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PREVALENCE OF SOIL-TRANSMITTED HELMINTHS AMONG SCHOOL PUPILS AT PRESEC STAFF PRIMARY SCHOOL

BY

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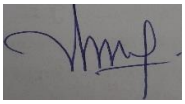
DECLARATION

I, Asare Kojo Asante, declare that except for other people's investigations which have been duly acknowledged, this thesis is the result of my own original research undertaken under supervision and that it has neither in whole nor in part been presented for another degree in this university or elsewhere.

Asare Kojo Asante.

Sign: 

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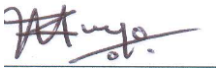
Sign: 

Date: 7/06/2021

DEDICATION

I dedicate this work to my late father Mr. Kojo Asare Cherebua, my beloved mother Victoria Otchere. My siblings, cousins, uncles and aunties. Finally, to all my friends and loved ones.

ACKNOWLEDGEMENT

I wish to express gratitude to the Almighty God for the bountiful mercies and grace. My profound gratitude to my supervisor Dr Mawuli Dzodzomenyo for allowing me to partake in this study. I thank my entire family for their support and encouragement throughout the hard times. I also thank the Principal and staff of Presec Staff School for their help in this research work. I am grateful to the Educational Directorate in the La-Nkwatanang District of the Greater Accra Region for allowing this study to be conducted in their locality.

ABSTRACT

Background: Neglected Tropical Diseases (NTDs) are classified as diseases predominantly affecting people in the tropical region at large. Soil-transmitted helminths (STH) are a group of intestinal worms that infect both adults and children with a range of medical and surgical conditions. Soil-Transmitted Helminths (STH) is a classic example of numerous NTDs. The burden of STH infection among school children continues to pose a threat and of austere public health importance. The present study aimed at establishing the prevalence of STH among school pupils at Presec Staff Primary school located in the La Nkwantanang Municipal in the Greater Accra Region as well as assess their knowledge level on worm infection. Preventive measures put in place by the school to address the spread of worm infection were also observed.

Method: A cross-sectional study employing a quantitative method was used to obtain data for the study. Simple random sampling was used to recruit 217 pupils for the study. A structured questionnaire was used to collect data on participants demographic characteristics as well as knowledge on STH while the Formal-ether concentration technique was used to examine the stool samples participants for helminth infections. STATA v15 was statistical software used in analysing data obtained from the study. Descriptive statistics were reported in terms of frequencies and percentages for categorical variables while that of continuous variables were reported in terms of means and standard deviations. Test of association between categorical independent variables and the outcome variable was done using the chi-square or Fishers' exact test of independence. The Welch t-test was used to compare the mean ages among children with and without STH infection. Logistic regression analysis was used to determine the effect of independent variables on the prevalence of STH infection.

Results: The results of the study showed an overall prevalence of 16% STH in the stools of participants. The types of STH identified in the stools of participants after laboratory tests

were *Ascaris lumbricoides*, *Ancylostoma duodenale* or *Necator americanus* and *Trichuris trichiura*. Parasitological examination of Ascaris *lumbricoides* constituted 12.44%, *Ancylostoma duodenale*, 1.84% and *Trichuris trichiura*, 1.84%. Soil-Transmitted Helminths infection was significantly higher in male ($P<0.05$), those who lived in compound houses ($P<0.05$). The study participants had a fair knowledge of STH infections. The availability of toilet and handwashing facilities were some of the measures put in place by the school authorities to address reduce the risk factors associated with STH infections.

Conclusion: There is an appreciable prevalence of STH among school pupils at Presec Staff Primary school and this was significantly associated with males and those who lived in compound houses. Appropriate measure to improve the knowledge of pupils on STH as well as promoting good personal hygiene practices is recommended.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AOR	Adjusted Odds Ratio
CDC	Centre for Disease Control
CI	Confidence Interval
DHIMS	District Health Information Management Systems
FIG	Figure
GIT	Gastrointestinal Tract
GHS	Ghana Health Services
JHS	Junior High School
LMIC	Low and Middle-Income Countries
MOH	Ministry of Health
NGO	Non-Governmental Organization
NTD	Neglected Tropical Disease
OR	Odds Ratio
PMLH	Princess Marie Louise Hospital
SHEP	School Health Education Program
STH	Soil-Transmitted Helminths
UNICEF	United Nations International Emergency Children's Fund
UOR	Unadjusted Odds Ratio
USAID	United States Agency for International Development
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Soil-transmitted helminths (STH), which is also known as Gastrointestinal (GI) nematode are a group of intestinal worms that infect both adults and children with a range of medical and surgical conditions (Jourdan et al., 2018). That is, pre-school-aged children, school-aged children, and reproductive women are most at risk of STH morbidities (World Health Organisation (WHO), 2015; Crompton & Nesheim, 2002). Soil-transmitted helminths (STH) infection is a well-known parasitic disease, which affects people globally, particularly, poor people living in the tropical and sub-tropical regions (WHO, 2012; Mehraj et al., 2008).

