GASTRO-INTESTINAL PROTOZOANS AND HELMINTHS INFECTING CHILDREN IN DAYCARE CENTRES AND NURSERY SCHOOLS IN SABON-GARI LOCAL GOVERNMENT AREA OF ZARIA, KADUNA STATE

BY

GLORIA NYARIM JOSEPH

DEPARTMENT OF ZOOLOGY,

AHMADU BELLO UNIVERSITY, ZARIA

NIGERIA

MAY, 2017

GASTRO-INTESTINAL PROTOZOANS AND HELMINTHS INFECTING CHILDREN IN DAYCARE CENTRES AND NURSERY SCHOOLS IN SABON-GARI LOCAL GOVERNMENT AREA OF ZARIA, KADUNA STATE

BY

Gloria Nyarim JOSEPH (B.Sc. Zoology, ABU, 2010)
(MSC/SCI/31510/2012-2013)

A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc.) DEGREE IN ZOOLOGY

DEPARTMENT OF ZOOLOGY,
FACULTY OF LIFE SCIENCE,
AHMADU BELLO UNIVERSITY, ZARIA
NIGERIA

MAY, 2017

DECLARATION

I declare that the work in this thesis entitled "**Gastro-intestinal protozoans and helminths infecting children in daycare centres and nursery schools in Sabon-Gari Local Government Area of Zaria, Kaduna State**" was carried out by me in the Department of Zoology, under the supervision of Prof. T.O.L. Aken'Ova and Dr. E. Kogi. 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.

Gloria Nyarim JOSEPH _____ _____

Signature Date

CERTIFICATION

This dissertation entitled "**GASTRO-INTESTINAL PROTOZOANS AND HELMINTHS INFECTING CHILDREN IN DAYCARE CENTRES AND NURSERY SCHOOLS IN SABON-GARI LOCAL GOVERNMENT AREA OF ZARIA, KADUNA STATE**" by Gloria Nyarim JOSEPH meets the regulations governing the award of the Master of Science degree in Zoology of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

Professor T.O.L. Aken'Ova _____ _____
Chairperson, Supervisory Committee Signature Date
Department of Zoology,
Ahmadu Bello University, Zaria.

Dr. E. Kogi _____ _____
Member, Supervisory Committee Signature Date
Department of Zoology,
Ahmadu Bello University, Zaria.

Professor I. S. Ndams _____ _____
Head of Department Signature Date
Department of Zoology,
Ahmadu Bello University, Zaria.

Professor S. Z. Abubakar _____ _____
Dean, School of Postgraduate Studies, Signature Date
Ahmadu Bello University, Zaria.

DEDICATION

This thesis is dedicated to God Almighty for giving me strength and inspiration; and to my family, especially my husband and children, for their patience, support and understanding during the course of this work.

ACKNOWLEDGEMENTS

My appreciation goes to Almighty God for the inspiration, guidance, provision and protection throughout the course of this research.

My profound gratitude to my team of supervisors, Prof. T. O. L. Aken'Ova and Dr. E. Kogi for painstakingly reading my work, for their corrections and contributions to the quality of this research. I am forever indebted to them.

I would like to thank Mal. Saleh Usman and Mal. Ibrahim Bello for technical assistance, and Mr. Kingsley Solomon of Entomology and Parasitology Research Laboratory, Department of Zoology, for always making the laboratory available to me during my research and for technical assistance; My thanks also to Mrs. Lami Samson for her time and assistance with letters that I needed to the sampled schools.

My thanks to my Friends: Sim Ahmadu, Kamba Bayo, Ugochukwu Oguike, Kabadiya Dawuda, Michelle Olise, Emmanuel Abah and Paul Abu for their support and encouragement. I will forever remain grateful.

Finally to my husband-Martin Edache; my children-Joshua and Ochanya; and my siblings-Godwin, James, Grace and Patience; I appreciate every bit of your love, patience, concern and support to me. I honestly cannot appreciate you enough.

ABSTRACT

Intestinal infections caused by protozoans and helminths are globally endemic and have been described as constituting the greatest worldwide cause of illness and disease, with more severe cases in children. The prevalence and risk factors of gastro-intestinal parasitic infections of protozoans and helminths in children in seventeen (17) schools (daycare and nursery sections), in Sabon-Gari Local Government Area of Zaria, Kaduna State, were investigated. The study was carried out between January and March, 2015 (dry season), and between May and July, 2015 (wet season). Questionnaires were administered and a total of 772 stool samples were collected from the children and examined for parasite cysts and eggs. The stool samples were examined using formol-ether concentration technique and data obtained were analysed using Microsoft Excel and Epi-info software packages. The overall prevalence of the protozoa plus helminths was 9.33%. The cysts of two intestinal protozoans, *Balantidium coli* Malmsten, 1857 (0.26%) and *Entamoeba histolytica* Lesh, 1873 (0.26%), and eggs of six intestinal helminths: Hookworm (4.92%); *Ascaris lumbricoides* Linnaeus, 1758 (3.50%); *Dipylidium caninum* Linnaeus, 1758 (0.52%); *Diphyllobothrium latum* Linnaeus, 1758 (0.39%); *Strongyloides stercoralis* Normand, 1876 (1.04%) and *Hymenolepis nana* Grassi, 1887 (0.26%) were identified. The protozoan cysts were only observed in the stool samples of nursery school children. There was a higher and statistically significant difference in prevalence of intestinal protozoans and helminths in girls (12.04%) than in boys (6.67%) ($P = 0.007$). Increase in age was found to be positively and significantly associated with the intestinal protozoan and helminth infections ($P = 0.000695$), with the lowest prevalence in children aged between 0 and 2 years (5.00% and 4.76%) and highest prevalence in the 6year-olds (12.26%). The prevalence of intestinal parasitic protozoan and helminth infections among children in the day care and nursery schools was associated with risk factors such as improper hand-washing, drinking of tap water, possession of domestic animals, use of pit latrines and sharing of toilets between staff and children, and the dry season ($OR \geq 1$). This study has identified that intestinal parasites are prevalent among children in day care centres and nursery schools in Sabon-Gari Local Government Area of Zaria, there is therefore the need for an intervention programme for sustainable elimination of these intestinal parasitic infections.

TABLE OF CONTENTS

Contents **Page**

Title page……..……..…….....i

Declaration……...iii

Certification……..iv

Dedication……..…v

Acknowledgements……..…….....vi

Abstract……...vii

Table of Contents……....viii

List of Tables…….……...…...xi

List of Figures…….xii

List of Plates…….……..xiii

List of Appendices…….……..…….....xiv

CHAPTER ONE

1.0 INTRODUCTION……...1

1.1 BACKGROUND OF THE STUDY…….....1

1.2 STATEMENT OF THE RESEARCH PROBLEM……...…2

1.3 JUSTIFICATION…….……...3

1.4 AIM……...3

1.5 OBJECTIVES…….…….....4

1.6 HYPOTHESES……....4

CHAPTER TWO

2.0 LITERATURE REVIEW…….……..…….....6

2.1 Intestinal parasites ……..…….....6

2.2 Intestinal protozoans ……..…….....6

2.2.1 Global distribution and prevalence of intestinal protozoans ……..7

2.2.2 Distribution and prevalence of intestinal protozoan in Nigeria……..8

2.2.3 Transmission and pathogenesis of some intestinal protozoans…….…....9

2.2.4 General Life-cycle of intestinal protozoans…….…….10

2.3 Intestinal helminths……..……..11

2.3.1 Global distribution and prevalence of intestinal helminths……..…..……11

2.3.2 Distribution and prevalence of intestinal helminths in Nigeria...…..……12

2.3.3 Transmission of intestinal helminths …….…….…….13

2.3.4 Pathogenesis of some intestinal helminths……...…….……...14

2.3.5 General life-cycle of intestinal helminths……15

CHAPTER THREE

3.0 MATERIALS AND METHODS…….16

3.1 Study Area……..16

3.2 Study population ……....16

3.3 Ethical clearance.....16

3.4 Sample Size …..…….....16

3.5 Tools for data collection……..…..…….....19

3.6 Laboratory examination of stool samples ……..……..21

3.7 Data Analysis……..21

CHAPTER FOUR

4.0 RESULTS…….....23

4.1 Prevalence of species of intestinal protozoans and helminths in children of the daycare centres and nursery schools..……..…..23

4.2 The prevalence of intestinal protozoans and helminths in the nursery schools children 23

4.3 The prevalence intestinal helminths in children of the daycare centres ……33

4.4 Prevalence of intestinal helminths among the children according to age…...33

4.5 Prevalence of intestinal protozoans and helminths among children according to gender…..…….....33

4.6 Prevalence of intestinal helminths in children of the nursery schools during the dry and wet seasons…..…….37

4.7 Prevalence of intestinal helminths in children of the day care centres during the dry and wet seasons ……..…….…37

4.8 Relationship between some risk factors and the prevalence of intestinal protozoans and helminths in children of the daycare centres and nursery schools…….……..40

CHAPTER FIVE

5.0 DISCUSSION…….……..…..……42

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS……..….....48

6.1 Conclusions……...….....48

6.2 Recommendations……..……49

REFERENCES…….……..……...50

APPENDICES…….……...55

LIST OF TABLES

Table Page

4.1 Summary of infestation data of species of intestinal protozoans and helminths in children of daycare centres and nursery schools……...31

4.2 The prevalence of intestinal protozoans and helminths in children of the nursery schools ……...……...….32

4.3 The prevalence of intestinal helminths in children from daycare centres…..……34

4.4 Prevalence of intestinal protozoans and helminths in children according to age……...35

4.5 Prevalence of intestinal protozoans and helminths in children according to gender……36

4.6 Prevalence of the intestinal helminths in children of the nursery schools during the dry and wet seasons…...……...……...38

4.7 Prevalence of intestinal helminths in children of the daycare centres during the dry and wet seasons.....39

4.8 Relationship between some risk factors and the prevalence of intestinal protozoans and helminths among children in the daycare centres and nursery schools...…...……41

LIST OF FIGURES

Figure **Page**

3.1 Map of Nigeria showing the 36 states and the Federal Capital Territory and map of Kaduna State showing the Local Government Areas…….17

3.2 Map of Sabon Gari Local Government area showing locations of the schools sampled….....18

LIST OF PLATES

Plate		**Page**
I	Cysts of *Entamoeba histolytica*	24
II	Egg of *Dipylidium caninum*	25
III	Egg of *Diphyllobothrium latum*	26
IV	Egg of *Hymenolepis nana*	27
V	Egg of *Ascaris lumbricoides*	28
VI	Hookworm egg	29
VII	*Strongyloides stercoralis* egg	30

LIST OF APPENDICES

Appendix		Page
I	Questionnaire ……..….55	
II	Prevalence of intestinal parasites among children and nannies in daycare and nursery schools in the dry season……..….56	
III	Intestinal parasites common to children and the nannies from some sampled daycare centres and nursery schools……..….57	

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

Intestinal parasitic infections caused by protozoans and helminths are globally endemic and have been described as constituting the greatest worldwide cause of illness and disease (Chan, 1997; Pillai and Kain, 2003). It has been estimated that 3.5 billion people worldwide are infected with intestinal parasites and the most affected population with highest morbidity are children (Lawn *et al.*, 2005; Chirdan *et al.*, 2010). Also, over 270 million preschool children and over 600 million school-age children live in areas where these parasites are intensively transmitted (WHO, 2015). Intestinal parasitic infections in children have been attributed to their exposure to contaminated meals at onset of weaning when the child's immune system and personal hygiene are still poor, and when the child is beginning to explore the environment through crawling and other activities (Yilgwan and Okolo, 2012).

