

**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA**

**INTESTINAL HELMINTHS INFESTATION IN CHILDREN ATTENDING
PRINCESS MARIE LOUISE CHILDREN'S HOSPITAL**

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LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD
OF MASTER OF PUBLIC HEALTH DEGREE**

JULY, 2015

DECLARATION

I hereby declare that this submission is my own work towards the MPH degree and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University or elsewhere.

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Student Name

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Signature

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Date

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Supervisor Name

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Signature

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Date



DEDICATION

I would like to dedicate this work first to the almighty God, then to my mother Theresia Ulomi and my father Mirisho Njoroge and to my dear wife Nuru Sylvester Nguo.



ACKNOWLEDGEMENT

My sincere thanks firstly go to the Almighty God for his grace, strength and wisdom as well as the guidance of the Holy Spirit throughout the entire period of this work.

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ABSTRACT

Background: Soil-transmitted helminths (STHs) remain a major health threat to humans especially children throughout the world, mostly in developing nations including Ghana. The present de-worming program by the Ministry of Health is only for children of school-going age, hence occupational risk groups and non-school going children may remain as sources of infection throughout the year.

Objective: To determine the prevalence of intestinal helminth infestation and associated risk factors among children attending Princess Marie children Hospital, in Accra Ghana.

Method: A cross-sectional study involving 225 children was conducted between May 2015 to June 2015. Each participant was selected using consecutive sampling method that is every patient available who meet inclusion was recruited. Questionnaire and observations were used to identify socio-demographic and associated risk factors. Fresh stool samples were examined using light microscopy to identify the helminth parasites and the type of species. Data were analyzed using Stata version 12 statistical software.

Results: Two species of intestinal helminths were identified with an overall prevalence of 17.33% (39 out of 225 children). The predominant intestinal parasites was Hookworm with a prevalence of 10.22% (23/225) and *Ascaris lumbricoides* (7.11%; 16/225). There was no double or triple infestation observed. Significant associations were observed between intestinal helminth infestation and age group beyond 47 months, place of residence, washing hands after using toilet and dirt on the fingernails of children ($P < 0.05$).

Conclusions: Significant associations were observed between intestinal helminth infestation and age group beyond 47 months, place of residence, washing hands after using toilet and dirt on the fingernails of children. Interventional programs such as deworming should be promptly commenced at Princess Marie Louise Children Hospital that should target every child attending the hospital. The control strategy that should be initiated for

STH should involve periodic ant-helminthic drugs treatment of children at the risk area, particularly school-age children and non-school age children with age 0-17 years old.

Keywords: Intestinal helminths, Infestation, children, Soil-transmitted helminths, Hookworm, *Ascaris lumbricoides*, Princess Marie children Hospital.



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LIST OF ACRONYMS

AOR	Adjusted Odds ratio
COR	Crude Odds ratio
DALYs	Disability adjusted life years
GIT	Gastro-intestinal tract
SSA	Sub-Saharan Africa
STH	Soil-transmitted helminth
WHO	World Health Organization



CHAPTER ONE

INTRODUCTION

1.1 Background

Intestinal helminths are parasites that inhabit the human gastrointestinal tracts and are one of the most prevalent forms of parasitic disease causing organisms. The soil transmitted helminths *Ascaris lumbricoides* (*A. lumbricoides*), hookworm and *Trichuris trichiura* (*T. trichiura*) are parasitic nematode worms causing human infection through contact with parasite eggs or larvae that thrive in the warm and moist soil of the world's tropical and subtropical countries. They are one of the world's most important causes of physical and intellectual growth retardation in children (Massey, Elsheikha, & Morsy, 2009).

Ascariasis caused by *A. lumbricoides* causes widespread morbidity due to a variety of medical and surgical complications (Abera & Nibret, 2014)

It has been estimated that 1.471 billion cases of infection globally and 65 000 deaths occur due to *A. lumbricoides*. Hookworm in human is caused by helminthic parasites, *Necator americanus* (*N. americanus*) and *Ancylostoma duodenale* (*A. duodenale*) and is transmitted through contact with contaminated soil. It is one of the most common chronic infections with an estimated 1.3 billion cases globally and directly accountable for 65 000 deaths annually (Mehraj V, Hatcher J, Akhtar S, Rafique G, & Beg MA, 2008).

The two hookworm species that infect human exhibit differences in their pathogenicity, mode of transmission, geographical distribution and these differences may influence the disease. Clinical manifestations of hookworm disease are the consequences of chronic intestinal blood loss and iron deficiency anemia. In children, chronic hookworm disease retards physical growth which is sometimes most apparent at puberty (Masoumeh, Farideh, Mitra, & Heshmatollah, 2012) .

Likewise, *A. lumbricoides* and hookworm, *T. trichiura* considerably affect the physical and mental development in children. About 1.049 billion cases of infection occurred due to *T. trichiura* and 70 000 deaths occur due to *T. trichiura* annually. *Hymenolepis nana* (*H. nana*) infection has cosmopolitan distribution and most commonly infects humans, especially school-aged children (aged 4-10 years) (Abera & Nibret, 2014)]

The global burden of disease caused by the three major intestinal nematodes is about 22.1 million disability adjusted life years (DALYs) lost to hookworm, 10.5 million for *A. lumbricoides* and 6.4 million for *T. trichiura*. (Anah et al., 2008).

1.3 billion People infected worldwide and often associated with iron deficiency anaemia. The World Health Organization (WHO) has estimated that *schistosomiasis* and soil-transmitted helminth infections represent 40% of the disease burden due to all tropical diseases excluding malaria. Giardiasis, with an estimated 200 million infected people, is most common in children aged one to five years old, and in severe cases may be associated with acute and persistent diarrhea, malabsorption of nutrients and impairment of children's growth and development (Anah et al., 2008).

In sub-Saharan Africa, hundreds of millions of people are afflicted by *schistosomiasis*, and more than a quarter has one or more intestinal helminth infections occurring simultaneously (Ugbomoiko, Dalumo, Danladi, Heukelbach, & Ofoezie, 2012).

Many die from intestinal obstruction and complications caused by large adult worms and millions more are malnourished, stunted and severely anaemia.

The mechanism for induction of anemia by intestinal helminths other than hookworms and *Trichuris* is not clearly understood, but it has been suggested that helminth infections lead to decreased erythropoiesis (Yatich et al., 2009).

Worm infestation is a major problem in children from resource limited countries due to impure water, low socio-economic status; poor sanitation and low literacy level of parents particularly mothers. Causes of anaemia are often multifactorial and are related in a

complex way. First, the relative importance of each factor for example, hookworm or malaria varies in different settings (Miller, Rosario, Rojas, & Scorza, 2003).

More than 100 million African children are thought to be anaemic and prevalence in settings where malaria is endemic ranges between 49% and 76%. Pre- school children in Africa have some of the highest rates of anaemia in the world. The presence of anaemia in children under 5 years of age is of particular relevance because it negatively impacts on mental development and future social performance. The interplay of worms and anaemia exists, however, only few studies have been carried out to establish the relationship between anaemia and worm infection (Anah et al., 2008).

Stool examination forms an important part in the diagnosis of intestinal parasitic infections and also for those helminthic parasites that localize the biliary tract and discharge their eggs into the intestine. In the case of helminths infections the adult worms, their eggs or larvae are found in the stool.

Soil-transmitted helminth infections are widely distributed throughout the tropics and subtropics. Climate is an important determinant of transmission of these infections, 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 (Nguhiu et al., 2009).

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. 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. Whether such age dependency indicates changes in exposure, acquired immunity, or a combination of both remains controversial. Although heavy hookworm infections also occur in childhood, frequency and intensity commonly remain high in adulthood, even in elderly people. Soil transmitted helminth infections are often referred to as being “over-dispersed” in endemic communities, such that most worms are harboured by a few individuals in an endemic area. There is also evidence of familial and household aggregation of infection. With the relative contribution of genetics and common household environment being debated (Nguyen et al., 2012).

Estimates of annual deaths from soil-transmitted helminth infection vary widely, from 12 000 to as many as 135 000. Because these infections cause more disability than death, the worldwide burden, like many neglected tropical diseases, is typically assessed by disability-adjusted life years (DALY).