Soil-transmitted helminths comprise roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*), and hookworm (*Ancylostoma duodenale or Necator americanus*) (Pullan et al., 2014; WHO, 2012). The roundworm, which is the commonest STH, is transmitted through contact with contaminated soil containing eggs and larvae of the roundworm. Hookworms are transmitted through contact with contaminated soil where an infective larva in the third stage penetrates the skin. Whipworms are transmitted through ingestion of contaminated soil with infective embryonated eggs (Tudor 2015). Eggs and larvae of the various species of helminths thrive best in the tropical and subtropical climatic zones, where there is humid, warm and moist soil (Dahal et al., 2019; Alexander & Blackburn, 2019).

The transmission of the parasites to children includes ingestion of parasite ova through contaminated water, soil or food, which is improperly cooked and penetration of larvae through the skin where children walk barefooted (CDC, 2016; WHO, 2012). Also, children

having open defecation, staying around dumping sites, or school children dumping refuse in and around the school compound expose them to STH infections. Hence, studies have confirmed that children living in areas with poor environmental sanitation, poor practices of personal hygiene such as lack of handwashing with soap, and insufficient water are most at risk for STH infections (Brooker et al., 2009; Nalugwa et al., 2015; Nute et al., 2018; WHO, 2015; Ahmad et al., 2017).

A World Health Organization (WHO, 2019) report on STH infections indicated that approximately 1.5 billion (24%) of the world's population were infected with STH as of 2019. Furthermore, the report showed that out of the 1.45 billion infections due to Soil-Transmitted Helminths, 438.9 million (30.3%), 464.6 million (32.0%), and 819.0 million (56.5%) were attributed to hookworm, *T. trichiura*, and *A. lumbricoides* respectively. Additionally, it was reported that among children attending school, over 267 million preschool children and 568 million school-age children who were infected lived in areas where these parasites were heavily transmitted (WHO, 2019).

In Sub-Saharan African countries such as Ghana, intestinal parasitic infections are still major public health issues (Abaka-Yawson et al., 2020; Chelkeba et al., 2020). A global estimate revealed that in the Sub-Saharan African Region, 118 million people (13.6%), 101 million people (11.6%), and 118 million people (13.6%) were infected by hookworm, *T. trichiura*, and *A. lumbricoides* respectively (Pullan et al., 2010).

Ghana Health Service (GHS, 2016) report observed that the major STH in Ghana were hookworm, *T. trichiura, A. lumbricoides, S. stercoralis, N. americanus,* and *A. duodenale.* In addition, it was demonstrated that out of the 3 million school-age children selected for mass

drug administration for STH, approximately 2.56 million schoolchildren had STH infections (GHS, 2016).

Some of the symptoms associated with the STH infection in children included a generalized itching of the skin when the larvae are found in the bloodstream, dry cough, abdominal discomfort, general weakness and easy fatigability and vomitus (MOH, 2016). The effects of STH on children are numerous. For instance, infections due to STH cause children to be malnourished and anaemic, cognitive impaired, physically disabled, retard in growth and delayed developmental growth (Erra et al., 2018; Pullan et al., 2010; Freeman et al., 2015; Masaku et al., 2017; Abera & Nibret, 2014).

The suggestion is that to primarily diagnose helminths infections, there is the need for an electronic microscope, which is the fundamental instrument for determining the presence of eggs and larvae in a stool through wet preparation and the Kato Kats technique (CDC, 2016). Additionally, digital imaging to an extent can be used in diagnosing helminths. (CDC, 2016). However, the recommended regimen for helminthiasis is either Albendazole or Mebendazole 200mg to 400mg, either single or divided doses (CDC, 2016). Other researchers have also intimated that a vaccine for hookworm infection has been introduced as a regimen (Sabin, 2017; Vermeire, Lantz, & Caffrey, 2012; Haldeman, Nolan, & Ng'habi, 2020).