Although infections with intestinal protozoans and helminths are said to cause problems to their hosts, parasites are seen to live for long periods in the bowel without causing symptoms or requiring treatment (Haque, 2007). Certain risk factors have been associated with the proliferation of these intestinal parasitic infections among which are low socio-economic status and poor living conditions as well as people in over-crowded areas with poor environmental sanitation, poor garbage disposal, unsafe water supply and unhygienic personal habits (Adamu *et al*., 2006).

Most intestinal protozoans and helminths are easily transmitted from person to person by direct contact or through contaminated food, water and environments. Over 70 species of parasitic protozoans and helminths infect humans (Odu *et al*., 2013); this leads to

dysenteric and diarrhoeic conditions, intestinal obstruction, malnutrition, iron deficiency, anaemia, malabsorption and other such conditions (Buchini *et al*., 2007). Most common protozoan parasites infecting humans include *Giardia duodenalis* Leeuwenhoek, 1681; *Cryptosporidium* spp. Tyzzer , 1912; *Entamoeba histolytica* and *Balantidium coli*, while *Trichuris trichiura* Morgani, 1740; *Strongyloides stercoralis, Ascaris lumbricoides, Necator americanus* Stiles, 1898 and *Ancylostoma duodenale* Dubini, 1834 are some common helminths that affect children (Cox, 2002; *Cheesebrough, 2009*; *Okpala et al., 2014;* Abera *et al*., 2014).

Day care centres and nursery schools are environments where children are more likely to acquire intestinal parasites and pre-school children have been reported to harbour the greatest number of intestinal parasites, especially worms (Crompton and Nesheim, 2002; Gonçalves *et al*., 2011). Childcare-acquired infections within these institutions may occur due to contact among children, poor toilet facilities, poor sanitary conditions and contaminated playgrounds in the nursery schools (Odoba *et al.,* 2012). Transmission of intestinal parasites among the children can be attributed to the children's ignorance on the occurrence and mode of transmission of such parasites as well as poor hygienic and sanitary habits. Children have been reported to be at the greatest risk of helminthiasis and other intestinal parasitic infections which are often associated with poor growth, reduced physical activity and impaired learning ability. Also, due to the global endemicity of these intestinal parasites, they greatly affect the health, growth and development of children worldwide (Wakelin, 1996; Matthys *et al.,* 2011; Okpala *et al.,* 2014).

1.2 Statement of research problem

It is an established fact that diarrhoea is an important cause of morbidity and death among children, especially children under 5years in developing countries. This leads to about 9%

of all deaths among children under age 5 worldwide in 2015 (UNICEF, 2016). The prevalence of parasitic protozoa and helminths among children, especially those in the day care centres and nursery schools is poorly reported and therefore not known to permit formulation of intervention strategies by relevant authorities, especially in Sabon-Gari Local Government Area.

1.3 Justification

Over 270 million pre-school children and over 600 million school-age children live in areas where intestinal protozoans and helminths are intensely transmitted, and are in need of treatment and preventive interventions (WHO, 2015). Studies around the globe and some parts of Nigeria reported various protozoans and helminths to be prevalent among day care, pre-school (mostly under 5years) and school-age children (Chirdan *et al.*, 2010; Obadiah *et al*., 2011; Okpala *et al.,* 2014; Umeh *et al.,* 2015); some of the studies have associated these parasitic infections to diarrhoeic and dysenteric conditions, anaemia, retarded growth among other illnesses. In most of these studies, the prevalence of these intestinal parasites was associated to parent's occupations, family background, housing conditions and feeding habits. Hence, there is a need to assess the health risk associated with attendance of day care centres and nursery school within Sabon Gari Local Government Area towards proffering an intervention programme by relevant authorities.

1.4 Aim

The aim of this study is to evaluate the occurrence of gastro-intestinal helminths and parasitic protozoans in children attending day care centres and nursery schools within Sabon-Gari Local Government Area of Zaria, Kaduna State, Nigeria.

1.5 Objectives

The objectives of this study are:

1. To determine the prevalence of gastro-intestinal protozoan parasites and helminths infecting children in day care centres and nursery schools in Sabon-Gari Local Government Area of Zaria, Kaduna State.
2. To identify the risk factors associated with the prevalence of gastro-intestinal protozoans and helminths infection in children of the day care centres and nursery schools.
3. To determine the association of gender and age with the prevalence of gastro-intestinal protozoans and helminths infecting children in the day care centres and nursery schools.
4. To assess the effect of seasons on the prevalence of gastro-intestinal protozoan and helminth infections in children of the day care centres and nursery schools in the study area.

1.6 Hypotheses

1. Gastro-intestinal protozoans and helminths are not prevalent in children of day care centres and nursery schools in Sabon-Gari Local Government Area of Zaria, Kaduna State.

2. There are no risk factors that significantly affect the prevalence of gastro-intestinal protozoans and helminths infection among children in the day care centres and nursery schools.

3. Gender and age are not associated with the prevalence of gastro-intestinal protozoans and helminths in children of the day care centres and nursery schools.

4. Seasons does not influence the prevalence of gastro-intestinal protozoans and helminths in children of the day care centres and nursery schools in the study area.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Intestinal parasites

Intestinal parasitic infections cause a tremendous burden of disease in the tropics and subtropics as well as temperate climates due to its wide global distribution (CDC, 2014a). Prevalence of intestinal parasites has been reported from all over the world of which an estimated 3.5 billion people are affected, most of whom are children residing in developing countries (WHO, 2000). Parasitic infections can occur in children of all ages such as infants, toddlers, and very young children. Toddlers, preschoolers and young school children in day care centres and school settings are at risk for parasitic diseases caused by both parasitic protozoans and helminths which are mostly spread by person-to-person contact as is common during childhood play (Obadiah *et al*., 2011). Pets and other animals are also potential sources of infection with intestinal parasites such as *Toxoplasma gondii* Nicolle and Manceaux, 1908; *Toxocara* Spp. Wilder, 1950; *Dipylidium caninum*, among others that can affect children of all ages (WHO, 2015; O'Donoghue, 2010). The major intestinal parasitic infections of global public health concern, of the protozoan species are *Entamoeba histolytica* and *Giardia lamblia* and soil transmitted helminths *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm (WHO, 2000; Haque, 2007).

2.2 Intestinal Protozoans

Intestinal protozoan parasites can be said to have contributed immensely in undermining the health of children as they are commonly known to cause gastrointestinal infections compared to helminths (Haque, 2007). Several epidemiological studies within and outside

Nigeria have indicated that a high prevalence of intestinal parasitic infections, including protozoan, as a contributing factor affecting approximately one-quarter of the world's population, especially children, mostly due to their poor hygienic and sanitary habits coupled with voracious eating habits (Uguoma *et al.,* 2008). Also, recent estimate indicates that more than 880 million children are in need of treatment for intestinal protozoan parasites and helminths (WHO, 2016).

Pathogenic intestinal protozoa infections are common in school-age children in the developing world and they are frequently associated with malabsorption syndromes and gastrointestinal morbidity (Speich *et al*., 2013). Although several protozoan parasites affect humans, not all of them are pathogenic. The most pathogenic intestinal protozoans are *Entamoeba histolytica, Cryptosporidium parvum* and *Giardia lamblia*. Others may include *Isospora* spp., *Trichomonas vaginalis* and *Entamoeba coli* among others (Amin, 2002; Harhay *et al*., 2010). In developed countries, protozoan parasites more commonly cause gastrointestinal infections compared to helminths because the former multiply within the host.

2.2.1 Global Distribution and Prevalence of Intestinal Protozoans

Diarrhoea, at a global level, is a major contributor to childhood mortality and morbidity in the developing world and is estimated to cause 2.5million deaths each year (Kosek *et al*., 2003).

In a study carried out by Jayarani *et al*. (2014) on intestinal parasitic infections in pre-school and school going children from rural area of Puducherry, India, a prevalence of 15% was reported. *Giardia lamblia* was the most prevalent parasite (44%) and it was more prevalent in school going children (10%) than in preschool children (13.33%).

In Ghana, a high prevalence of 89.5% with *Giardia lamblia* was reported by **Nkrumah and Nguah (2011) in their study to associate diarrhoea with prevalence of** *G. lamblia* **in children. The prevalence of *G. lamblia* was associated with childhood diarrhoea.**

Al-hindi and El-Kichaoi (2008) r**eported the prevalence of intestinal parasites in pre-scholars in Gaza where the protozoans *E. histolytica, G. lamblia* and *Entamoeba coli* were identified. *G. lamblia* was the highest prevalent parasite with a prevalence of 10.3% and it is also seen to be more associated with diarrhoea in children. *E. histolytica*/*dispar* was found to be more prevalent in children of 0-10month (63.6%) than other age groups. This was found to be influenced by milk bottles contamination or breast feeders and creeping of those children on contaminated grounds.**

Speich *et al*. (2013) also reported a prevalence of (48.7%) with protozoan parasite in school-age children in Pemba Island of Tanzania, where almost half of the children sampled (550 samples) were infected with at least one of the three pathogenic intestinal protozoans identified: *Giardia intestinalis, E. histolytica/E. dispar* and *Blastocystis hominis***.**

2.2.2 Distribution and Prevalence of Intestinal Protozoans in Nigeria

Various reports have shown the occurrences of intestinal protozoan parasites especially in pre-school and school-age children within and outside Nigeria. Childhood dysentery associated with *E. histolytica* was reported by Obadiah *et al*. (2011) in Zaria with a prevalence of 42.62%.

Benjamin *et al*. (2013) reported a prevalence of 14.3% of *Cryptosporidium parvum* among children in some rural parts of Imo State, Nigeria. Prevalence of this parasite was

reported to be higher in children between 0-5years of age and infection rate decreased with increase in age.

A study was conducted on asymptomatic Giardiasis and nutritional status of children in two Local Government Areas in Kaduna State, Nigeria by Inabo *et al*. (2011) involving children of day-care centres and nursery and primary schools. Of the 374 samples examined, 150 (41.45%) were positive for *Giardia lamblia* with the highest prevalence of asymptomatic giardiasis in the age group 3-5 years (32.9%) and the lowest prevalence in the 0-2 years (11.6%). These prevalences indicates the need for intervention in the schools so as to provide a somewhat cleaner environment to enhance child safety even outside their homes; some of the children might be the cause of infecting others due to poverty and higher risk of infection at home than in school.