Epidemiological research carried out in different countries has shown that the social and economic situation of the individuals is an important cause in the prevalence of intestinal parasites. In addition, poor sanitary and environmental conditions are known to be relevant in the propagations of these infectious agents (Okuyay, Ertug, Gultekin, Onen, & Beser, 2004).

The lower estimates assume that most hookworm cases do not result in severe anemia or pronounced protein loss by the host, whereas the higher estimates show the long-term results of infection such as malnutrition and delayed cognitive development, especially in children. For these reasons, school-aged children have been the major targets for anti-helminthic treatment, and the scale of disease in this age group was pivotal in leveraging support for school-based control.

1.2 Problem Statement

Historically, soil-transmitted helminth (STH) infections were prevalent in developed countries but sustained control efforts and economic development helped to eliminate it. In many parts of sub-Saharan Africa and South and Southeast Asia, there had, until recently, been little change in the prevalence of STH over the last half of the 20th century.

In the last ten years, however, there has been increased political and financial support for the global control of STH infection, with a strong focus on school-based deworming. Where scaling-up of treatment has happened it has occurred in changing social and economic contexts, including increased urbanization. Such a changing landscape necessitates accurate description of the contemporary distribution of STH transmission and population at risk, and this information can inform the estimation of the global burden of disease due to STH (Pullan & Brooker, 2012).

In sub-Saharan Africa, hundreds of millions of people are afflicted by schistosomiasis, and more than a quarter has one or more intestinal helminth infections occurring simultaneously.

Children of school age and immune-deficient individuals are particularly vulnerable, with heavy infections associated with cognitive impairment, iron-deficiency anemia, growth retardation, malabsorption and malnourishment (Teklemariam, Dejenie, & Tomass, 2014)

A study on gastro-intestinal (GIT) parasites is important for the management of human colony and the safety of children because many of these parasites are potentially zoonotic

In addition, these parasites also cause different levels of tissue damage and ill-health to human. Soil-transmitted helminths (STHs) remain a major health threat to humans especially children throughout the world, mostly in developing nations including Ghana. The present de-worming program by the Ministry of Health is only for children of school-going age; hence occupational risk groups and non-school going children may remain as sources of infection throughout the year (Humphries et al., 2011).

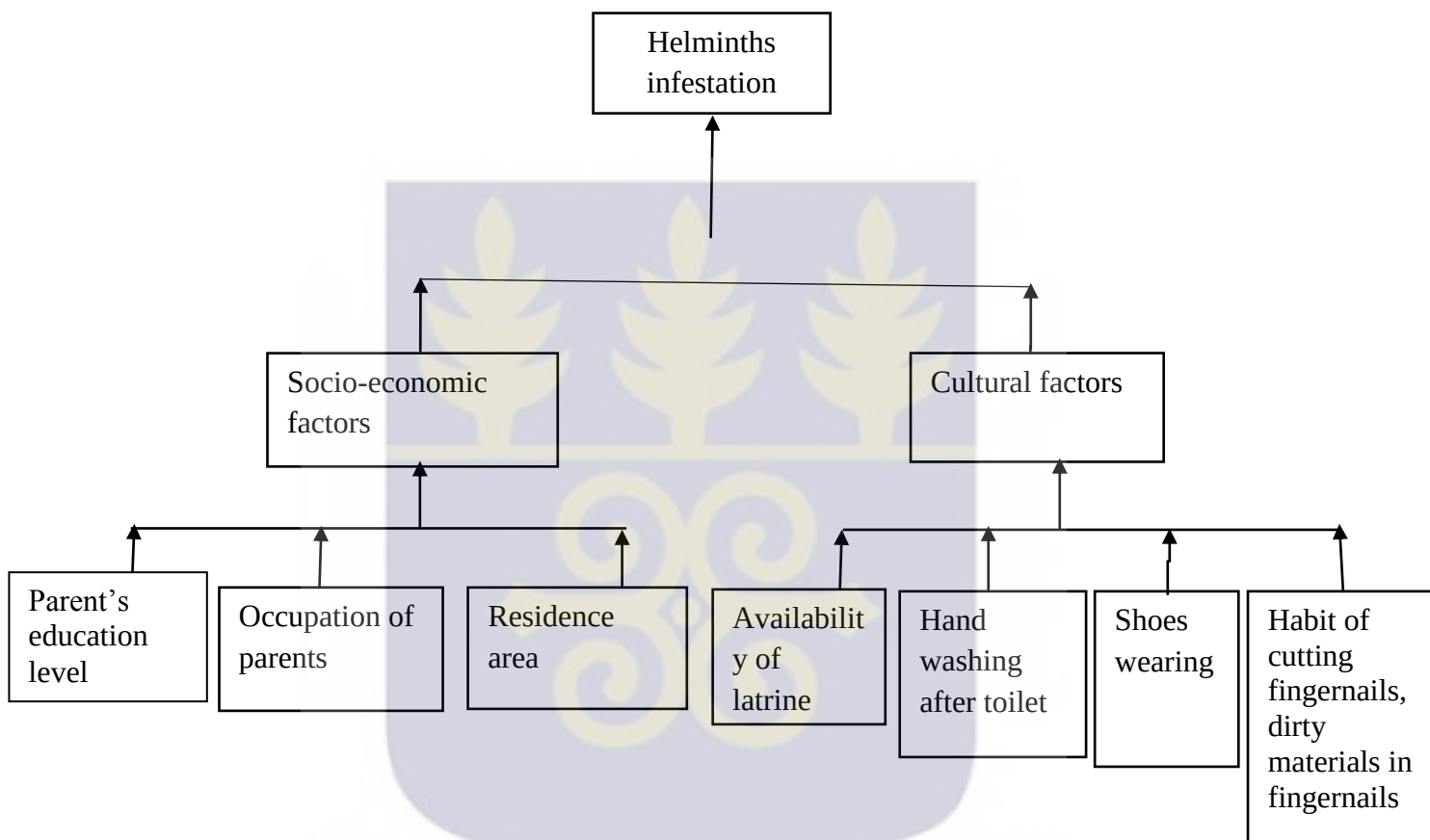
Despite the increasing interest in helminth infestation causing anemia and retarded growth in children, only few studies have assessed the intestinal helminth infestation in children and its risk factors. The prevalence of intestinal helminth infestation in children and its risk factors in Accra, Ghana have not been previously reported.



1.3 Conceptual framework

The prevalence of helminth infestation is increasing in sub-Saharan Africa (SSA).

Below is an illustration of the interaction among factors that lead to helminth infestation in children



1.4 Justification

The increased prevalence of helminth infestation especially in developing countries has been neglected for some time now.

Children of school age and immune-deficient individuals are particularly vulnerable, with heavy infestations associated with cognitive impairment, iron-deficiency anemia, growth retardation, malabsorption and malnourishment. All these factors invariably affect the health status and ultimately the academic performance of children in schools in developing countries. Surprisingly, helminth infestation has been considered a neglected tropical disease which attracts less research attention and funding, globally and even in SSA including Ghana. Against this background this study aims at determining the prevalence

and associated factors of helminth infestation in children attending Princess Marie Children's Hospital in the Greater Accra region of Ghana.

