixed with it using a glass rod to obtain a thin smear. Large particles were removed before a cover slip was placed on the smear. A drop of Lugol's iodine was added to the edge of the cover slip and allowed to diffuse into the saline mount. The smear was examined using a binocular light microscope for the presence of geohelminth and *Schistosoma mansoni* eggs or larva using the x10 objective lens.

3.6.2 The formol-ether concentration technique

The formol-ether concentration technique was done by placing 2g of the feaces into a test tube containing 10ml of distilled water. This was emulsified and the mixture was strained through a gauze-sieve into a centrifuge tube and centrifuged at approximately 2,500 r.p.m for 3minutes. The supernatant was decanted and 10% formol-saline was added to the tube containing sediments within 2.5mm of the top of the tube and then mixed with a glass rod. About 3ml of ether was added to the mixture in the tube, corked and then shaken vigorously. The mixture was centrifuged again for two minutes at 2,000 r.p.m. after which, the fatty debris at the interface of the liquids was loosened with a swab-stick, and the whole supernatant fluid together with the debris was poured away. A drop of Lugol's iodine solution was added to the deposit at the bottom of the tube and shaken. A drop of the content was pipette on a microscope glass slide covered with a coverslip and examined under light microscope using the x10 objective lens. The eggs were also photomicrographed using owo film, in an Olympus camera attached to a wild microscope (Model No. M40-1-02438).

3.7 Identification of the Parasite

Parasites eggs/ova or cyst observed were identified by using the text of Sloss and Kemp(1978) and Soulsby (1982). Further confirmatory identification was carried out at the Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, A.B.U. Zaria.

3.8 Administration of Questionnaires

A structured questionnaire was administered to the pupils. Information obtained includes, name, age, sex, class, name of the school, parents occupation, source of water, type of toilet used, water contact activities and personal hygiene

3.9 Data Analysis

The descriptive data was analyzed with standard techniques such as mean, standard deviation, frequency counts and percentage. Simple vicariate analysis using 2 x 2 contingency table analyses with χ^2 was utilized to investigate differences between proportions. Value of $P \leq 0.05$ was considered significant. The crude and adjusted odds ratio obtain from the vicariate and multiple logistic regression analyses was presented in 95% confidence intervals, Students T-tests and one way analysis of variance (ANOVA) was used to test mean differences.

CHAPTER FOUR

4.0 RESULTS

4.1 Identification and Prevelence of Geohelminthiasis and Schistosomiasis among Pupils

Out of the 600 students examined 95(15.8%) were found to be infected with at least one species of geohelminth or *Schistosoma mansoni*, The overall prevalence for *S. mansoni* was 7.5%. LGEA primary school Angwal had the highest prevalence of *Schistosoma mansoni* of (52.0%) followed by Ungwa Dodo and Sambang with a prevalence of (8.0%) each while LGEA Gidan Kundi had the least (2.0%). The prevalence of Hookworm was (6.0%).The pupil of LGEA Sambang and LGEA Kyari had the highest prevelance of Hookworm of (18.0%) each, LGEA Angwal had the prevalence (14.0%) while Chori Baraki, Ungwa Dodo, Ramindop A. and Taime had the least prevalence (2.0%) each. The prevalence of *Ascaris lumbricoides* was (2.0%). LGEA Sambang and Ungwan Rana had the highest prevalence of *Ascaris lumbricoides* of (6.0%) each, while the least prevalence (2.0%) was obtained from LGEA Chori Baraki, Kwoi Central, Ungwa Dodo and Taime (Table 4.1).