2.2.3 Transmission and pathogenesis of some intestinal protozoans

Protozoan parasites that live in human intestine are transferred to another human or from other animals to humans through either of the following routes:

i. Faeco-orally: this is where environmentally-resistant cyst stages of these parasites are passed in faeces of one host and ingested with food or water by another host e.g. *Entamoeba histolytica*, *Giardia duodenalis* and *Balantidium coli*.
ii. Direct: transmission of trophozoites through intimate body contact, such as sexual e.g. *Trichomonas vaginalis* Donne, 1836.
iii. Predator-prey**:** transmission of trophozoites encysted within the tissues of a prey animal such as herbivores, which are eaten by a predator, which subsequently sheds spores into the environment to be ingested by new prey animals e.g. *Toxoplasma gondii* (O'Donoghue, 2010; Graczyk *et al*., 2015).

Protozoan infection results in tissue damage leading to disease. In chronic infections, the tissue damage is often due to an immune response to the parasite and/or to host antigens (Yaeger, 1996).

2.2.4 General Life-cycle of intestinal protozoans

There is not a common life-cycle or sequence of morphological stages to represent the protozoans, however, it can be said that some protozoa have complex life-cycles requiring two host species while others require a single host to complete their life-cycle. A single infective protozoan entering a susceptible host has the potential to produce an immense population. However, reproduction is limited by events such as death of the host or by the host's defense mechanisms, which may either eliminate the parasite or balance parasite reproduction to cause a chronic infection. (Yaeger, 1996).

Most protozoans have enormous reproductive potential because they have short generation time. They undergo rapid sequential development and produce large numbers of progeny either asexually through fission as in the amebas and flagellates that infect humans or sexually through the fusion of gametes to form zygote, or unique process of conjugation, but the most common is the binary fission (Yaeger, 1996; O'Donoghue, 2010).

During its life-cycle, a protozoon generally passes through several stages that differ in structure and activity. Generally, the life-cycle of many protozoan parasites includes two stages:

The first form is a motile form, the trophozoites, which is able to colonize the walls of the digestive tract of the host vertebrate causing several intestinal pathologies.

The second form is the cyst, which is resistant to adverse conditions in the environment and highly infectious to the host, being responsible for dissemination of the parasite from one host to another to spread disease (O'Donoghue, 2010).

2.3 Intestinal Helminths

A broad range of organisms comprising two major phyla; the Nematoda (nematodes) and the Platyhelminthes (flatworms). Infections with helminths are most prevalent in tropical and subtropical regions of the developing world where adequate water and sanitation facilities are inadequate (Haque *et al.,* 2007). There are four species of pathogenic intestinal helminths that are commonly described as geohelminths or soil-transmitted helminths; these are *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale* and *Necator americanus*. Recent estimates suggest that *Ascaris lumbricoides* can infect over a billion, *T. trichiura* 795 million, and hookworms 740 million people worldwide, causing very few deaths compared to the chronic and insidious effects on health and nutritional status of the host. Intestinal helminth infections impair physical and mental growth of children, thwart educational achievement, and hinder economic development (Drake *et al.,* 2000).

2.3.1 Global distribution and prevalence of intestinal helminths

More than 1.5 billion people or 24% of the world's population are infected with soil-transmitted helminth infections worldwide. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China and East Asia (WHO, 2015). Over 270 million pre-school children and over 600 million school-age children live in areas where these parasites are intensively transmitted, and are in need of treatment and preventive interventions (WHO, 2015).

In a study on prevalence of soil transmitted helminths (STH) in pre-school children of Kenya, Shivairo *et al*. (2014) showed that out of 179 children examined,154 (86%) were positive for one or more STH studied. *T. trichiura, Ascaris lumbricoides* and hookworm were the common parasites with prevalences of 50.84%, 25.14%, 10.06% respectively.

Abera *et al* (2014) in a cross-sectional study to determine the prevalence of gastrointestinal helminths and associated risk factors among school children in Tilili town, Ethiopia identified four species of intestinal helminths; *Ascaris lumbricoides*, *Trichuris trichiura*, hookworm and *Hymenolepis nana*. The overall prevalence was 44.2% (170 of 385 school children sampled) and predominant parasites were *Ascaris lumbricoides* and *Trichuris trichiura* with prevalence of 39.7% and 7.8% respectively.

In Kenya, Brooker *et al.,* (2000) reported a prevalence of 91.7% with helminth infection in children. The helminths identified were hookworm, *Ascaris lumbricoides*, *Trichuris trichiura* and *Schistosoma mansoni*, Sambon 1907.

2.3.2 Distribution and prevalence of intestinal helminths in Nigeria

High prevalence of intestinal helminth infections have been reported among school children in studies carried out within Nigeria.

Odu *et al*. (2013) reported prevalence of 21.8% and 10.1% in semi-urban and urban primary school children respectively in Rivers State. Children from the semi-urban area had higher prevalence of helminths (21.8%) than those in the urban area (10.1%) and also, *Ascaris lumbricoides, T. trichiura* and hookworm were the common helminths identified.

In a study carried out by Okpala *et al* (2014) in day care children from Esan West L.G.A. of Edo State, 11 (13.8%) of the 80 children examined were infected with one or more

intestinal parasites. Helminths identified were *Ascaris lumbricoides* (8.8%) and *T. trichiura* (2.5%).

In Kaduna State, Odoba *et al.* (2012) reported a prevalence of 29% in soil sampled from some school playgrounds in Zaria and a prevalence of 32% helminths infections among the children of those schools. Eggs of *Ascaris lumbricoides*, *Strongyloides stercoralis*, *Toxocara* spp. and *Taenia* spp. were found in both the soil and stool samples examined with the exception of *Fasciola* spp. Rudolphi 1819; and hookworm, which were only found in the stool samples. This revealed cross-contamination of the intestinal parasite between the primary school children and their playing grounds.

A study on prevalence of intestinal helminths among primary school children was carried out in Gwagwada, Kaduna by Auta *et al.* (2013). Out of the 283 school children examined for infection, 190 (67.1%) were found to be positive. The prevalence of each intestinal helminths found were *Ascaris lumbricoides* (30.7%), *Taenia* spp (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%).

A prevalence of 6.67% with intestinal helminths was obtained from nursery school children in Sabon-Tasha, Kaduna by Kuboye (2013). The eggs of hookworm, *Ascaris lumbricoides*, *Hymenolepis nana* and *Schistosoma mansoni* were recovered.

WHO (2015) report show that the main species of helminths that infect people and especially children are *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm which happen to be the trend among many children in Nigerian schools.

2.3.3 Transmission of intestinal helminths

Helminths are transmitted to humans in many different ways. The simplest is by accidental ingestion of infective eggs e.g. *Ascaris lumbricoides, Echinococcus granulosis*; or larvae of some hookworms in contaminated food or water. Other worms have larvae that actively penetrate the skin e.g. hookworms, schistosome species and *Strongyloides stercoralis*. In some cases, infection requires an intermediate host vector where the intermediate vector transmits infective stages of the helminth when it bites the host to take a blood meal. In other cases, the larvae are contained in the tissues of the intermediate host and are taken in when human eats that host e.g. *Clonorchis sinensis* McConnell, 1875.

The levels of infection in humans therefore depend on standards of hygiene, the climate (which may favour survival of infective stages), the ways in which food is prepared and the degree of exposure to insect vectors (CDC, 2014a; Helbig *et al*., 2012).

2.3.4 Pathogenesis of some intestinal helminths

Helminths, just like protozoa, can be either free-living or parasitic, however, in their adult form, helminths cannot multiply in humans unlike the protozoans therefore, only the intensity of helminths within an individual can lead to disease conditions (Hotez *et al.,* 2008).

Helminths are the most common infectious agents of humans in developing countries and produce a global burden of disease that exceeds better-known conditions such as malaria and tuberculosis (Hotez *et al.,* 2008). Many people infected with helminths can be seen to be asymptomatic although exhibition of symptoms leading to morbidity may be due to the site, duration and level of parasite burden in the infected person (Helbig *et al*., 2012) as people with light infections usually have no symptoms. Infection with helminths often cause morbidity, and sometimes death, affecting cognitive processes, inducing tissue

reactions, such as granuloma, and provoking intestinal obstruction or rectal prolapse. Hookworms cause chronic intestinal blood loss that can result in anemia and roundworms may possibly compete for vitamin A in the intestine (Helbig *et al*, 2012, WHO, 2015).

Helminths also lead to nutritional impairment as worms feed on host tissues, including blood, which leads to a loss of iron and protein. They also cause loss of appetite and therefore, a reduction of nutritional intake and physical fitness with some, such as *Trichuris trichiura*, causing diarrhea and dysentery (WHO, 2015).

2.3.5 General Life-Cycle of Intestinal Helminths

Helminths have three main life-cycle stages: eggs, larvae and adult. Adult worms are found in definitive hosts in which sexual development occurs while larvae may be free-living or parasitize invertebrate vectors. The life-cycles of varies across the different classes of the helminths; trematodes, cestodes and nematodes

Trematodes have more complex life-cycles where 'larval' stages undergo asexual amplification in snail intermediate hosts. Eggs hatch to release free-swimming miracidia which actively infect snails and multiply in sac-like sporocysts to produce numerous rediae. These stages mature to cercariae which are released from the snails and either actively infect new definitive hosts. Some form encysted metacercariae on aquatic vegetation which is eaten by definitive hosts (O'Donoghue, 2010).

Cestode eggs released from gravid segments embryonate to produce 6-hooked embryos (hexacanth oncospheres) which are ingested by intermediate hosts. The oncospheres penetrate host tissues and become metacestodes (encysted larvae). When eaten by definitive hosts, they excyst and form adult tapeworms.

Nematodes produce eggs that embryonate in utero or outside the host. The emergent larvae undergo four moults before they mature as adult male or female worms.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study area

Sabon-Gari Local Government Area of Zaria is located within longitude 11°05′0″N to 11°15′30″N and latitude 07°34′E to 7°47′E (Fig. 3.2). It is one of the 23 Local Government Areas of Kaduna State. It is bordered to the North by Kudan L.G.A., to the South by Zaria L.G.A., to the East by Soba L.G.A. and to the West by Giwa L.G.A. (Fig. 3.1B). It has the population of 286,871 people as at 2006 census.

3.2 Study population

The study population comprised children in day care centres and nursery schools within Sabon-Gari Local Government Area of Zaria, Kaduna State which were randomly selected. Prior visit was made to schools informing them about the research after which consent was sought from the school authorities and the children's parents and guardians through the school, to carry out the study.

3.3 Ethical clearance

Ethical clearance was obtained from Ahmadu Bello University Committee for Use of Human Subjects for Research, Zaria, Kaduna State.