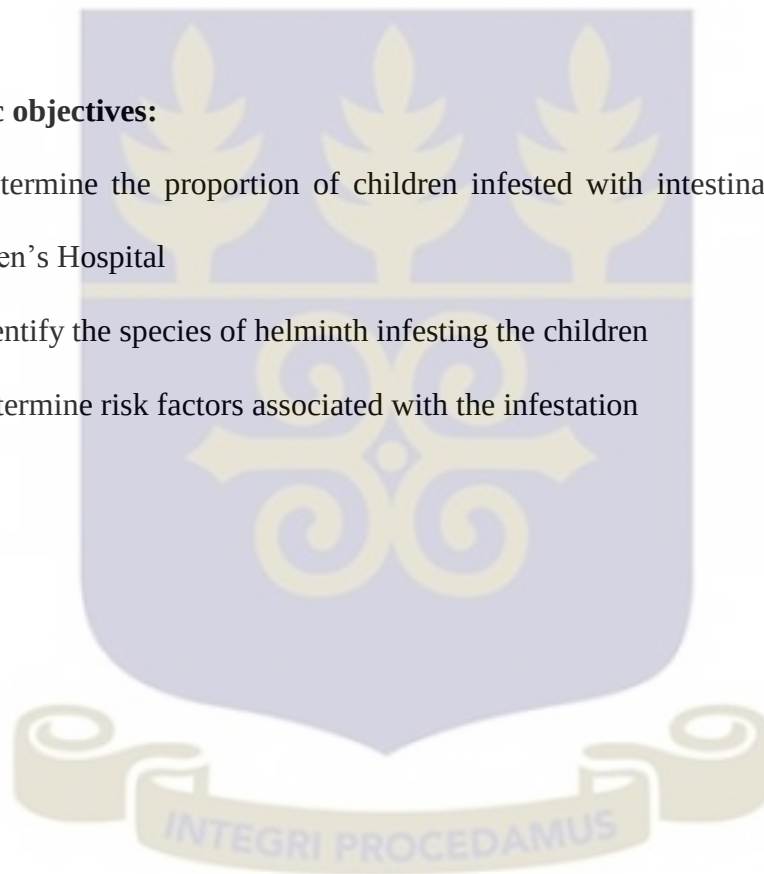
1.5 Objectives

1.5.1 General objective:

To determine the prevalence of intestinal helminth infestation among children attending Princess Marie children Hospital

1.5.2 Specific objectives:

1. To determine the proportion of children infested with intestinal helminth at the children's Hospital
2. To identify the species of helminth infesting the children
3. To determine risk factors associated with the infestation



CHAPTER TWO

LITERATURE REVIEW

2.1 Helminths Classification

Helminth is a general term meaning worm. The helminths are invertebrates characterized by elongated, flat or round bodies. In medically oriented schemes the flatworms or platyhelminths (platy from the Greek root meaning “flat”) include flukes and tapeworms. Roundworms are nematodes (nemato from the Greek root meaning “thread”). These groups are subdivided for convenience according to the host organ in which they reside, e.g., lung flukes, extra intestinal tapeworms, and intestinal roundworms (Mehraj V et al., 2008).

Helminths develop through egg, larval (juvenile), and adult stages. Knowledge of the different stages in relation to their growth and development is the basis for understanding the epidemiology and pathogenesis of helminth diseases, as well as for the diagnosis and treatment of patients harboring these parasites.

There are three major groups of helminths containing members that have man as their main hosts. These are the **Digenean Flukes (Trematode)**, the **Tapeworms (Cestodes)**, and the **Roundworms (Nematodes)**.

Nematode



Cestode



Trematode



Nematodes (roundworms) have long thin unsegmented tube-like bodies with anterior mouths and longitudinal digestive tracts. They have a fluid-filled internal body cavity (pseudocoelum) which acts as a hydrostatic skeleton providing rigidity (so-called 'tubes under pressure'). Worms use longitudinal muscles to produce a sideways thrashing motion. Adult worms form separate sexes with well-developed reproductive systems.

Cestodes (tapeworms) have long flat ribbon-like bodies with a single anterior holdfast organ (scolex) and numerous segments. They do not have a gut and all nutrients are taken up through the tegument. They do not have a body cavity (acoelomate) and are flattened to facilitate perfusion to all tissues. Segments exhibit slow body flexion produced by longitudinal and transverse muscles. All tapeworms are hermaphroditic and each segment contains both male and female organs.

Trematodes (flukes) have small flat leaf-like bodies with oral and ventral suckers and a blind sac-like gut. They do not have a body cavity (acoelomate) and are dorsoventrally flattened with bilateral symmetry. They exhibit elaborate gliding or creeping motion over substrates using compact 3-D arrays of muscles. Most species are hermaphroditic (individuals with male and female reproductive systems) although some blood flukes form separate male and female adults (Brown, 2005).

2.2 Life-cycles

In general, gastrointestinal tract is the primary involvement site of parasites during their life cycle.

Helminths form three main life-cycle stages: eggs, larvae and adults. Adult worms infect definitive hosts (those in which sexual development occurs) whereas larval stages may be free-living or parasitize invertebrate vectors, intermediate or paratenic hosts. Nematodes produce eggs that embryonate in utero or outside the host. The emergent larvae undergo 4 metamorphoses (moult) before they mature as adult male or female worms.

Cestodes 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.

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 or form encysted metacercariae on aquatic vegetation which is eaten by definitive hosts.

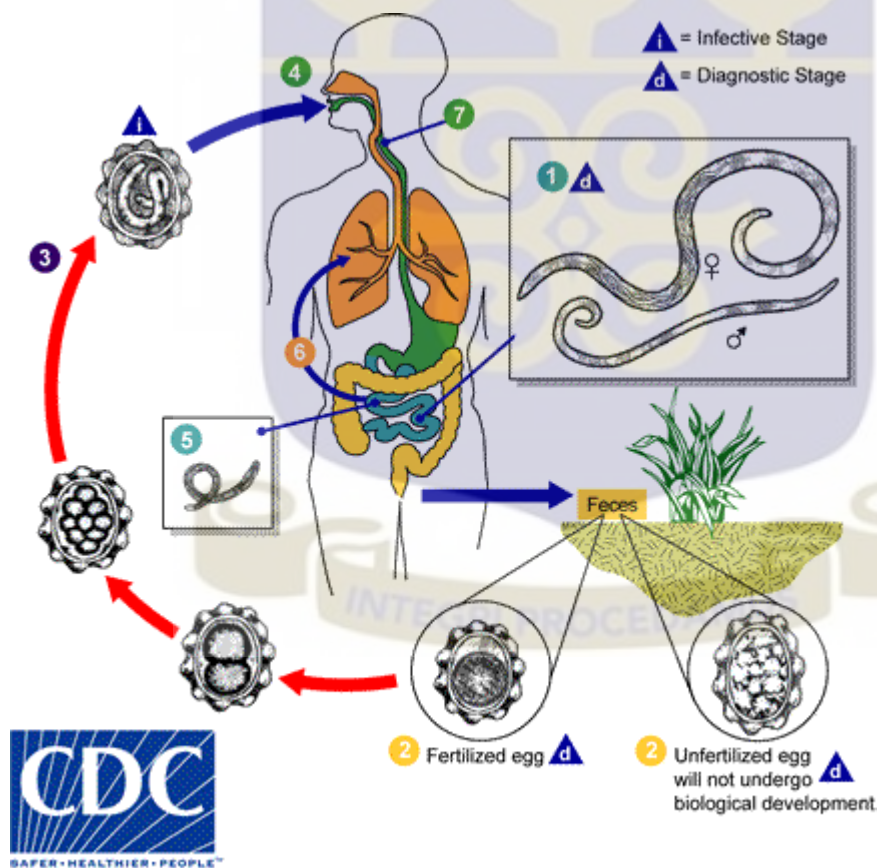


Figure 1: Life cycle of *Ascaris lumbricoides* a common intestinal helminth that infect children

Adult worms (1) live in the lumen of the small intestine. A female may produce approximately 200,000 eggs per day, which are passed with the feces (2). Unfertilized eggs may be ingested but are not infective. Fertile eggs embryonate and become infective after 18 days to several weeks (3), depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed (4), the larvae hatch (5), invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs (6). The larvae mature further in the lungs (10 to 14 days), penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed (7). Upon reaching the small intestine, they develop into adult worms (1). Between 2 and 3 months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live 1 to 2 years.

2.3 Helminths Characteristics

Worms affect the nutrition of their host by either ingesting blood leading to loss of iron or by depleting nutrients. Synergism exists between intestinal inflammation caused by worms and growth failure. New studies show that hookworm inhibits growth and promotes anaemia in preschool as well as school age children (Mehraj, Hatcher, Akhtar, Rafique, & Beg, 2008).

Indicative changes of intestinal parasitic infections are:

Cytological changes in the blood eosinophilia which gives an indication of tissue invasion by helminthes, a reduction in white blood cell count indicates of kala-azar, infection and anemia is a feature of hookworm infestation

Serological tests are carried out only in laboratories where special antigens are available.