Table 4.1 Identification and prevelence of geohelminthiasis and Schistosomiasis among pupils

\LGEA Schools	Number Examined	*Schistosoma Mansoni*	Hookworm	*Ascaris lumbricoides*	*Strongyloides stercoralis*	Total	Mean
Angwal	50	26(52.0)	7(14.0)	0	0	33(66.0)	16.5±380
Central Kwoi	50	2(4.0)	6(12.0)	1(2.0)	0	9(18.0)	4.5±3.80
Chori Baraki	50	0	1(2.0)	1(2.0)	0	2(4.0)	1.0±3.80
Dura	50	2(4.0)	0	2(4.0)	0	4(8.0)	2.0±3.80
Fai	50	1(2.0)	3(6.0)	1(2.0)	1(2.0)	6(12.0)	3.0±3.80
Gidan Kundi	50	1(2.0)	0	0	0	1 (2.0)	0.5±3.80
Kyari Daddu	50	0	7(14.0)	0	0	7(14.0)	3.5±3.80
Ungwa Dodo	50	4(8.0)	1(2.0)	1(2.0)	1(2.0)	7(14.0)	3.5±3.80
Ramindop A	50	2(4.0)	1(2.0)	0	0	3(6.0)	1.5±3.80
Ungwa Loko Sambang	50	4(8.0)	9(18.0)	3(6.0)	0	16	8.0±3.80
Taime	50	3(6.0)	1(2.0)	1(2.0)	0	5	2.5±3.80
Ungwan Rana	50	0	0	2(4.0)	0	2	1.0±3.80
Total	600	45(7.5)	36(6.0)	12(2.0)	2(3.3)	95	
Means		7.5±2.20[a]	6.0±2.20[ab]	2.0±2.20[ab]	0.3±2.20[b]		
ANOVA		P-value					
Location		0.236					
Parasites		0.092					
Error		Not applicable					

Strongyloides stercoralis had the prevalence of (3.3%). *Strongyloides stercoralis* had a prevalence of 2.0% each in LGEA Fai and Ugwa Dodo. The low prevalence of *Strongyloides stercoralis* in faeces agreed with previous studies (Ijagbone and Olagunji, 2006; Adeboye *et al.*, 2007).

4.2 Prevalence based on Age Distribution

The pupils aged 12years and above had the highest prevalence (43.4%), Pupils under this age-group play a lot in the sand. Besides, little or no care is given to them; they are allowed to do things on their own (Obiukwu *et al*., 2008) unlike those in age-group of 3-5 years had the lowest (2.9%) (Table 4.2). There was no significant difference (P>0.05) in prevalence between the various age groups in the selected schools.

4.3 Prevalence of Infection in Relation to Sex

Table (4.3) shows the sex specific prevalence showed the highest prevalence in males (17.7%) than females (13.8%). There was no statistically significant difference (P>0.5) in prevalence between males and females. This corroborates other reports (Obiukwu *et al.* 2008; Egwunyenga and Atakiru, 2005). They reported that both males and females had the same chances of being infected by these parasites.

Table 4.2: Prevalence of parasite based on age distribution in selected primary schools in Jaba Local Government Area

Age(Years)	Number Examined	Number Positive	Percentage
3-5	202	6	3.0

6-8	124	22	17.8
9-11	198	34	17.1
≥12	76	33	43.4
Total	600	95	15.8
χ^2=7.831		df=3	P value=0.166

Table 4.3 Prevalence of parasites based on sex of pupils

Sex	Number Examined	Positive	Percentage
Male	310	55	17.7
Female	290	40	13.8
Total	600	95	15.8
χ^2=0.645	df=1	p-value=0.422	

4.4 Prevalence in Relation to Risk Factors

Table 4.4 shows the prevalence in relation to risk factors. The type of toilet used by the pupils,pit latrine (OR=13.22), the source of water for drinking and other domestic chores; stream (OR=1.97), well (OR=1.24) water contact activities; fishing (OR=1.30), personal hygiene; washing of hands (OR=1.02), parent occupation; farmers (OR=1.01), traders (OR=1.15) were associated with the prevalence of geohelminthiasis and intestinal schistosomiasis in the study area (OR≥1). Water closet (OR=0.65), tap (OR=0.53), borehole (OR=0.74), swimming (OR=0.77) and civil servants (OR=0.84) did not associate with the prevalence of the the parasite infection among the pupils (OR<1).