3.4 Sample size

The sample size was determined using Fisher's sampling formula (1956):

$$N = \frac{Z^2 PQ}{d^2}$$

Where: N = Sample size to be calculated,

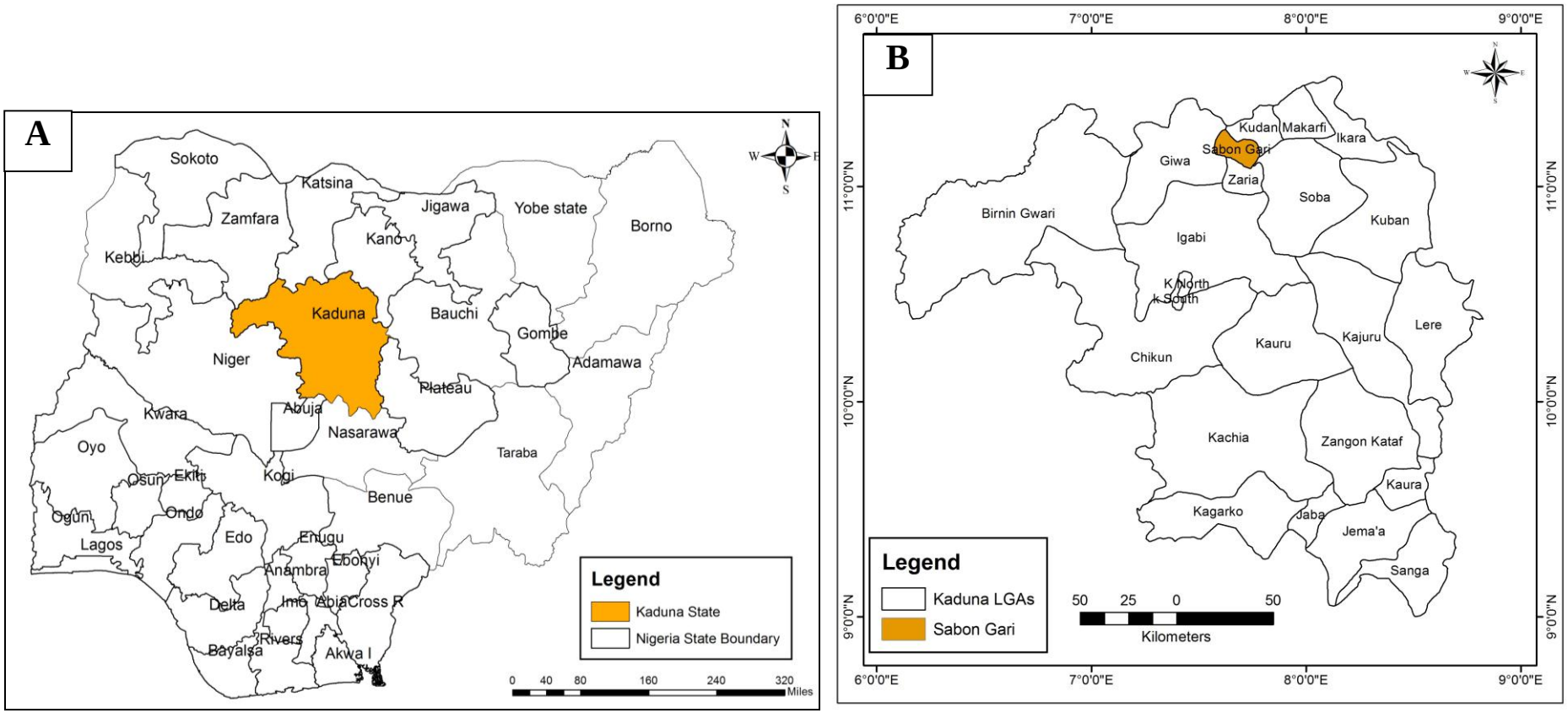


FIGURE 3.1: A, Map of Nigeria showing the thirty six states and the Federal Capital Territory**;** B, Map of Kaduna State showing the Local Government Areas. *SOURCE:* Modified from Administrative Map of Kaduna State 2016.

.

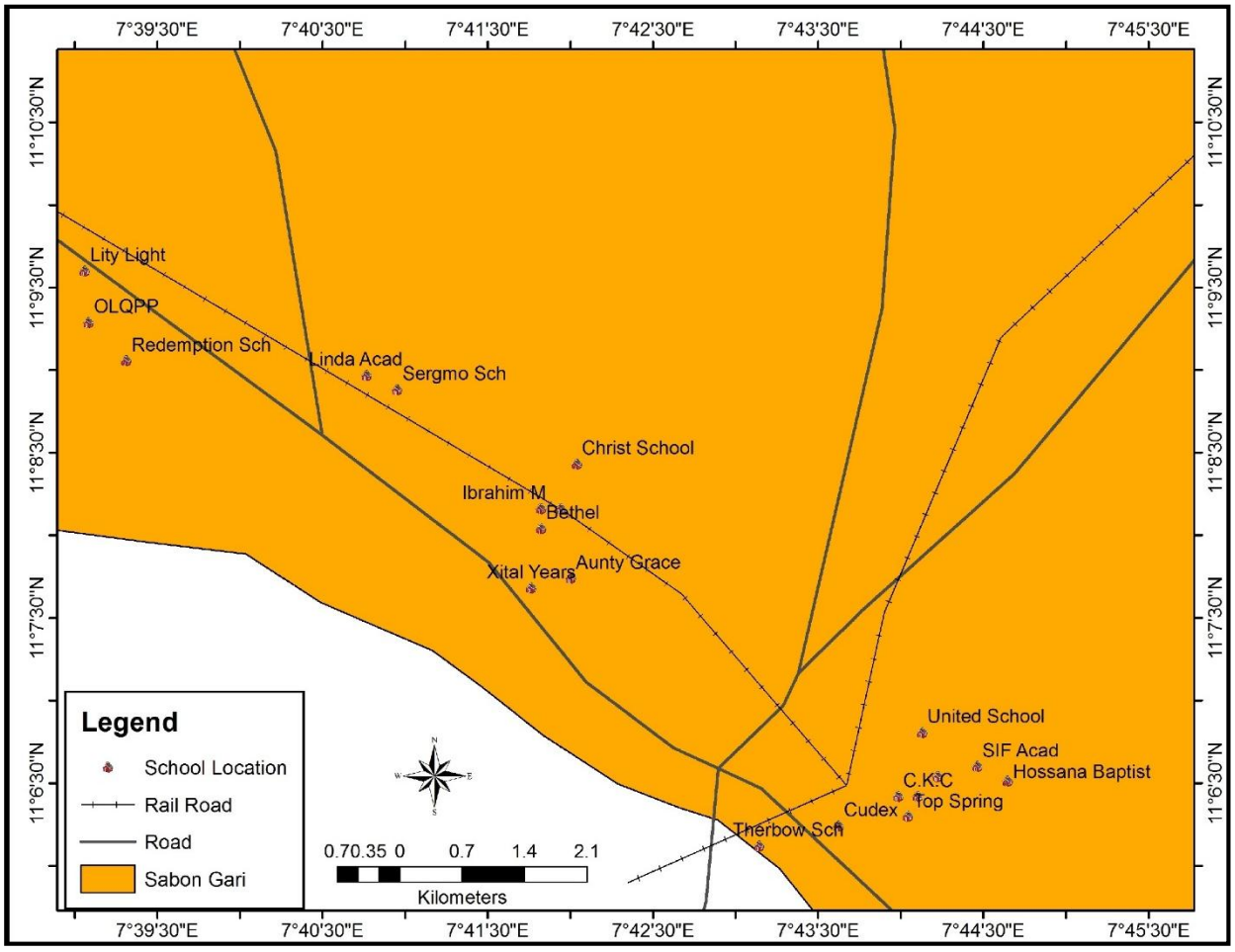


FIGURE 3.2: Map of Sabon Gari L.G.A of Zaria, Kaduna State showing locations of the schools sampled. *SOURCE*: Adopted and modified from Administrative Map of Kaduna State 2016.

Z = critical value of the standard normal distribution (1.96 at 95% confidence interval),

P = estimated prevalence of intestinal infection at 57.58% = 0.5758 (Chirdan *et al.*, 2010)

Q = 1.00-P and d = absolute precision or sampling error tolerated 5% = 0.05.

By substituting;

$N = 1.96^2 \times 0.5758 \times (1-0.5758)/0.05^2$

$= 3.8416 \times 0.5758 \times 0.4242/0.0025$

$= 375.33$

= 375 children.

Therefore, the minimum calculated sample size for this study was 375 children. However, a total number of 772 samples were collected from the children in the day care centres and nursery schools for this study.

3.5 Tools for data collection

a. Sample collection

Stool samples were collected and analysed between January and March, 2015 for the dry season and between May and July, 2015 for the wet season.

Specimen bottles were labelled with identification numbers and distributed to consenting parents/guardians of the children through the schools, with instruction on when and how to collect the samples; the samples should be collected early in the morning or it should be the first faeces of the day.

For children using diapers, the nannies assisted in collecting the faecal samples from the diapers or the child's anus immediately they defecated to avoid absorption of the faeces by the diaper.

Toilet-trained children and children using the potty were instructed to urinate first without defaecating, in order to avoid contaminating the faecal sample. The urine was discarded appropriately and potty rinse properly. A polyethene bag was placed in the potty/toilet seat and the children were asked to defaecate on it. Stool samples were scooped using the scoop attached to the cover of the specimen bottle, placed in the bottles and covered properly.

The stool samples were collected in the morning from the children, placed in an insulated box with ice packs and transported to the Parasitology and Entomology Research Laboratory of the Department of Zoology, Faculty of Life Sciences, Ahmadu Bello University, Zaria. The samples were preserved in 10% formal-saline solution and stored in the refrigerator for future processing and examination. Second visits, and in some cases third visits, were made to the schools (each visit was made early in the morning on a different day) in order to retrieve bottles that had not been returned.

b. Questionnaire Administration

Questionnaires were also administered to the parents through the school in order to obtain socio-demographic data of the children; and data on certain risk factors (such as toilet type, availability of hand washing facilities, use of disinfectants in cleaning classrooms and toilets and if the children use the same toilets as the staff especially in the case of the children in the nursery school) associated with the school were also obtained through oral interview. The questionnaire was retrieved alongside the sample bottles (Appendix I).

3.6 Laboratory examination of stool samples

The stool samples were examined for parasite eggs, cysts and oocysts using the formaldehyde-ether concentration technique as described by Cheesbrough (2009; 2013):

i. About 1g of the stool was suspended in 10ml of 10% formaldehyde solution and mixed with a glass rod.
ii. The suspension was poured into a centrifuge tube through a gauze-lined funnel to remove debris.
iii. About 3ml of di-ethyl ether was added to the filtrate and thoroughly mixed. This was then placed into a centrifuge and spinned for 1 minute at 3000 rpm.
iv. The four layers formed at the end of centrifugation were the ether with dissolved fats, debris, formaldehyde solution and sediment of eggs and/or larvae, in the first to the fourth layer from the top respectively.
v. The first three upper layers were decanted leaving only the sediment at the bottom. The sediment, along with a drop of left over supernatant was placed on a glass slide, covered with a slide cover slip and examined microscopically using ×10, ×40 and ×100 objectives respectively.
vi. Any cysts of protozoans and eggs of helminths found were identified using the bench aid for the diagnosis of intestinal parasites (WHO, 1994) and the Laboratory Manual by Cheesbrough (2009; 2013).

3.7 Data analyses

Normal descriptive statistic was used to present data in tables and the prevalence were calculated. Correlation by regression analysis was used to determine the age specific variation as regards intestinal parasitic infections in the children and Student's t-test was used to determine gender-related prevalence of the infections. Odd's Ratio analysis was

used to determine associations between potential risk factors and the intestinal parasitic infection in the children of daycare centres and nursery schools in Sabon-Gari Local Government Area of Zaria, Kaduna State.