Many parasitic infections can be cured by specific chemotherapy. For the treatment of intestinal helminthiasis, drugs are given orally for direct action on the worms. To obtain

maximum parasitocidal effect, it is desirable that the drugs administered should not be absorbed and the drugs should also have minimum toxic effect on the host.

Measures may be taken against every parasite infecting humans. Preventive measures designed to break the transmission cycle are crucial to successful parasitic eradication. Such measures include; reduction of the source of infection and the parasite being attacked within the host, thereby preventing the dissemination of the infecting agent. Therefore, a prompt diagnosis and treatment of parasitic diseases is an important component in the prevention of dissemination. Sanitary control of drinking water and food, proper waste disposal through establishing safe sewage systems and use of screened latrines are encourage (Park, Kim, Ha, & Lee, 2008).

2.4 Epidemiology

The infestations are more prevalent among the poor segments of the population. They are closely associated with low household income, poor personal and environmental sanitation, and overcrowding, limited access to clean water, tropical climate and low altitude. Intestinal parasitic infections such as amoebiasis, ascariasis, hook- worm infection and trichiuriasis are among the ten most common infections in the world (Gelaw et al., 2013).

Helminth eggs have tough resistant walls to protect the embryo while it develops. Mature eggs hatch to release larvae either within a host or into the external environment. The four main modes of transmission by which the larvae infect new hosts are faecal-oral, transdermal, vector-borne and predator-prey transmission (Organization & WHO, 2014).

Sub-Saharan Africa, a region where intestinal helminth infection is endemic in both rural and urban areas, the overlapping distribution of these parasitic infections results in high rates of infestation (Yatich et al., 2009).

Direct life cycle nematode infections are among the most prevalent infectious diseases of people. The World Health Organization (WHO) estimates that infection with *Ascaris*

lumbricoides, *Trichuris trichiura* and the hookworms (*Ancylostoma duodenale* and *Necator americanus*) with associated morbidity, affect approximately 250, 46 and 151 million people respectively. The majority of these infections occur in developing countries especially sub-Saharan Africa where increased population density and urbanization, poverty, inadequate sanitation and poor health awareness contribute to the increasing prevalence of infections (Traub, Robertson, Irwin, Mencke, & Thompson, 2004).

Despite recent advances in epidemiological understanding of parasite population behavior and cost-effective control strategies, the proportion of parasite populations in developing countries has remained virtually unchanged over the past 50 years (Chan et al. 1994). It could be argued that the major reason behind this fact is the relative unimportance placed on the public health impact of intestinal helminth infections in previous years as global mortality rates for intestinal helminthiasis are considered low compared with other infectious diseases. Chronic helminthiasis can lead to insidious and debilitating disease, especially in children (O'Lorcain & Holland 2000), (Traub et al., 2004).

Infections caused by Soil Transmitted Helminths including hookworm are associated with poverty and underdevelopment and are most prevalent in the poorest communities of the developing world including almost all countries of the sub-Saharan Africa (WHO, 2002). The burden of these helminth infections has been consistently underestimated in the past, but there is now a general consensus that STH infections represent an important public health problem especially for children (Uneke, 2010).

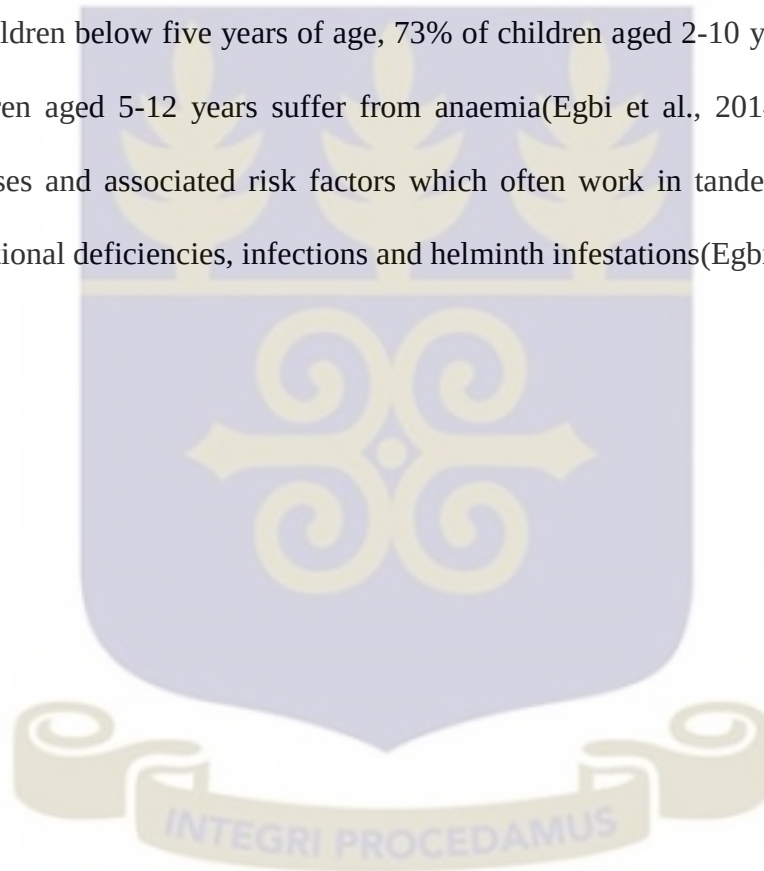
WHO stresses the importance of soil transmitted helminth control using a combination of chemotherapy and improved living conditions (WHO 1996; Guyatt et al. 2001). Most recent control programmes have focused on chemotherapeutic-based options for control as they have been proven to be the most cost-effective and easy to implement (Stoltzfus et al. 1997, 1998; Guyatt et al. 2001). However, it has been increasingly recognized that for

control to be both effective and sustainable, it is necessary to adopt an integrated approach (Warren 1990; Geerts & Gryseels 2000).

One of the major reasons for the lack of integrated approaches is the lack of short-term benefits of the programmes (Traub et al., 2004).

Children are typically at increased risk resulting in high prevalence and intensity of infection due to high level of exposure (WHO, 2002), (Uneke, 2010).

Anaemia in children is a public health issue in Ghana. It has been reported that 76% of Ghanaian children below five years of age, 73% of children aged 2-10 years, and 63% of school children aged 5-12 years suffer from anaemia(Egbi et al., 2014). Anaemia has multiple causes and associated risk factors which often work in tandem. They include various nutritional deficiencies, infections and helminth infestations(Egbi et al., 2014).



CHAPTER THREE

METHODS

3.1 Study design

A cross-sectional study design was used to conduct this study to determine helminths infestation in children (outcome) and exposure factors using light microscopy and interview questionnaire.

3.2 Study area

The study was carried out at Princes Louise Marie children hospital (PML). Princess Marie Louise hospital is a Ghana health service healthcare institution located in Accra, within the Ashiedu Keteke sub metro of the Greater Accra region that provides medical care services, pursues diseases control and offers reproductive and child health (RCH), family planning (FP) and nutrition services. Currently, the hospital has a total of 273 staff with 6 permanent doctors and 147 nurses .The medical service of PML consists of 82 beds.

3.3 Inclusion and exclusion criteria

Inclusion criteria were children with 10 years and younger attending the Hospital.

Exclusion criteria were children above 10 years and those administered with anti-helminthic drugs during and prior to 2 weeks of the study period.

3.4 Variables

Under this cross sectional study, the dependent variables was helminth eggs and Independent variables included parents education level, parents occupational, availability of latrine at home and habit of using latrine, hand washing after toilet and dirty materials in fingernails of children.

3.5 Study population

The study population involved were children attending Princes Marie children hospital in the Greater Accra of Ghana.

3.5 Sampling

3.5.1 Sample size

The **Cochrane's** formula was used to calculate the minimum sample size required (Kothari, 2004)

$$\text{Sample size} = \frac{Z_{1-\alpha/2}^2 p(1-p)}{d^2}$$

Where

Z= abscissa of the normal curve that cuts off an area α at the tails (1.96)

d = level of precision considering the level of significance at 5%

P= Prevalence of helminths to children from previous studies 45% (Abera & Nibret, 2014)

Assuming the prevalence of intestinal helminthes in the study area to be 45%. Sample size of 194 was estimated. Due to anticipation of non-compliance 10% of the sample size was added to the normal sample size to make a total of 225 sample size.