Table 4.4: Prevalance of geohelminthiasis and intestinal schistosomiasis in relation to risk factors

Risk Factors	No. Examined	No. Positive	Percentage	Odd Ratio	C.I
Type of Toilet					
Pit latrine	420	59	14.1	13.22	4.1-1.03
Water closet	40	26	65.0	0.05	6.58-6.53
Bush	140	10	7.1	0.34	0.17-0.67
Sources of water					
Stream	209	46	22.0	1.97	1.26-3.7
Well	311	37	11.9	1.24	0.34-0.84
Tap	32	6	18.8	0.53	0.50-3.10
Bore hole	48	6	12.5	0.74	0.31-1.80
Water Contact activities					
Swimming	220	38	17.3	0.77	0.47-1.26
Fishing	187	40	21.4	1.30	0.80-2.14
Personal hygiene					
Washing of hands	570	77	13.5	1.02	0.72-1.45
Wearing of shoes	504	67	13.2	0.98	0.69-1.40
Parents Occupation					
Civil servants	107	15	14.0	0.84	0.46-1.53
Farmers	378	60	15.9	1.01	0.64-1.59
Traders	115	20	17.4	1.15	0.67-1.98



Plate 1: *Schistosoma mansoni* eggs

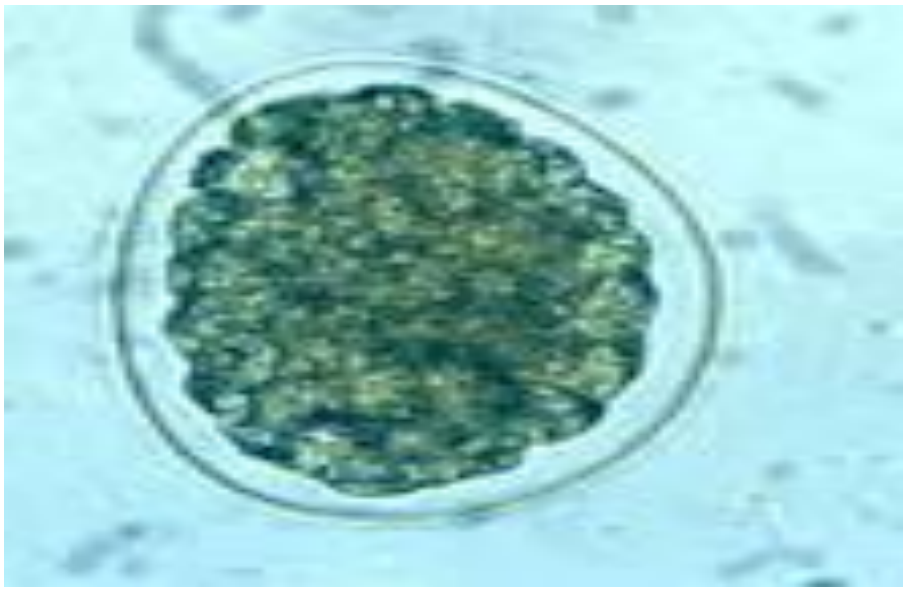
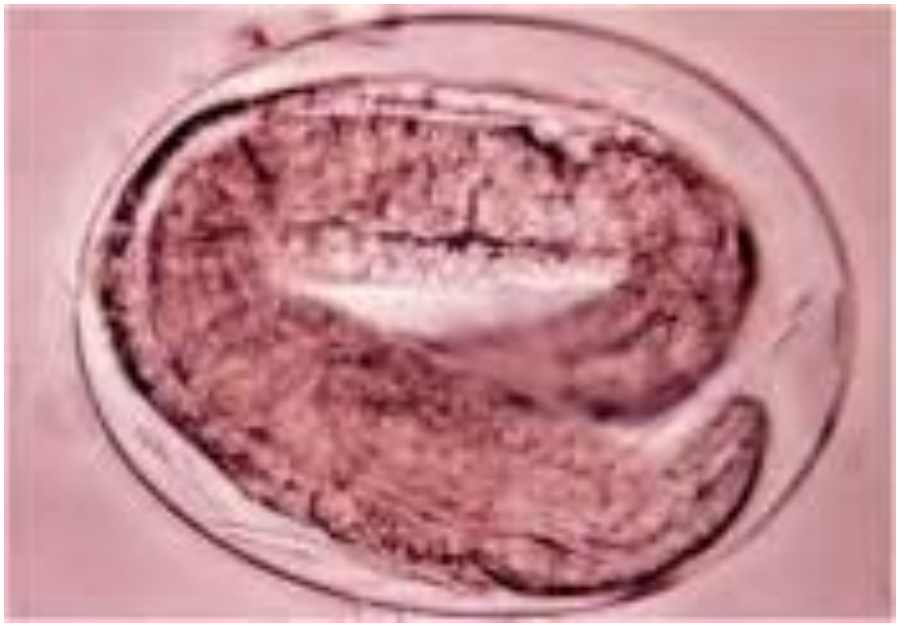