CHAPTER FOUR

4.0 RESULTS

4.1 Prevalence data of the species of intestinal protozoans and helminths in children of the day care centres and nursery schools

Cysts and eggs of eight (8) intestinal parasites were recovered from stool samples examined in this study. They include the cysts of two protozoans (*Entamoeba histolytica* (Plate I) and *Balantidium coli*) and the eggs of six helminths (*Dipylidium caninum, Diphyllobothrium latum, Hymenolepis nana, Ascaris lumbricoides,* Hookworm and *Strongyloides stercoralis*) (Plates II, III, IV, V, VI and VII respectively). Parasite with the highest prevalence was Hookworm (4.92%) followed by *A. lumbricoides* (3.50%) then *S. stercoralis* (1.04%), which are all soil transmitted helminths. The intestinal parasites with the lowest prevalence were the protozoans, *E. histolytica* (0.26%) and *Balantidium coli* (0.26%); and *H. nana* (0.26%) (Table 4.1).

4.2 The prevalence of intestinal protozoans and helminths in children of the sampled nursery schools

Protozoan cysts were found in one child each from only three schools (CHS, OQP and RDS) in the sampled day care centres and nursery schools in Sabon-Gari L.G.A.; while helminth infection was recorded in children from all the schools with the exception of SGS where neither protozoa nor helminths were recorded. Children from UNS, AGS and SIF had high prevalences of intestinal parasites (19.23%, 17.86% and 15.71% respectively) with low prevalences in children of BAC and OQP (4.44% and 4.84% respectively). The prevalence of the protozoans (0.44%) was generally low compared to the helminths (9.66%) and variation in prevalence of the intestinal protozoans and helminths across the schools was statistically significant (P = 0.0000203; Table 4.2).

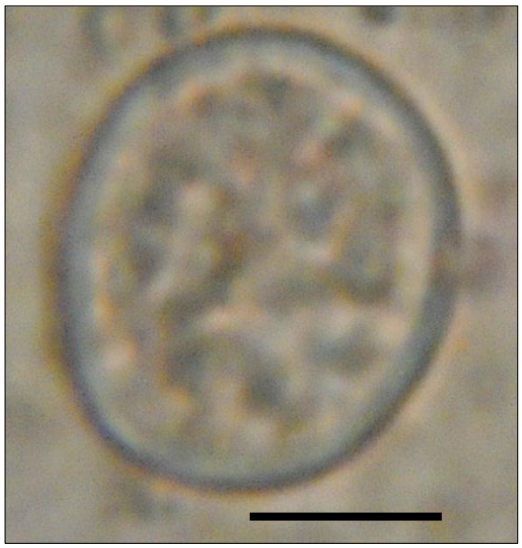


Plate I: Cyst of *Entamoeba histolytica* at × 400 microscopic magnification. Note the two characteristic nuclei.

Scale line = 6µm



Plate II: Egg packet of *Dipylidium caninum* (containing several eggs; **e**). ×100 microscopic magnification

Scale line = 24µm.

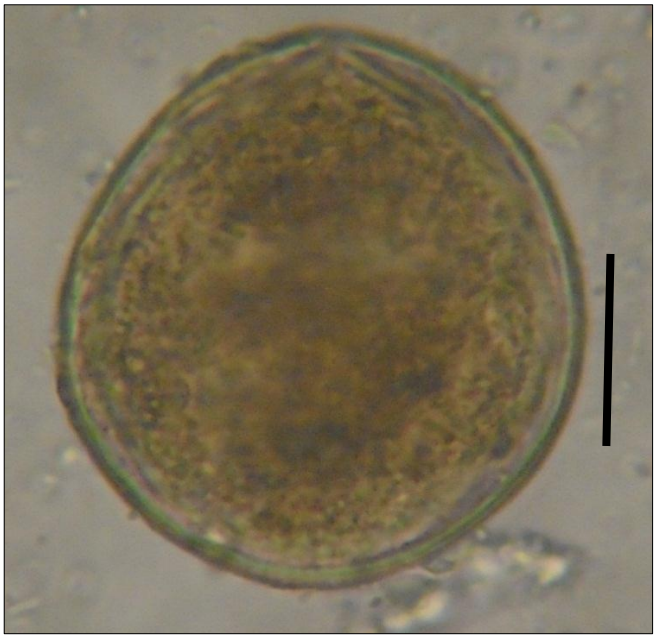


Plate III: Egg of *Diphyllobothrium latum* at × 400 microscopic magnification. Note the characteristic operculum at one end.

Scale line = 20µm

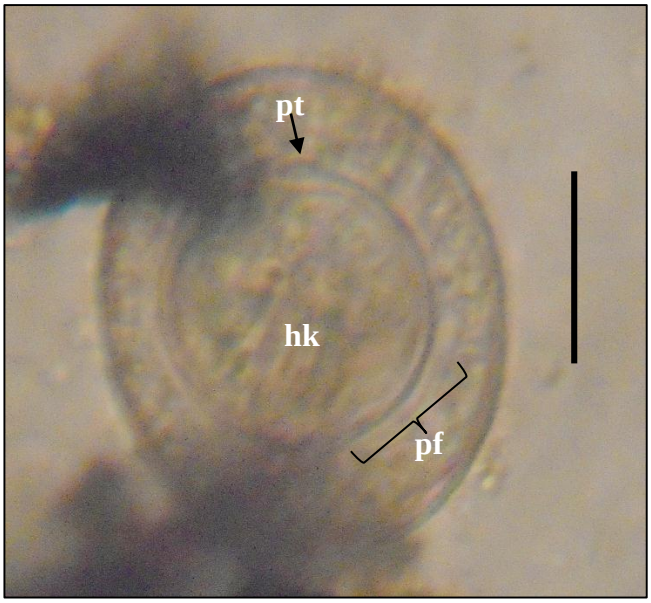


Plate IV: Egg of *Hymenolepis nana* at × 400 microscope magnification. Note characteristic hooks (**hk**), polar filaments (**pf**) and polar thickening (**pt**).

Scale line = 20µm.



Plate V: Fertilized egg of *Ascaris lumbricoides* at × 100 microscope magnification. Egg is at early stage of development. Note conspicuous mamillation on its surface.

Scale line = 24µm.



Plate VI: Hookworm egg at × 100 microscope magnification with thin hyaline shell.

Scale line = 20µm.



Plate VII: *Strongyloides stercoralis* egg at × 100 microscope magnification. Note transparent shell with a developing larva.

Scale line = 24µm

Table 4.1: Summary of infestation data of the species of intestinal protozoans and helminths in children of the day care centres and nursery schools (n = 772)

Parasites cysts/eggs seen		Number infected	Prevalence (%)
Protozoan parasites	*Balantidium coli*	2	0.26
	Entamoeba histolytica	2	0.26
Total		**4**	**0.52**
Helminths	*Ascaris Lumbricoides*	27	3.50
	Hook worm	38	4.92
	Dipylidium caninum	4	0.52
	Diphyllobothrium latum	3	0.39
	Strongyloides stercoralis	8	1.04
	Hymenolepis nana	2	0.26
Total		**82**	**10.62**

Table 4.2: The prevalence of intestinal protozoans and helminths in children of the nursery schools

		Protozoans		**Helminths**		**Total**	
Schools	No. examined	No. positive	Prevalence (%)	No. positive	Prevalence (%)	No. positive	Prevalence (%)
SIF	70	0	0	11	15.71	11	15.71
TSS	45	0	0	5	11.11	5	11.11
CKC	40	0	0	5	12.50	5	12.50
HBS	38	0	0	2	5.26	2	5.26
UNS	52	0	0	10	19.23	10	19.23
CIS	38	0	0	5	13.16	5	13.16
TBS	58	0	0	4	6.89	4	6.89
AGS	28	0	0	5	17.86	5	17.86
VYS	31	0	0	2	6.45	2	6.45
BAC	45	0	0	2	4.44	2	4.44
CHS	44	1	2.27	2	4.55	3	6.81
OQP	62	1	1.61	2	3.23	3	4.84
RDS	62	1	1.61	6	9.68	7	11.29
SGS	15	0	0	0	0	0	0
LDA	17	0	0	1	5.88	1	5.88
CLS	38	0	0	4	10.52	4	10.52
Total	683	3	0.44	66	9.66	69	10.10

P = 0.0000203

4.3 The prevalence of intestinal helminths among the sampled children of the day care centres

The overall prevalence of helminth infection in the sampled day care centres was 3.49% with the highest prevalence in children of the day care section of CIS (11.11%) followed by CLS (10.0%) while the least prevalence recorded with helminth was children in IBM (5.55%). However, of the children from the remaining schools (SIF, TSS, VYS, BAC, OQP, RDS and SGS), no helminth was detected in their samples. Protozoans were not recorded in children of the day care centres (Table 4.3).

4.4 Prevalence of intestinal protozoans and helminths among the children according to age

The prevalence of intestinal protozoan and helminth infections was directly proportional with age as the infection was observed to increase with age (Table 4.4); those aged 5 years and 6 years had higher prevalences (11.90% and 12.26% respectively) with the least prevalence in children <1year (5.00%) (Table 4.4). Regression analysis showed that there was a significant increase in prevalence with a corresponding increase in age ($R = 0.957593$; $P = 0.000695$).

4.5 Prevalence of intestinal protozoans and helminths in children according to gender

The prevalence of intestinal protozoans and helminths was significantly higher in females (12.04%) than males (6.67%) ($P<0.05$). Females were significantly associated with the intestinal protozoan and helminths (OR = 1.92; CI = 1.16 – 3.17) (Table 4.5).

Table 4.3: The prevalence of intestinal helminths in children from the day care centres

Schools	No. examined	No. positive	Prevalence (%)
SIF	3	0	0
CIS	9	1	11.1
TBS	13	0	0
VYS	4	0	0
IBM	3	0	0
OQP	18	1	5.55
RDS	13	0	0
AGS	15	0	0
SGS	10	1	10.0
CLS	1	0	0
Total	**89**	**3**	**3.49**

Table 4.4: Prevalence of intestinal protozoans and helminths in children according to age

Age	No. examined	No. positive	Prevalence (%)	Odd's Ratio	Lower – Upper (CI)
<1	20	1	5.00	0.51	0.06 – 3.82
1	41	3	7.32	0.76	0.23 – 2.51
2	105	5	4.76	0.66	0.29 – 1.49
3	174	14	8.04	0.89	0.49 – 1.69
4	200	18	9.00	0.95	0.54 – 1.66
5	126	15	11.90	1.39	0.76 – 2.55
6	106	13	12.26	1.44	0.76 – 2.72
TOTAL	**772**	**69**	**8.93**		

R = 0.957593 (P = 0.000695)

Table 4.5: Prevalence of intestinal protozoans and helminths in children according to Gender

		Protozoan		**Helminths**		**Total**		**Odd's Ratio**	**C.I (lower-upper)**
Gender	No. examined	No. positive	Prevalence (%)	No. positive	Prevalence (%)	No. positive	Prevalence (%)		
Males	390	1	0.26	25	6.41	26	6.67	0.52	0.32-0.86
Females	382	2	0.52	44	11.52	46	12.04	1.92	1.16-3.17
Total	**772**	**3**	**0.39**	**69**	**8.94**	**72**	**9.33**		
								$\chi^2 = 5.97$	P = 0.007

4.6 Prevalence of intestinal helminths in children of the nursery schools during the dry and wet seasons

Out of the 461 children sampled from the nursery schools in the dry season 52 (11.28%) were infected. The highest prevalence (19.05%) was recorded in children of AGS while no infection was recorded in children of SGS. The overall infection prevalence in the dry season was at 11.8% (Table 4.6). In the wet season, an overall infection prevalence of 7.21% was obtained. The highest prevalence of infection (27.27%) occurred in children attending UNS; no parasites (0%) were recorded in children of HBS, TBS, VYS, BAC, OQP, SGS and LDA. The variation in prevalence between both seasons was not statistically significant (P = 0.38) (Table 4.6); Odd's Ratio value showed dry season to be more associated with intestinal helminth infection than the rainy season (OR = 1.64), although the association was not statistically significant.