3.5.2 Sampling method

Participants' recruitment was done using consecutive sampling, which is every patient attend the hospital that is 10 years child and younger and those not administered with anti-helminthic drugs during and prior to 2 weeks of the study period, the parents asked

willingly to fill a consent form for their child and recruited until the required sample size was obtained.

3.6 Data collection techniques

Stool samples were collected and verbal consent was obtained from both children and their guardians. Children and guardians were guided on how to bring the stool samples and then they were provided with clean plastic stool vials with toilet tissue paper. After collecting sufficient fresh stool sample with plastic vial from each participant, codes were given to all plastic vials and then each child was interviewed using a structured questionnaire. Then the sample was taken immediately to the hospital laboratory for examination.

A drop of saline was placed on a clean slide, then small piece of stool was placed on the slide containing normal saline (0.85%) and mixed, and covered with a cover slip (if the specimen contain mucus, the examination was done without saline). The mucus is put on the slide and covered with cover slip. The processed samples were examined under 10X and 40X light microscope for identification of helminth eggs, and species type. The helminthes eggs identification was done using the helminthes key identification by Melvin and Brooke, 1982; Ash and Orihel, 1987 as attached at the back.

3.7 Quality control

Research assistants were trained to ensure they were familiar with the objectives of the study. Data collected were checked for accuracy and completeness. Necessary corrections were made where possible. Completed forms were coded and entered into excel program every day and then imported to Stata 12 statistical software.

Confidentiality of participant's data was ensured by keeping data in lock cabinet and restricting it to the research team only.

3.8 Data processing and analysis

3.8.1 Presentation

Data was collected through structured questionnaire, and parasitological examination of stools was scored as helminths eggs present or absent, and was organized and summarized using descriptive statistics by means of tables.

3.8.2 Statistical method

Data was analysed using STATA version 12 statistical software. Chi-square was used to test association between independent variables and main outcome (helminth eggs). Univariate and multivariate logistic regression analysis were performed with Odds Ratio (OR) and 95% confidence interval (CI) to determine the association between infection and potential risk factors associated with main outcome (intestinal helminthic infections). P-values less than 0.05 was considered to be statistically significant.

3.9 Ethical consideration/issues

Ethical clearance was obtained from the Ghana Health Service. Also permission was sought from Head of Princes Marie children hospital before commencement of the study.

Parents/guardians were completed an informed consent and assent forms before the study was commenced.

3.10 Pilot or pre-test study

A pilot study was conducted by administering questionnaires before going to the field. The pilot testing was conducted at the Achimota Government Hospital before the commencement of the study.

CHAPTER FOUR

RESULTS

A total of 250 participants (127 males and 123 females) aged 0–10 years (0-120months) participated in the study; Mean age of participants is 47.56 months. The prevalence of intestinal parasitic infections is shown in Table 1. Of the total 225 stool samples examined the overall prevalence of intestinal helminths was 17.33% (39/225).

Among these a total of 25 (64.10%) were males and 14 (35.90%) were females and they were all positive for only single infection. No double infestation was detected and there was no significant difference in helminths infestation between males and females ($P > 0.05$) Table 1.

Hookworm was the predominant intestinal helminth species with a prevalence of 10.22% (23/225) followed by *A. lumbricoides* (7.11%; 16/225) (Table 2).

According to their residence, 191(84.89%) were from urban and 34 (15.1%) children were from rural areas. 21(10.99%) out of 191 children were from urban and 18(52.94%) out of 34 from rural areas were infested with intestinal helminths and there was significant difference in infestation between urban and rural children ($P < 0.05$) (Table 1).

The two major intestinal helminths namely *Ascaris lumbricoides* and hookworm were identified with overall prevalence of 17.33% in this study. Among participant sex, 11 (8.7%) male children and 6 (6.1) female children were infested with *Ascaris lumbricoides* while 15 (11.8%) male and 8 (8.2%) female were positive for hookworm and the difference was not significance ($P > 0.05$) [Table 2].

Among the age groups, the highest prevalence was 43.28% (29/67) for those between 72-120 months, 13.33% (4/30) for those between 48-71 months, 9.26% (5/54) for those between 24-47months and the least was 1.35% (1/74) for children between 0-23 months and the difference of infestation between these age group was statistically significant ($P < 0.05$) (Table 1).

According to their parents occupation, 172 (76.44%) were employed and 53 (23.56%) parents were not employed either in formal or informal sector. 17 (9.88%) of 172 children of parents who were employed and 22 (41.51%) of 53 children of parents who were not employed were positive for intestinal helminths and there was significant difference between parents employed and parents who were not employed ($p < 0.05$) (Table 1).

According to parents education, 28 (12.44%) have never been to school, 11 (4.89%) had primary level education while 153 (68%) had secondary school level education. 33 (14.67%) had tertiary education qualification and there is significant difference between parents educational level ($p < 0.05$).

For those with latrine at home and who are using it, 180 (80%) were having a latrine at home and 45 (20%) were not having the latrine at home. 16 (8.89%) who were having the latrine at home and 23 (51.11%) who did not have latrine at home were infested with intestinal helminths and the difference was significance ($P < 0.05$) (Table 1).

Among 250 children who participated in this study 182 (80.89%) had washed hands after using toilet and 43 (19.11%) did not wash hands after toilet. 10 (5.49%) who washed hands after toilet and 29 (67.44%) who didn't wash hands after toilet were positive for helminths infestation and the difference was significance ($P < 0.05$) (Table 1).

Among 250 children who participated in this study 103 children had dirt in their fingernails. 35 (33.98%) with dirt in their fingernails and 4 (3.28%) without dirt in their fingernail were positive for intestinal helminths and the difference was significance ($P < 0.05$) (Table 1).

Table 1: Overall prevalence of intestinal helminth infestation in children

Characteristics	No participant. (%)	Positive (%)	Negative(%)	P-value
Sex				
Male	127 (56.4)	25 (19.7)	102 (80.3)	0.28
Female	98 (43.6)	14 (14.3)	84 (85.7)	
Age(months)				
0-23	74 (32.9)	1 (1.4)	73 (98.6)	<0.0001
24-47	54 (24.0)	5 (9.3)	49 (90.7)	
48-71	30 (13.3)	4 (13.3)	26 (86.7)	
72-120	67 (29.8)	29 (43.3)	38 (56.7)	
Residence				
Urban	191 (84.9)	21 (10.9)	170 (89.1)	<0.0001
Rural	34 (15.1)	18 (52.9)	16 (47.1)	
Parent Occupation				
Employed	172 (76.4)	17 (9.9)	155 (90.1)	< 0.0001
Not employed	53 (23.6)	22 (41.5)	31 (58.5)	
Parents Education				
Never been to school	28 (12.4)	14 (50)	14 (50)	<0.0001
Primary school	11 (4.9)	7 (63.6)	4 (36.4)	
Secondary school	153 (68)	17 (11.1)	136 (88.9)	
Tertiary education	33 (14.7)	1 (3.1)	32 (96.9)	
Latrine at home				
Has latrine	180 (80)	16 (8.9)	164 (91.1)	<0.0001
Has no latrine	45 (20)	23 (51.1)	22 (48.9)	
Hand wash after toilet				
Wash hand after toilet	182 (80.9)	10 (5.5)	172 (94.5)	<0.0001
Not washing hands	43 (19.1)	29 (67.4)	14 (32.6)	
Fingernail dirty				
Present dirty in fingernail	103 (45.8)	35 (33.9)	68 (66.1)	<0.0001
No dirty in fingernail	122 (54.2)	4 (3.3)	118 (96.7)	

Table 2: Prevalence of intestinal helminths species by Sex.