Plate II: Hookworm egg



Plate III: *Ascaris lumbricoides* egg



PlateIV*:* *Strongyloides stercoralis* larva

CHAPTER FIVE

5.0 DISCUSSION

The results of the study demonstrate high prevalence of intestinal parasites among school pupils in the study area. The high prevalence observed in this study could be due to the fact that a great number of pupils prefer to defecate in the nearby bush and farms around their school, because their pit latrines were always soiled. It could also be as a result of infection from their homes, Similar studies by Mba and Amadi (2001), and Okon and Oku (2001) reported high prevalence of parasitic infections in the rural setting, pri-urban and urban- slum. Crompton (1999) reported that the high prevalence observed in his study was attributed to poor environment and personal hygiene, shortage of good water supply and indiscriminate defecation. *Schistosoma mansoni*, was the most prevalent intestinal helminth among pupils in the area. The parasites have been reported in humans from Kaduna, Adamawa, Niger, and Benue States of Nigeria (Idris, 1988, Akogun and Badaki, 1988, Nwosu and Ogunrinade, 1999; Akogun and Akogun, 1999). Intestinal and helminthic infections are caused by ingesting the cysts, eggs or larval stages of the agent while drinking contaminated water, eating improperly washed or uncooked vegetables irrigated with water, or direct contaminated contact with water containing the infective stages, making it impossible to penetrate the skin of humans (Okuofu and Oniye, 1995, Fabiyi, 2001). Such exposures are usually enhanced by illiteracy, poor personal and environmental hygiene which are more prevalent in the study area.

The prevalence of infection among the male pupils (17.7%) was higher than their female (13.8%) counterparts but this was not statistically significant. This could be attributed to the fact that males have fewer restrictions than the females whose leisure hours are

strictly controlled. The males are free to swim, play games and work in the farms and gardens than their protected female counterparts. Akogun and Badaki (1988) observed that *schistosomiasis* affected more males than females in a settlement near Yola. Etim *et al*., (2002) obtained similar result in Biasie area of Cross River State.

The highest prevalence of infection among older pupils compared with the younger is not statistically significant. It could be attributed to the more rigorous activities they involve in, such as fetching of water for domestic or school services, playing harder games, gardening etc, which could expose them to infection. These categories of pupils are the seniors in the schools and so are freer. Also at home, they assist in carrying most of the domestic activities. They may therefore expose themselves to infection in the home, farms, and gardens or within the school environment.

The low prevalence among the younger category of pupils may be through the restrictions imposed on them. Similarly, in the study area, almost all household water comes from the local river, springs and open wells which are unprotected from the droppings of wild and domestic animals. Furthermore, household waste water is frequently discharged into the local river, which further promotes the transmission of pathogenic intestinal helminths and *Schistosoma mansoni* down river.

Generally, transmission of infection can be during outdoor play with no slippers or shoes on soil contaminated with faeces (Adeoye *et al*., 2007). Some of the children might have contacted infection through ingestion of helminth eggs and schistosoma eggs in contaminated food, drinking infected water, eating with or licking unwashed contaminated hands and fingers, clothing or air, especially during outdoor play in the soil

(Adeoye *et al*., 2007). Combination of defecating in open spaces, playing in soil and the geophagus habit of the children could be a good source of high helminth infection (Etim and Akpan, 1999).

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

I The prevalence of geohelminthiasis and schistosomiasis among primary school pupils in Jaba Local Government is high (15.8%) and is well associated with *Schistosoma mansoni* and hookworm infection.

II Age group 12 and above years, recorded highest prevalence. But male and female have equal chances of acquiring the disease because they play on the same ground and most of them eat without washing their hands.