4.7: Prevalence of intestinal helminths in children of the day care centres during the dry and wet seasons

A total of 89 children were sampled from 10 day care centres, 52 in the dry season and 37 in the wet season. In the dry season, 2 (3.85%) children were infected with intestinal helminths and only 1(2.70) child was infected in the wet season. The total prevalence of helminth infection across the dry and wet seasons was 3.37% (Table 4.7). The variation in prevalence between both seasons was not statistically significant (P = 0.717553).

Table 4.6: Prevalence of the intestinal helminths in children of the nursery schools during the dry and wet seasons

	Dry season		**Wet Season**		**Total**	
School	No examined	No positive (%)	No examined	No positive (%)	Total examined	Total positive (%)
SIF	57	9(15.79)	13	2(15.39)	70	11(15.71)
TSS	31	4(12.90)	14	1(7.14)	45	5(11.11)
CKC	21	3(14.28)	19	2(10.53)	40	5(12.5)
HBS	19	2(10.53)	19	0(0)	38	2(5.26)
UNS	41	7(17.07)	11	3(27.27)	52	10(19.23)
CIS	21	3(14.29)	17	2(11.76)	38	5(13.16)
TBS	39	4(10.26)	19	0(0)	58	4(6.90)
AGS	21	4(19.05)	7	1(14.29)	28	5(17.86)
VYS	21	2(9.52)	10	0(0)	31	2(6.45)
BAC	32	2(6.25)	13	0(0)	45	2(4.44)
CHS	29	2(6.90)	15	0(0)	44	2(4.54)
OQP	40	2(5.00)	22	0(0)	62	2(3.22)
RDS	45	3(6.67)	17	3(17.65)	62	6(9.68)
CLS	25	3(12.0)	13	1(7.69)	38	4(10.53)
SGS	8	0(0)	7	0(0)	15	0(0)
LDA	11	1(9.09)	6	0(0)	17	1(5.88)
TOTAL	**461**	**51(11.06)**	**222**	**15(6.76)**	**683**	**66(9.66)**

P = 0.038635; OR = 1.637

Table 4.7: Prevalence of intestinal helminths in children of the day care centres during the dry and wet seasons

	Dry season		Wet Season		Total	
Schools	No Examined	No Positive (%)	No examined	No Positive (%)	Total examined	Total Positive (%)
SIF	3	0(0)	0	0(0)	3	0(0)
CIS	6	1(16.67)	3	0(0)	9	1(11.11)
TBS	9	0(0)	4	0(0)	13	0(0)
VYS	0	0(0)	4	0(0)	4	0(0)
IBM	3	0(0)	0	0(0)	3	0(0)
OQP	10	1(10.00)	8	0(0)	18	1(5.56)
RDS	7	0(0)	6	0(0)	13	0(0)
AGS	9	0(0)	6	0(0)	15	0(0)
SGS	1	0(0)	0	0(0)	1	0(0)
CLS	4	0(0)	6	1(16.67)	10	1(10.00)
Total	**52**	**2(3.85)**	**37**	**1(2.70)**	**89**	**3(3.37)**
					P= 0.717553	

4.8: Relationship between some risk factors and the prevalence of intestinal protozoans and helminths among children in the day care centres and nursery schools

The data obtained from the response through the questionnaires were analysed and some risk factors were associated with the prevalence of some intestinal protozoan and helminths among the children within the study area. The risk factors were hand washing with water only (OR = 2.35), use of pit latrine (OR = 1.72), sharing of toilets between staff and children (OR = 1.70), non-use of disinfectant in cleaning (OR = 1.72), tap and borehole water for drinking (OR = 1.66 and OR = 1.23), ownership of pets/ domestic animals (OR = 1.22) and deworming (OR = 1.20) as the children were observed to have odds of infection with the intestinal parasites (OR≥1). However, the association of some of the risk factors with the intestinal infections was statistically not significant; with the exception of hand washing with water only (CI=1.33-4.19), use of pit latrine (CI=1.05-2.84), sharing of toilets between staff and the children (CI=1.04-2.79) and non-use of disinfectant in cleaning (CI=1.00-3.21) (CI ≥ 1) (Table 4.8). Hand washing with water only had the highest significant association with the intestinal parasites (CI=1.33-4.19).

Table 4.8: Relationship between some risk factors and the prevalence of intestinal protozoans and helminths among children in the day care centres and nursery schools

Risk factors	Number infected	Number uninfected	Odd's Ratio	Lower-Upper
Hand washing provision				
Water only	56	418	2.36	1.33-4.19
Water with soap	16	282	0.42	0.24-0.75
After play hand wash				
Yes	15	276	0.40	0.22-0.73
No	39	256	2.05	1.26-3.34
Sometimes	18	168	1.05	0.60-1.85
Toilet facility				
Pit latrine	29	197	1.72	1.05-2.84
Water system	43	503	0.58	0.35-0.96
Sharing toilets (staff/ children)				
Yes	30	207	1.70	1.04-2.79
No	42	493	0.59	0.36-0.97
Use of disinfectants in cleaning				
Yes	23	368	0.42	0.25-0.71
No	17	103	1.72	1.00-3.21
Sometimes	32	229	1.65	1.01-2.69
Source of child's drinking water				
Tap	24	162	1.66	0.99-2.79
Bottle	01	31	0.30	0.04-2.26
Borehole	20	167	1.23	0.71-2.11
Well	01	19	0.51	0.07-3.83
Sachet	26	321	0.67	0.40-1.10
Domestic animals				
Yes	25	213	1.22	0.73-2.03
No	47	487	0.82	0.49-1.37
Deworming				
Yes	38	337	1.20	0.74-1.96
No	34	363	0.83	0.51-1.35

CHAPTER FIVE

5.0 DISCUSSION

The cysts and eggs of eight intestinal protozoans and helminths of medical importance were identified in the stools of children in day care centres and nursery schools in Sabon-Gari Local Government Area. They include the cysts of *Entamoeba histolytica* and *Balantidium coli*; and eggs of Hookworm, *Ascaris lumbricoides, Strongyloides stercoralis, Hymenolepis nana, Dipylidium caninum* and *Diphyllobothrium latum*. The results obtained here support the fact that in developing countries, including Nigeria, intestinal helminths have prevailed due to poor living standards, poor environmental sanitation and ignorance of health-promoting behaviours as stated by Odoba *et al*. (2012). *Ascaris lumbricoides*, *Strongyloides stercoralis* and hookworm were the predominant parasites identified and are soil transmitted helminths. The presence of these soil transmitted helminths in the children can be associated to their play habits; most of these children are in their oral stage and they play a lot with soil and soiled objects which serves as factors that predisposes them to these intestinal parasites when they put these objects in their mouths. Also, the prevalence of these soil transmitted helminths may have occurred among children who licked/ sucked their fingers which might have been soiled or contaminated. Some of the parasites identified in this study had been reported to occur among children in day care centres by Chirdan *et al*. (2010); in nursery schools, Sabon Tasha, Chikun by Kuboye (2013) and among primary school pupils and their playgrounds in Zaria by Odoba *et al.* (2012). This might be because day care centres and nursery and primary schools mostly exist together and children from nursery and primary schools share the same playgrounds, where most of these helminths have been reported to occur by Nock *et al.* (2003) and Odoba *et al.* (2012), with high prevalences of 52% and 32% respectively.

The 9.33% prevalence of intestinal protozoan parasites and helminths obtained in this study is similar to the prevalence of 6.67% reported by Kuboye (2013) from nursery school children in Sabon Tasha, Chikun L.G.A., Kaduna State. Three of the helminths recorded in this study (Hookworm, *Ascaris lumbricoides* and *Hymenolepis nana*) correspond with the helminths recorded by Kuboye (2013). This may illustrate the general trend among nursery school children throughout the state, since similar environmental conditions prevail. However, the overall prevalence of the intestinal parasites recorded in this study is low (9.33%), compared to the studies carried out by Chirdan *et al*. (2010) in ten day care centres in Jos (57.8%), Nock *et al.* (2003) on geohelminth eggs in the soil and stool samples of primary school pupils in Samaru, Zaria (52.0%); and Odoba *et al*. (2012) on helminths in soil and stool samples from playgrounds and children of some selected primary schools in Zaria (29%). The low prevalence can be attributed to the fact that some of the schools sampled within the study area were private schools where the environmental conditions are more hygienic than the public schools as stated by Odu *et al*. (2013) and Chukwudike (2014). Auta *et al.* (2013) reported a high prevalence of 67.1% in Gwagwada, Kaduna State; on the prevalence of helminths in primary school children attending public schools.

Generally, the prevalence of intestinal helminths was higher in the dry season than in the wet season in both the day care centres (dry = 3.85%; wet = 2.70%) and the nursery schools (dry = 11.8%; wet = 7.21%); with the prevalence of helminths being more significantly associated with the dry season than the wet season. This can be attributed to the fact that there is a lot more dust in the dry season than in the wet season; the dust would carry with it dry faecal matter containing resistant cysts and eggs of parasitic protozoans and helminths, and dispersing them on the children's eating utensils, leading to possible infection. It might also be due to poor hygiene level of the nannies/caregivers

as they handle these children and their food/feeding utensils. The findings on the prevalence of intestinal protozoan parasites and helminths according to season does not agree with those of Chukwudike (2014), who reported a higher prevalence of helminthiasis in the wet season than the dry season (22.4%); it however agrees with the report of Uneke *et al*. (2006) and Garba *et al*. (2014) in which a higher prevalence of intestinal parasites was obtained in the dry than the wet season (16.9% and 10.70% respectively).

More nursery school children (9.66%) were infected than children in the day care centres (3.37%), most likely because children in the day care centres remain indoors and are always being attended to by nannies/caregivers unlike the nursery school children who play mostly in sand, without much attention. The prevalence of intestinal parasites in the nursery school children can also be attributed to their poor eating habits and very poor personal hygiene.