Sex	<i>Ascaris lumbricoides</i> Positive (%)	Hookworm Positive (%)	P-value
Male n= 127	11 (8.7)	15 (11.8)	0.48
Female n=98	6 (6.1)	8 (8.2)	

In the univariate logistic regression model, age group beyond 47, residence (COR=10.25 95%CI 4.54- 23.16), occupation (COR=7.0 95%CI 3.34- 14.63), parents education and those with secondary education and above, latrine at home (COR= 0.09 95%CI 0.04- 0.19), those who wash hands after using toilet (COR= 0.03 95%CI 0.01- 0.06) and those having dirt in finger nail (COR= 15.85 95%CI 5.41- 46.47) were significantly associated with increased risk of helminths infestation ($p < 0.05$).

In multivariate analyses of risk factors, significant association was observed between intestinal helminth infestations with age group beyond 47 months, residence (AOR = 7.35 95%CI 1.68- 32.11), hand wash after using toilet (AOR = 0.04 95%CI 0.01- 0.20) and dirty material in fingernails (AOR = 7.96 95%CI 1.73- 36.65). Parent's education was not significantly associated with increased risk of helminth infestation in multivariate analysis but in univariate analysis those parents with secondary school qualification and above was significant.

After controlling for residence, occupation, parents education, latrine at home, washing hands after using toilet and dirt in finger nails the odds of being infested with gastrointestinal parasites for children aged 72 months and above was higher than those children less than 24 months (AOR = 51.87 95%CI 3.87- 694.71).

After adjusting for occupation, parents education, latrine at home, washing hands after using toilet and dirt in finger nails children from rural area were seven times more likely to be infested with gastrointestinal helminths than those from urban areas (AOR = 7.35 95%CI 1.68- 32.11)

After adjusting for occupation, parents educational, latrine at home and dirt in finger nails, children that did wash their hands after using toilet were 0.04 less likely to be infested than those who didn't wash their hands (AOR = 0.04 95%CI 0.01- 0.20).

Similarly, the odds of being infested with gastrointestinal helminths in those children whose fingernails contained dirty material were seven times higher than those who did not have dirty materials in their fingernail (AOR = 7.96 95%CI 1.73- 36.65).

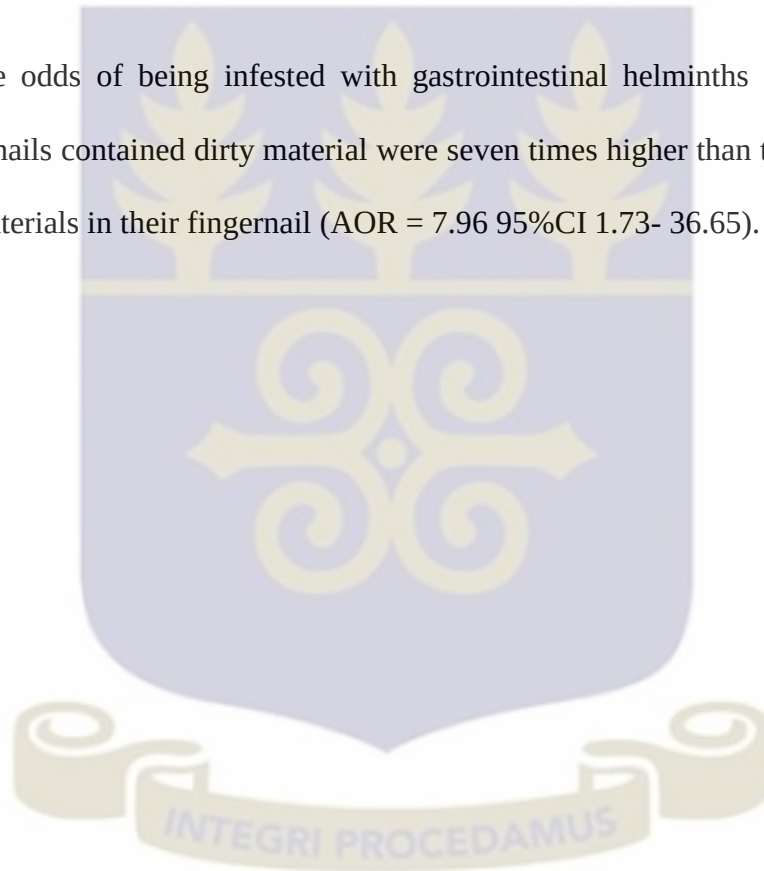


Table 3: Social-demographic factors significantly associated with helminth infestation

Variable	Crude OR (95%CI)	P-value	Adjusted OR (95%CI)	P-value
Age group				
<24	Ref		Ref	
24-47	7.45 (0.84- 65.72)	0.07	9.15 (0.58- 144.98)	0.12
48-71	15.1 (1.74- 131.00)	0.01	16.72 (1.00- 279.72)	0.05
72-120	60.11(7.85- 460.38)	0.00	51.87 (3.87- 694.71)	0.00
Residence				
Urban	Ref		Ref	
Rural	10.25 (4.54- 23.16)	0.00	7.35 (1.68- 32.11)	0.01
Parent occupation				
Employed	Ref		Ref	
Not employed	7.0 (3.34- 14.63)	0.00	2.92 (0.38- 22.27)	0.30
Parents education				
Never	Ref		Ref	
Primary	2.67 (0.58- 12.19)	0.21	3.93 (0.31- 49.74)	0.29
Secondary	0.13 (0.05- 0.31)	0.00	2.4 (0.27- 21.38)	0.44
Certificate& above	0.03 (0.004-0.26)	0.00	1.82 (0.08- 43.55)	0.71
Latrine at home				
No	Ref		Ref	
Yes	0.09 (0.04- 0.19)	0.00	0.80 (0.14-4.46)	0.79
Hand wash after toilet				
No	Ref		Ref	
Yes	0.03 (0.01- 0.06)	0.00	0.04 (0.01- 0.20)	0.00
Fingernail dirty				
No	Ref		Ref	
Yes	15.85 (5.41- 46.47)	0.00	7.96 (1.73- 36.65)	0.01

CHAPTER FIVE

DISCUSSION

In this study, the overall prevalence of intestinal helminth infestation was 17.33%. It was lower when compared to other studies which were done among children in different countries. Prevalence of 41.46% from Enderta district, Northern Ethiopia (Teklemariam et al., 2014), and 31% from rural Kenya (Nguhiu et al., 2009) were reported. The difference in prevalence could be attributed to timing and seasonal differences in conducting the study, environmental conditions and other geographical factors in these study areas.

The prevalence of helminth infestation in the current study was also relatively higher compared to other studies conducted on children (11.1%) in Ashanti region of Ghana (Tay, Gbedema, & Gyampomah, 2011) and in Osun state Nigeria 12.2% (Kirwan et al., 2009). The relatively higher rate of helminths infestation in children at Princes Marie Louise children hospital might be due to lack of hand washing habit after toilet, presence of dirty material in fingernails, availability and use of latrines at home and their residence.

The result of present study is also comparable with previous studies conducted in different parts of Ghana, among children at Kumasi which revealed that the proportion of helminthic infestations among individuals age groups <1, 1 to 9, were 1.3% and 10.8% respectively (Walana, Aidoo & Tay, 2014). The higher prevalence of 17.33% obtained at Princes Marie Louise Children Hospital in comparison with the above report could be attributed to lack of hands washing after using of toilet, education level of parents and rural residence where there is shortage of clean water and other social services.

In the current study two common intestinal helminths species were identified in 225 children, the most frequent helminth one being hookworm followed by *A. lumbricoides* with prevalence of 10.22% and 7.11% respectively. Similar results was reported from Tilli town in Ethiopia (Abera & Nibret, 2014) with hookworm prevalence of 7.8%.

Boys had a higher prevalence of helminths infection than girls although the difference in this prevalence was not statistically significant. This result was supported by previous study which revealed that there was no statistical significant difference between the prevalence rate of intestinal infection across gender (Taheri, Namakin, Zarban, & Sharifzadeh, 2011).

Provision of health education on transmission of intestinal helminth to children and parents would motivate washing of hands after using toilet and cutting their fingernails regularly to prevent dirt in fingernails and thereby contribute a lot in the prevention and control of intestinal helminths infestation.