III pupils of rural schools harbor more intestinal parasites than their urban counterparts due to differences in the observance of personal and environmental hygiene and access to information.

6.2 Recommendations

I Since the prevalence of the geohelminth and schistosomiasis is high in the study area, it is recommended that the pupils should enroll in the deworming programme. The World Health Organization has also recommended regular mass treatment for schools where the prevalence of geohelminths infection exceeded 50% (WHO, 2012). In areas where the prevalence of mild to moderate underweight exceeds 25% and where parasites are wide spread, high priority should be given to deworming programme. It is important for regular deworming programme for the school children to be carried out until such time when the measures taken have reduce the prevalence of geohelminths infection and malnutrition to a low level with

standard of sanitation adequate to prevent transmission and re-occurrence of the infection.

II There should be public health enlightment campaign on the mode of transmission of the parasite among primary school pupils. It is recommended that as a means of preventing intestinal helminthiasis among the pupils, public education on the need for improved disposal of human and animal feces.

III There should be proper control of domestic animals living in or around the houses, observance of good personal and environmental hygiene and the need for the pupils to wear shoes for protection against worm stages that penetrate skin, should be emphasized. Significant effort should be geared towards improving environmental conditions, provision of safe and clean water, provision of adequate sanitation and social infrastructure so as to improve the care capacity of mothers food handlers to protect children from food borne diseases or harzards (Balthazar and Land, 1993).

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APPENDIX 1 Research Questionnaire

AHMADU BELLO UNIVERSITY, ZARIA

FACULTY OF SCIENCES
DEPARTMENT OF BIOLOGICAL SCIENCES

SEPTEMBER, 2013

RESEARCH QUESTIONNAIRE

TITLE: PREVALENCE OF GEOHELMINTHIASIS AND INTESTINAL SCHISTOSOMIASIS IN PRIMARY SCHOOL PUPILS IN JABA LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA.

SIR,

KINDLY ASSIST TO FILL IN THE APPROPRIATE ANSWER TO THE QUESTIONS BELOW; FOR EACH CHILD ENROLLED INTO THE RESEARCH STUDY. ANSWERS PROVIDED WILL BE USED FOR THE RESEARCH PURPOSE **ONLY**.

1. REF. №.: …… 2. GENDER ……

3. SCHOOL: ……..…… 4. CLASS: ……..

5. HEIGHT: …… 6. AGE: …… 7. PLACE OF BIRTH: ……..

8. OCCUPATION OF PARENT: ……

9. EDUCATIONAL QUALIFICATION (S) OF THE PARENT: ……..

10. TYPE OF FAMILY: …….. 11. FAMILY SIZE: ……

12. TYPE OF TOILET: …… 13. NUMBER OF TOILETS……..

14. DO YOU WASH YOUR HANDS AFTER DEFAECATION? :……..

15. DO YOU WASH FRUITS AND VEGETABLES BEFORE EATING? : …….

16. METHODS OF REFUSE DISPOSAL: ……..

17. SOURCE OF DRINKING WATER: …….....

18. SOURCE OF LAUNDRY WATER: …….....

19. DO YOU SWIM IN THE RIVER? :……

20. ARE YOU AWARE OF DISEASES CAUSED BY GEOHELMINTH?: …….

21. DO YOU TRIM YOUR FINGER NAILS? : …… 22. ARE YOU DEWORMED?.....…

23. LAST VISIT TO THE HOSPITAL/CLINIC: …….

FOR RESEARCHER USE ONLY

RESULT OF LAB EXAMINATION:

1. MACROSCOPIC FAECAL EXAMINATION
   a. Formed ( ) b. Diarrheic ( ) c. Blood ( ) d. Musuc ( )

2. MICROSCOPIC FEACAL EXAMINATION (Eggs and/or Larvae seen)
   a. *Ascaris lumbricoides*: ……
   b. *Trichuris trichiura*: ……
   c. Hookworm: ……
   d. *Schistosoma mansoni*: ……
   e. Taenia species: ……...
   f. *Entamoeba coli*: ……
   g. *Enterobius vermicularis*: ……
   h. *Entamoeba histolytica*: ……...