The seemingly directly proportional relationship between prevalence of infection and increase in age may be related to increased soil contact within the age-group under study (1-5years) through their increased play habits and poor personal hygiene. Low prevalence in children that are less than 1 year old and the 1 year olds (≤1year olds) can be as a result of breast feeding, which was reported to give protection against many gastro-intestinal infections in infants (Abdel-Hafeez *et al.*, 2013; Kutty, 2014). Inabo and John (2010) and Okpala *et al.* (2014) also observed a similar trend in Zaria and Sabon-Gari Local Government Areas, Kaduna State and Esan West Local Government Area, Edo State respectively. Yilgwan and Okolo (2012) also observed a lower prevalence in the exclusively breastfed children, followed by those breastfed with supplements while a higher prevalence of intestinal parasites was reported in children that were not breastfeeding.

There was a higher and statistically significant difference in prevalence of intestinal protozoans and helminths in females (12.04%) than in males (6.67%). Females were seen to frequent the toilets compared to their male counterparts which might have predisposed them to infections with these intestinal parasites. Also, female children play more with sand than the males which is another source of infections, especially with soil transmitted helminths. Odoba *et al*. (2012) also made a similar observation where the prevalence of intestinal parasites was associated with the females (30.0%) than the males (27.5%) in pupils of some selected primary schools in Zaria, Kaduna State.

Hand washing, especially with soap and water, significantly reduced the rate of infection as hand washing with only water was significantly associated with high prevalence of intestinal protozoan parasites and helminths. Children within the day care and nursery school setting are of the habit of sucking their fingers consciously or unconsciously, which is a potential route for getting infected with intestinal parasites, especially when the hands are contaminated (Obadiah *et al.*, 2011; Tetteh, 2012; W.H.O., 2015). However, Kuboye (2013) found no association between hand washing and the prevalence of intestinal parasites in Nursery school children in Sabon Tasha, Kaduna State.

The use of pit latrine was associated with the prevalence of intestinal protozoans and helminths than water cistern. This can be attributed to the fact that most of the children in the nursery schools defaecate on the floor or by the mouth of the pit of the pit-latrines. This faecal matter can be disseminated by flies and other mechanical vectors or by other children through their shoes to the playgrounds and the classrooms. If such faeces contain cysts or eggs of any parasite, the children will possibly get infected. This agrees with the findings of Uneke *et al.* (2006) who reported that the use pit latrines and defaecating in the bush were more closely associated with high prevalence of infection by intestinal parasites than other methods. They obtained prevalences of 12.8% and 33.8%

respectively in children who used the pit-latrines and bush. However, contrary to the findings in this study, Kuboye (2013) did not record any association between type of toilet and infection by intestinal parasites.

Schools that used disinfectants in cleaning their classrooms and toilets were observed to have low association with intestinal protozoans and helminths than those that did not. This is because by disinfecting the environments after cleaning, germs alongside cysts/eggs of various parasites are destroyed, thereby lowering the risk of spreading infection. According to CDC (2014b), the use of disinfectants in cleaning reduced the odds of contracting intestinal parasites, thus supporting the results of this study.

The source of drinking water of the children was another factor that influenced the prevalence of intestinal protozoa parasites and helminths. The fact that tap and borehole water were highly associated with the prevalence of these parasites is surprising, since they are known to be sources of potable water. The water from the sources might have been contaminated at source or might not have been treated properly. Contamination can also result from poor handling, contaminated water vessels and containers, and leaky soak-away plumbing. Kuboye (2013) also reported similar association of tap water with intestinal parasitic infections in nursery school children in Sabon Tasha, Kaduna State.

Ownership of domestic animals was found to be associated with the intestinal parasites. This predisposes humans, especially children, to zoonotic infections. Animals such as dogs and cats roam the streets and get their mouths and body contaminated with cysts/eggs of intestinal parasites which can be passed on to their owners and children causing infection (Auta *et al.,* 2013). Chukwudike (2014) also reported an association between ownership of pets/domestic animals with children by helminths in Bwari Area Council, Abuja.

The fact that children who were said to have been de-wormed had a higher prevalence than those that were not de-wormed is surprising. However, association of deworming with the prevalence of protozoans and helminths is not significant. The positive response of the parents/caregivers to de-worming might be for just one bout of de-worming and not a regular occurrence as required.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Intestinal protozoans and helminths are prevalent in day care and nursery school children in Sabon-Gari Local Government Area (9.33%). Intestinal helminths are more prevalent in the sampled nursery schools than intestinal protozoan parasites and only helminths parasites were recorded in children of the sampled day care centres. This means the first null hypothesis that "gastro-intestinal protozoans and helminths are not prevalent in children of day care centres and nursery schools in Sabon-Gari Local Government Area", is rejected.

There is significant association between some risk factors such as hand washing with only water (OR=2.35) and not washing hands after play (OR=2.05), use of pit latrines (OR=1.72), sharing of toilets between staff and students (OR=1.70) and non-use of disinfectants in cleaning (OR=1.72) (CI≥1); with the prevalence of intestinal protozoan and helminth infections in the study area. The second hypothesis is also rejected.

Age and gender significantly correlates with the prevalence of intestinal protozoans and helminths in day care and nursery schools in Sabon-Gari L.G.A. rejecting the third hypothesis which states that "age and gender are not associated with the prevalence gastro-intestinal protozoans and helminths infecting children in day care centres and nursery schools in Sabon-Gari Local Government Area of Zaria, Kaduna State".

Seasons affect the prevalence of intestinal protozoans and helminths which is more in the dry season than the wet season. The fourth hypothesis, "Seasons does not affect the prevalence of gastro-intestinal protozoan parasites and helminths infecting children in day

care centres and nursery schools in Sabon-Gari Local Government Area of Zaria, Kaduna State," is also rejected.

6.2 Recommendations

Based on the results of this study, it is recommended that the management of the schools should provide appropriate hand washing facilities (such as clean running water with liquid soap and possibly hand sanitizer) and the teachers and nannies/caregivers should ensure that the children practice appropriate hand washing/ use the facilities properly.

Good hygiene practices should be introduced into the schools' syllabuses by the Ministry of Education and any other relevant authority, especially with regards to proper hand washing with soap and water.

School management should make sure that toilets are cleaned properly and ensure adequate water supply.

Parents should also be advised/sensitized through health personnel and the media on the need to deworm their children regularly as recommended by WHO (2017).

REFERENCES

Abdel-Hafeez, E. H., Belal, U. S., Abdellatif, M. Z., Naoi, K. and Norose, K. (2013). Breastfeeding protects infantile diarrhoea caused by intestinal protozoan infections. *Korean Journal of Parasitology*, **4**: 31-42.

Abera, A. and Nibret, E. (2014). Prevalence of gastrointestinal helminthic infections and associated risk factors among school children in Tilili town, northwest Ethiopia. *Asian Pacific Journal of Tropical Medicine*, **14**: 525-530.

Adamu, H., Endeshaw, T., Teka, T., Kife, A. and Petros, B. (2006). Prevalence of intestinal parasites. *Ethiopian Journal of Health Division*, **20**(1): 39-47.

Al-Hindi, A. I. and El-Kichaoi, A. (2008). Occurrence of gastrointestinal parasites among pre-school children, Gaza, Palestine. *The Islamic University Journal*, **16**(1): 125-130.

Amin, O. M. (2002). Seasonal prevalence of intestinal parasites in the United States during 2000. *American Journal of Tropical Medicine and Hygiene*, **66**(6): 799–803.

Auta, T., Kogi, E. and Audu, O. K. (2013). Studies on the intestinal helminths infestation among primary school children in Gwagwada, Kaduna, North Western Nigeria. *Journal of Biology, Agriculture and Healthcare*, **3**(7): 48-53.

Benjamin, N., Uchechukwu, C., Ikechukwu, D., Oliver, A. and Muodebe, N. (2013). Cryptosporidiosis among children in some rural parts of Imo State, Nigeria. *Journal of Public Health and Epidemiology*, **5**(11):440-444.

Brooker, S., Edward, A. M., Sylvie, M., Alfred, I. L., Donald, A. P. B., and Michael, K. (2000). Epidemiology of single and multiple species of helminth infections among school children in Busia District, Kenya. *East African Medical Journal*, 77(3): 157-161.

Buchini, M. L. T., Pittner, E., Czervinski, T., Moraes, I. M., Moreira, M. M., Sanches, H. F. and Monteiro, M. C. (2007). Spatial distribution of enteroparasites among school children from Guarapuava, State of Paraná, Brazil. *Brazilian Journal of Epidemiology*, **10**: 568-578.

Centre for Disease Control and Prevention. (2014a). Parasites-Children. Retrieved April 5, 2015, from http://www.cdc.gov/parasites/about.html

Center for Disease Control and Prevention. (2014b). How to clean and disinfect schools to help slow the spread of flu. Retrieved April 5, 2015, from http://www.cdc.gov/flu/ school/ cleaning.htm

Chan, M. (1997). The global burden of intestinal nematode infections - fifty years on. *Parasitology Today*, **13**(11): 438-443.

Cheesbrough, M. (2009). District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press, New York. 198pp.

Cheesbrough, M. (2013). District Laboratory Practice in Tropical Countries. 3rd ed. Cambridge University Press, New York. 198pp.

Chirdan, O. O., Akosu, J. T. and Adah, S. O. (2010). Intestinal parasites in children attending day care centers in Jos, Central Nigeria. *Nigerian Journal of Medicine*, **19**(2): 219–222.

Chukwudike, C. O. (2014). Survey for eggs of geohelminths in school playgrounds and palms of pupils in Bwari Area Council, Abuja, Nigeria. M.Sc. thesis (unpublished). Ahmadu Bello University, Zaria. 199pp.

Cox, F. (2002). History of Human Parasitology. Topley and Wilson's Microbiology and Microbial Infections. *Clinical Microbiology Reviews*, **15**(4): 595-612. DOI: 10.1002 /9780470688618.taw0166

Crompton, D. W. T. and Nesheim, M. C. (2002). Nutritional impact of intestinal helminthiasis during the human life cycle. *Annual Review of Nutrition*, **22**:3559.

Drake, L. J., Jukes, M. C. H., Sternberg, R. J. and Bunday, D. A. P. (2000). Geohelminth infections (ascariasis, trichiuriasis, and hookworm): cognitive and development impacts. *Seminar in Paediatric Infectious Diseases*, **11**:245–51.

Garba, D. D., Thomas, H. Z., Jatau, E. D., and Inabo, H. I. (2014). Prevalence of intestinal helminths among primary school children in Chikun and Kaduna South Local Government areas of Kaduna State, Nigeria. *Journal of Medicine and Medical Research*, **2**(2): 6-11.

Gonçalves, A. L., Belizário, T. L., Pimentel, J. B, Penatti, M. P. and Pedroso, R. S. (2011). Prevalence of intestinal parasites in preschool children in the region of Uberlândia, State of Minas Gerais, Brazil. *Journal of the Brazilian Society of Tropical Medicine*, **44**(2): 191 - 193.

Graczyk, T. K., Knight, R. and Tamang, L. (2005). Mechanical transmission of human protozoan parasites by Insects. *Clinical Microbiology Reviews*, **18**(1): 128–132.

Harhay, M. O., Horton, J. and Olliaro, P. L. (2010). Epidemiology and control of human gastrointestinal parasites in children. *Expert Review of Anti-Infective Therapy*, **8**(2): 219–234. http://doi.org/10.1586/eri.09.119

Haque, R. (2007). Human Intestinal Parasites. *Journal of Health, Population and Nutrition*, **25**(4): 387-391.