According to this study, there was significant association between hand wash after using toilet and rate of gastrointestinal helminth infestations. This was in contrast to other studies (Gelaw et al., 2013) . This finding might be due to lack of regular health education program to parents which can enhance their awareness in transmission and control mechanism of helminth infection.

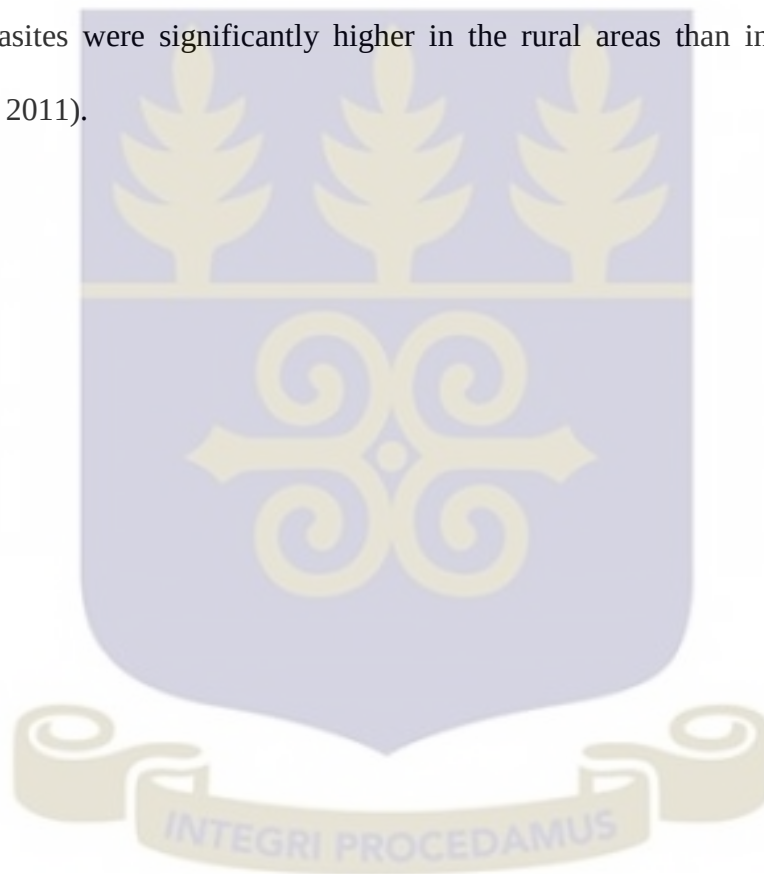
Eighty percent (80%) of children had toilet in their houses, but the rate of intestinal helminth infestations was not related to the presence or absence and usage of latrines ($P > 0.05$).

One hundred and eighty two (80.9%) children had hands wash habit after using the toilet and there was significant difference between the rate of helminths infestation and hand washing habit ($P < 0.05$) (table 4).

One hundred and three children (45.9%) had dirty material in their fingernails, out of these 33.9% were positive for helminth infections. There was significant relation between helminth infestation and dirty material in their fingernails. This is probably due to poor hygienic practice, socio-economic status and also playing habit of children with soil. This result was supported by previous studies which indicated that the rate of helminths

infection varied significantly with hand washing habits after defeacation (Ilechukwu et al., 2010).

One hundred and ninety one (84.9%) children were from urban areas and among these, 10.9% were infected with intestinal helminths. It was observed that children in rural areas were at higher risk of being infested than those from urban area ($P < 0.05$) (table 4). This probably might be due to poor hygiene practice, lack of clean and safe water in the rural area. This findings was similar to other study which showed that the prevalence of intestinal parasites were significantly higher in the rural areas than in the urban areas (TaHERi et al., 2011).



CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The current study has revealed a relatively high prevalence of intestinal helminthic infections among children attending Princess Marie Louise Children Hospital compare to study in Ashanti Region with prevalence of 11% (Tay et al., 2011). Two species *A. lumbricoides* and hookworm with prevalence of 10.22% and 7.11% respectively were identified. Hookworm is the most prevalent species of intestinal parasitic infestation in children attending this hospital. Significant associations were observed between intestinal helminth infestation and age group beyond 47 months, place of residence, washing hands after using toilet and dirt on the fingernails of children ($P<0.05$).

6.2 Recommendation

This study shows that interventional program such as deworming should be promptly commenced at Princess Marie Louise Children Hospital that should target every child attending the hospital.

The control strategy that should be initiated for STH should involve periodic ant-helminthic drugs treatment of children at the risk area, particularly school-age children and non-school age children with age 0-17 years old. Community education and environmental hygiene among parents and children should be encouraged.

Government should also improve the supply of safe water and implementation of the country's 'Enhanced Outreach Strategy' which will help to empower and enable rural households to control intestinal parasitic infestations.

REFERENCES

- Abera, A., & Nibret, E. (2014). Prevalence of gastrointestinal helminthic infections and associated risk factors among schoolchildren in Tilili town , northwest Ethiopia. *Asian Pacific Journal of Tropical Medicine*, 7(7), 525–530. [http://doi.org/10.1016/S1995-7645\(14\)60088-2](http://doi.org/10.1016/S1995-7645(14)60088-2)
- Anah, M. U., Ikpeme, O. E., Etuk, I. S., Yong, K. E., Ibanga, I., & Asuquo, B. E. (2008). Worm infestation and anaemia among pre-school children of peasant farmers in Calabar , Nigeria ., 11(3), 220–224.
- Brown, M. (2005). Intestinal helminths. *Medicine*, 33(8), 54–57. Retrieved from <http://www.sciencedirect.com/science/article/B82YB-4KY3VST-5/2/7664c73f3950aa4ac2190b16c5107b74>
- Egbi, G., Steiner-asiedu, M., Kwesi, F. S., Ayi, I., Ofosu, W., Setorglo, J., ... Armar-klemesu, M. (2014). Anaemia among school children older than five years in the Volta Region of Ghana, 17(Supp 1), 5–8. <http://doi.org/10.11694/pamj.suppl.2014.17.1.3205>
- Gelaw, A., Anagaw, B., Nigussie, B., Silesh, B., Yirga, A., Alem, M., ... Gelaw, B. (2013). Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: a cross-sectional study. *BMC Public Health*, 13, 304. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3621079&tool=pmcentrez&rendertype=abstract>
- Humphries, D., Mosites, E., Otchere, J., Twum, W. A., Woo, L., Jones-Sanpei, H., ... Cappello, M. (2011). Epidemiology of hookworm infection in Kintampo North Municipality, Ghana: Patterns of malaria coinfection, anemia, and albendazole treatment failure. *American Journal of Tropical Medicine and Hygiene*, 84, 792–800. <http://doi.org/10.4269/ajtmh.2011.11-0003>
- Ilechukwu, G. C., Ilechukwu, C. G. A., Ozumba, A. N., Ojinnaka, N. C., Ibe, B. C., & Onwasigwe, C. N. (2010). Some behavioural risk factors for intestinal helminthiasis in nursery and primary school children in Enugu , South Eastern Nigeria, 13(3), 288–293.
- Kirwan, P., Asaolu, S. O., Abiona, T. C., Jackson, A. L., Smith, H. V., & Holland, C. V. (2009). Soil-transmitted helminth infections in Nigerian children aged 0-25 months. *Journal of Helminthology*, 83, 261–266. <http://doi.org/10.1017/S0022149X08201252>
- Masoumeh, R., Farideh, T., Mitra, S., & Heshmatollah, T. (2012). Intestinal parasitic infection among school children in Golestan province, Iran. *Pakistan Journal Of Biological Sciences: PJBS*, 15, 1119–1125.
- Massey, S., Elsheikha, H., & Morsy, G. (2009). A cross-sectional study of intestinal parasitic infections of the European badgers in Woodchester Park, South West England. *Journal of the Egyptian Society of Parasitology*, 39(1), 171–182.