Helbig, S., Adja, A.M., Tayea, A. and Arya, N. (2012). Soil Transmitted Helminths. *Global Health Education Consotium.* pp 5-8

Hotez, P. J., Brindley, P. J., Bethony, J. M., King, C. H., Pearce, E. J. and Jacobson, J. (2008). Helminth Infections: The Great Neglected Tropical Diseases. Journal of Clinical Investigation, **118**(4): 1311–1321.

Inabo, H. I and John, H. D. (2010). Intestinal helminths among children in orphanages in some parts of Kaduna State, Nigeria. Continental Journal of Microbiology, **4**: 31-36.

Inabo, H.I., Ya'u B. and Yakubu S. E. (2011). Asymptomatic Giardiasis and Nutritional Status of Children in Two Local Government Areas in Kaduna State, Nigeria. *Sierra Leone Journal of Biomedical Research*, **3**(3): 157-162.

Jayarani. K., Sandhya, R. T. and Jayaranjani, K. (2014). Intestinal parasitic infections in preschool and school going children from rural area in Puducherry. Current Research in Microbiology and Biotechnology, **2**(4): 406-409.

Kosek, M., Bern, C. and Guerrant, R. L. (2003). The global burden of diarrhoeal disease, as estimated from studies published between 1992 and 2000. *Bulletin of World Health Organisation*, **81**: 197-204.

Kuboye, S. (2013). Intestinal helminthiasis among nursery school children in Sabon Tasha, Chikun Local Government Area, Kaduna State, Nigeria. An M.Sc Thesis (unpublished). Ahmadu Bello University, Zaria, 57pp

Kutty, P. K. (2014). Breastfeeding and risk of parasitic infection-a review. Asian Pacific Journal of Tropical Biomedicine, **4(**11): 847-858.

Lawn, J. E., Cousens, S. and Zupan, J. (2005). Lancet Neonatal Survival Steering Team. 4 million neonatal deaths: When? Where? Why? *Lancet*, **365**: 891-900.

Matthys, B., Bobieva, M., Karimova, G., Mengliboeva, Z., Jean-Richard, V., Hoimnazarova, M. and Wyss, K. (2011). Prevalence and risk factors of helminths and intestinal protozoa infections among children from primary schools in western Tajikistan. *Parasites and Vectors*, **4**: 195.

Nesti, M. M. and Goldbaum, M. (2007). Infectious diseases and daycare and pre-school education. *Journal of Paediatrics*, 83 (4): 299–312.

Nkrumah, B. and **Nguah, S. B. (2011).** *Giardia lamblia*: a major parasitic cause of childhood diarrhea in patients attending a district hospital in Ghana. *Parasites and Vectors*, **4**:163.

Nock, I.H., Duniya, D.N. and Galadima, M. (2003). Geohelminth Eggs in the Soil and Stool of Pupils of some Primary Schools in Samaru, Zaria Nigeria. *Nigerian Journal of Parasitology*, **24**: 115-122.

O'Donoghue, P. (2010). Para-sites. Retrieved April 5, 2015, from http://parasite.org.au/para -site/introduction/introduction.html

Obadiah, H. I., Nock, I. H., Ndams, I. S., Kogi, E. and Bugaje, M. A. (2011) Prevalence of *Entamoeba histolytica* infection in pre-school children in Zaria, Nigeria. *Nigerian Journal of Scientific Research*, **9&10**: 21-29

Odoba, M. B., Otalu, O. and Balogun, J. B. (2012). Prevalence of helminth parasite eggs in pupils and playing grounds of some selected primary schools in Zaria, Nigeria. *World Journal of Life Sciences and Medical Research*, **2**(5): 192-195.

Odu, N. N., Elechi, V. I. and Okonko, I. O. (2013). Prevalence of intestinal helminth infections among primary school children in urban and semi-urban areas in Rivers State, Nigeria. *World Rural Observations*, **5**(1): 52-61.

Okpala, H. O., Josiah, S. J., Oranekwulu, M. U. and Ovie, E. G. (2014). Prevalence of intestinal parasites among children in day care centres in Esan West Local Government Area, Edo State, Nigeria. *Asian Journal of Medical Sciences*, **6**(4): 34-39.

Pillai, D. R. and Kain, K. C. (2003). Common Intestinal Parasites. *Current Infectious Disease Reports*, **5**: 207-217.

Shivairo, R. S., Mokua, D. O., Muleke, C., Mukabane, D. K., Oswe, M. O. and Kumba, J. K. (2014). Soil transmitted helminths prevalence among pre-school age children in Elburgon Municipality, Kenya. *Journal of Biology, Agriculture and Healthcare*, **4**: 21-36.

Speich, B., Marti, H., Ame, S. M., Ali, M. A., Bagoch, I. I., Utzinger, J.,Albonico, M. and Keiser, J. (2013). Prevalence of intestinal protozoa infection among school age children on Pemba Island, Tanzania, and effect of single-dose albendazole, nitazoxanide and albendazole-nitazoxanide. *Parasites and Vectors*, **6**: 3. **DOI:** 10.11 86/1756-3305-6-3.

Tetteh, P. (2012). A Comparative Study of Intestinal Parasitic Infection and Associated Risk Factors among Primary School Children in Six Neighbouring Communities in Kumasi, Ghana. An M.Sc Thesis (Unpublished). Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. 187p.

Uguoma, V. M., Anyasodor, A. E. and Mbata T. I. (2008). Prevalence of intestinal protozoan parasites among children aged 5-12years in Owerri metropolis, South Eastern Nigeria. *The Tropical Journal of Health Science*, **15**(2): 43-48.

Umeh, C., Mbanugo, J. I. and Nwachukwu, E. (2015). Prevalence of Intestinal helminths parasites in stools of Nursery and Primary schools pupils in Uga, Anambra State, Nigeria. *Sky Journal of Microbiology Research*, **3**(1): 6-10.

Uneke, C., Eze, K., Oyibo, P., Azu, N. and Ali, E. (2006). *Soil-Transmitted Helminth Infection in School Children in South-Eastern Nigeria: The Public Health Implication. The Internet Journal of Third World Medicine*, **4**(1).

UNICEF (2016). Monitoring the situation of children and women. Retrieved November, 2016, from http://www.unicef.org/unicefstatistics08072016.htm

Wakelin, D. (1996). Helminths: Pathogenesis and Defenses. In: Baron S, (Ed). *Medical Microbiology*. University of Texas Medical Branch, Galveston. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK8191/

World Health Organization (1994). Bench Aid for the diagnosis of intestinal parasites. 23pp.

World Health Organization (2000). World health report conquering suffering enriching humanity. Geneva. 32p

World Health Organization (2015). Soil-transmitted helminth infections. Retrieved April 30, 2016, from www.who.int/mediacentre/factsheets/fs366/en/

World Health Organisation (2016). Intestinal worms - epidemiology. Retrieved October 11, 2016, from http://www.who.intestinal_worms_epidemiology/WHO_Epidemiology .htm

World Health Organisation (2017). Deworming in Children. Retrieved May 21, 2017, from http://www.who.int/elena/titles/deworming/en/

Yaeger, R. G. (1996). Protozoa: Structure, Classification, Growth, and Development. In: Baron, S. (Ed). *Medical Microbiology*. University of Texas Medical Branch, Galveston. Retrieved May 6, 2015, from http://www.ncbi.nlm.nih.gov/books/NBK8 191/

Yilgwan, C. S. and Okolo, S. N. **(**2012). Prevalence of diarrhea disease and risk factors in Jos University Teaching Hospital, Nigeria. *Annals of African Medicine*, **11**(4): 217-221.

APPENDICES

Appendix I: QUESTIONNAIRE

The researcher is an M.Sc. student of the Department of Biological Sciences, Ahmadu Bello University Zaria conducting a research on the topic "*Gastrointestinal Helminths and Protozoan Parasites infecting children in Daycare centres and Nursery School in Sabon-Gari Local Government Area of Zaria, Kaduna State*," and therefore need your co-operation in answering the questions below.

A. CHILDREN'S INFORMATION

1. Serial number: ……
2. Gender: Male [ ] Female [ ]
3. Age group: ……years …… months
4. Number children in family: ……
5. What is the main source of child's drinking water? Pipe-borne Water [ ] Sachet [ ] Borehole [ ] Well [ ] other (Specify…….)
6. Do you deworm your child? Yes [ ] No[ ]
7. Do you have animals/livestock in the house? Yes [ ] No [ ]
8. If yes, specify……..

B. INFORMATION ON SCHOOL/DAY CARE CENTRE

1. Type of toilet facilities in school. Water Cistern [] Pit latrine [] none [] others (specify…….)
2. Does the school have facilities for hand washing? Yes [] No []
3. Do children wash hands after visiting the toilet or playing? Yes [] No [] Sometime[]
4. If yes, with what? Soap and water [] Water only[]
5. Does the school use any disinfectant for cleaning? Yes [] No [] Sometimes[]
6. Do nannies/ teachers and student share toilet? .....
7. Do nannies/ caregivers wash hand before and after handling every child? Yes[] No[]

Thank you for your co-operation.

Appendix II: Prevalence of intestinal parasites among children and nannies in daycare and nursery schools in the dry season

S/N	Schools	No. of children examined	No. of children positive	Prevalence (%)	No. of nannies examined	No. of nannies positive	Prevalence (%)
1	SIF	60	9	15.00	7	2	28.57
2	BAC	32	2	6.25	5	1	20.00
3	CKC	21	4	19.05	2	0	0.00
4	OQP	47	3	6.38	5	0	0.00
5	LDA	11	1	9.09	1	0	0.00
6	CIS	27	4	14.82	1	0	0.00
7	TSS	31	4	12.90	2	0	0.00
8	IBM	10	1	4.00	1	0	0.00
9	CHS	29	3	10.35	2	1	50.00
10	HBS	19	2	10.53	2	0	0.00
11	CLS	29	3	10.35	5	1	20.00
12	SGS	9	0	0.00	2	1	50.00
Total		**325**	**36**	**11.08**	**35**	**6**	**17.14**

Appendix III: Intestinal parasites common to children and the nannies from some sampled daycare centres and nursery schools.

S/N	Schools	Parasites in children	Parasites in nannies	Parasites in children and nannies.
1	SIF	As, Dc, Dl, Hk, Ss	As, Hk	As, Hk
2	BAC	Hk	As	-
3	CKC	Hk	-	-
4	OQP	As, Bc, Eh	-	-
5	LDA	Hk	-	-
6	CIS	As, Hk, Ss	-	-
7	TSS	As, Hk	-	-
8	IBM	As	-	-
9	CHS	Bc, Hk	As	-
10	HBS	As, Dl, Hk	-	-
11	CLS	As, Hk	Hk	Hk
12	SGS	-	As	-

Keys:

Eh =*Entamoeba histolytica*
Bc =*Balantidium coli*
As =*Ascaris lumbricoides*
Dc =*Dipylidium caninum*
Dl =*Diphyllobothrium latum*
Hk =Hookworm
Ss =*Strongyloides stercoralis*