- Mehraj V, Hatcher J, Akhtar S, Rafique G, & Beg MA. (2008). Prevalence and factors associated with intestinal parasitic infection among children in an urban slum of Karachi. *PloS One*, 3(11), e3680. <http://doi.org/10.1371/journal.pone.0003680>
- Mehraj, V., Hatcher, J., Akhtar, S., Rafique, G., & Beg, M. A. (2008). Prevalence and factors associated with intestinal parasitic infection among children in an urban slum of Karachi. *PLoS ONE*, 3(11).
- Miller, S. A., Rosario, C. L., Rojas, E., & Scorza, J. V. (2003). Intestinal parasitic infection and associated symptoms in children attending day care centres in Trujillo, Venezuela. *Tropical Medicine & International Health* : *TM & IH* 8(4), 342–347.
- Nguhiu, P. N., Kariuki, H. C., Magambo, J. K., Kimani, G., Mwatha, J. K., Muchiri, E., ... Mkoji, G. M. (2009). Intestinal polyparasitism in a rural kenyan community intestinal polyparasitism in a Rural Kenyan Community, 86(6), 272–278.
- Nguyen, N. L., Gelaye, B., Aboset, N., Kumie, A., Williams, M. A., & Berhane, Y. (2012). Intestinal parasitic infection and nutritional status among school children in Angolela, Ethiopia. *Journal of Preventive Medicine and Hygiene*, 53(3), 157–164.
- Okuyay, P., Ertug, S., Gultekin, B., Onen, O., & Beser, E. (2004). Intestinal parasites prevalence and related factors in school children, a western city sample--Turkey. *BMC Public Health*, 4, 64.
- Organization, W. H., & WHO. (2014). mhGAP intervention guide. *Geneva: WHO*, 1–121. Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:mhGAP+Intervention+Guide#1> <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:mhGAP+intervention+guide#1>
- Park, M.-S., Kim, K. W., Ha, H. K., & Lee, D. H. (2008). Intestinal parasitic infection. *Abdominal Imaging*. <http://doi.org/10.1007/s00261-007-9324-z>
- Pullan, R. L., & Brooker, S. J. (2012). The global limits and population at risk of soil-transmitted helminth infections in 2010. *Parasites & Vectors*.
- Review, P. (2014). Prevalence of hookworm infection : a retrospective study in Kumasi, 4(Suppl 1), 158–161. <http://doi.org/10.12980/APJTB.4.2014APJTB-2013-0014>
- Taheri, F., Namakin, K., Zarban, A., & Sharifzadeh, G. (2011). Intestinal parasitic infection among school children in south khorasan province, iran. *Journal of Research in Health Sciences*, 1(1), 45–50.
- Tay, S. C. K., Gbedema, S. Y., & Gyampomah, T. K. (2011). Accuracy of diagnosis of intestinal helminth parasites in a reference diagnostic laboratory in the Ashanti Region of Ghana, 3(1), 12–16.
- Teklemariam, A., Dejenie, T., & Tomass, Z. (2014). Infection prevalence of intestinal helminths and associated risk factors among schoolchildren in selected kebeles of Enderta district , Tigray , 6(November), 166–173. <http://doi.org/10.5897/JPVB2014.0173>

- Traub, R. J., Robertson, I. D., Irwin, P., Mencke, N., & Thompson, R. C. A. (2004). The prevalence , intensities and risk factors associated with geohelminth infection in tea-growing communities of Assam , India, 9(6), 688–701.
- Ugbomoiko, U. S., Dalumo, V., Danladi, Y. K., Heukelbach, J., & Ofoezie, I. E. (2012). Acta Tropica Concurrent urinary and intestinal schistosomiasis and intestinal helminthic infections in schoolchildren in Ilobu , South-western Nigeria. *Acta Tropica*, 123(1), 16–21. <http://doi.org/10.1016/j.actatropica.2012.03.002>
- Uneke, C. J. (2010). Soil transmitted helminth infections and schistosomiasis in school age children in sub-Saharan Africa: Efficacy of chemotherapeutic intervention since World Health Assembly resolution 2001. *Tanzania Journal of Health Research*. <http://doi.org/10.4314/thrb.v12i1.56366>
- Yatich, N. J., Yi, J., Agbenyega, T., Turpin, A., Rayner, J. C., Stiles, J. K., ... Jolly, P. E. (2009). Malaria and Intestinal Helminth Co-infection Among Pregnant Women in Ghana : Prevalence and Risk Factors, 80(6), 896–901.



APPENDICES

Appendix 1: Questionnaire

RISK FACTORS ASSOCIATED WITH HELMINTHS INFESTATION

Thank you for taking part in this study. The information you provide will be used in research to investigate the factors contributing to Helminths infestation children. Any information you provide will remain confidential and anonymous and only relevant to the research. You have the right to withdraw from this study at any time (Voluntary participation). If you're interested in the final results of the research please contact me on 0504 169842 and I will be happy to provide you with a copy of the final report.

Questionnaire no-----

ID number.....

Age of the participant (years).....

Please answer all questions by putting a tick on the response of your choice

- 1) Gender
 - a) Male
 - b) Female
- 2) Place of residence?
 - a) Rural
 - b) Urban
- 3) Are you employed?
 - a) Yes
 - b) No
- 4) Parent's education level?
 - a) Certificated and above
 - b) Secondary school
 - c) Never go to school
- 5) Do you have a latrine at home?
 - a) Yes
 - b) No
- 6) Does your child wash hands after toilet?
 - a) Yes
 - b) No
- 7) Availability of dirt in fingernails?
 - a) Yes
 - b) No

Appendix 2: Letter of Assent

I am Robert Mirisho a student from School of Public Health, University of Ghana, Legon.

I am conducting a research on Intestinal helminthes infestation in children attending Princess Marie children's Hospital. This research is being conducted to better understand prevalence of intestinal helminthes infestation among children attending Princess Marie children Hospital

In particular, I am interested in identify the species of helminth infesting in children and risk factors associated with the infestation

As a participant, your child will be helping Clinicians and public health professionals to identify the species of helminth infesting the children and risk factors associated with the infestation and also what appropriate intervention to be implemented to control the infestation

No penalties or negative consequences will result from withdrawal. All responses will be treated as confidential as no names will be placed on the testing instrument; neither will it be shown to ANYONE without YOU (AND YOUR CHILD) permission. I hope that you allow him/her to participate fully since their views on the subject are important. If you want to ask anything more about the exercise, I would be ready to answer.

Please confirm the participation of your child by ticking in the box below.

☐

1. By ticking inside this box, I give my informed consent for my son/daughter/ward to be interviewed, with full awareness of the purpose and terms and conditions of the information given

Signature_____ Date_____

P.I/Research Assistant's name _____Signature _____Date_____

Appendix 3: Informed Consent Form for Participants

Research Topic: “Intestinal Helminthes Infestation in Children Attending Princess Marie Louise Children’s Hospital”

Principal Investigator. Robert Mirisho

You are invited to participate in this research study. The purpose of this research is for academic and public health purposes. Your participation will involve taking your child’s (10 years or younger) stool sample for helminth determination and completing a questionnaire.. It will take less than 10 minutes to complete this activities.

Risks and discomforts

There are no known risks associated with this research. You may experience some discomfort from the smell from your child’s stool.

Potential benefits

There are no direct benefits to you that would result from your participation in this research. However, this research will provide useful information about the health condition and the burden of helminth infestation in children.

Protection of confidentiality

Your name or your child’s name will not be revealed in the questionnaire or any publication resulting from this study. The study will ensure privacy and confidentiality of your child’s data.

Voluntary participation

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide to withdraw or not to participate in this study. No compensation will be provided for your participation (neither monetary nor any other incentive). However, your participation will be highly appreciated.

Participant

I have read this consent form and have been given the opportunity to ask questions. I give my consent for my child to participate in this study.

Participant’s signature _____ Date _____

Investigator declaration

I certify that the participant has been given ample time to read and learn about the study. All questions and clarifications raised by the participant have been addressed.

Investigator's signature _____ Date _____

Contact information

If you have any questions or concerns about this study or if any problems arise, please contact:

Robert Mirisho (Investigator) Phone no. 0504169842

Ms Hannah Frimpong (Ghana Health Service Ethical Review Committee administrator)

Mobile phone no: 0243235225 or 0507041223



Appendix 4: Ethics Approval



Appendix 5: Introductory Letters