Some documents also argue that soil-transmitted helminths can be prevented through enhanced personal hygiene practices such as regular handwashing with soap under running water before eating or after visiting the toilet, improved sanitation to decrease soil contamination with infective eggs, provision of clean water, periodic deworming to destroy infecting worms, and health education to avoid re-infection. Also, another analyst provided

the view that children should be compelled to wear shoes and avoid walking barefooted to prevent infection (CDC, 2016; WHO, 2019).

Given the public health challenges posed by STH infections, there was the need for an assessment of the prevalence, types of STH, level of knowledge of STH as well as preventive measures to address the spread of worm infection. This was viewed as a means towards increasing children's awareness of STH infection and enable them to adhere to preventive measures of the infection. However, it appeared that research on STH remained a grey area in sub-Saharan Africa, specifically in Ghana. Thus, this study was needed to determine the prevalence, types of STH, level of knowledge, and preventive measure against STH infections amongst school pupils at Presec Staff Primary School in the La Nkwatanang Municipality of the Greater Accra Region of Ghana. This was to enhance understanding of factors associated with the prevention and prevalence of STH infections among school pupils at Presec Staff Primary School.

1.2. Problem Statement

Soil-transmitted helminths have existed many decades ago in both developed and developing countries (Cross, 1996; CDC, 2016; Bethony et al., 2006). Even though developed countries have made significant achievements at controlling and ensuring total elimination of STH due to improved socio-economic conditions coupled with sustained control activities (CDC, 2016), many developing countries in both the tropics and subtropical regions still record the high prevalence of STH (WHO, 2017).

Children are the most at-risk group to suffer soil-transmitted helminth infection due to their playful and exploratory activities. There is a need to look at it since the occurrence of the infection affects the cognitive and physical development of the child (Liu et al., 2015; Alemu

et al., 2011). In addition, the child suffers malabsorption and anaemia from hookworm infection; rectal prolapse occurring in whipworm infection; and growth retardation and intestinal obstruction from roundworm infection (Abera & Nibret, 2014).

Masaku et al. (2020) identified in their study that the prevalence of STH among children is due to a lack of improved source of drinking water, not wearing of shoes, and lack of toilet facilities.

Also, inadequate knowledge of the causes of worm infection such as drinking dirty water and the symptoms of STH such as itching of the skin when the larvae are found in the bloodstream, dry cough increases the prevalence of STH among children (Naish et al., 2004; Nasr et al., 2013).

Lack of knowledge on the preventive measures against STH infection such as regular handwashing with soap under running water before eating or after visiting the toilet, frequent and proper dumping of refuse, availability of toilet facilities, availability of clean water, periodic deworming to destroy infecting worms, and avoiding walking barefooted increases the chances of children in getting STH infection (Nasr et al., 2013).

In Ghana, soil-transmitted helminth infections such as roundworm and hookworm infestation have been reported to be common among children, particularly, school children (Mirisho et al., 2017; Adu-Gyasi et al., 2018; Sam et al., 2018). A Ghana Health Service report recorded 1,433,020 cases of intestinal worm infection from 2012–2016 (GHS, 2016). Adu-Gyasi et al. (2018) found that the prevalence of intestinal helminth infection was 19.3% over 12 months for the middle-belt of Ghana. These researchers noted that the helminths targeted for elimination using mass drug administration (MDA) revealed that, the prevalence of hookworm, *T. trichiura* and *A. lumbricoides* was 12.1%, 0.8%, and 1.5% respectively.

Sam et al. (2018) found that the prevalence of STH among school pupils in the Upper East Region of Ghana was 2.79% and 9.40% using the direct wet mount method and formol-ether concentration technique respectively. Mirisho et al. (2017) showed that the prevalence of STH among children attending Princess Marie Louise Children's Hospital in Accra, Ghana was 17.3%, with hookworm and *A. lumbricoides* recording a prevalence of 10.2% and 7.1% respectively. Arguably, the high prevalence of STH in Ghana was due to the low quality of drinking water, poor access to improved sanitation, and the continuous practice of open defecation and free-range animal husbandry system in both the rural and urban areas (Bensah et al., 2012; Ayeh-Kumi et al., 2016; Adu-Gyasi et al., 2018).

1.3 Justification of Study

It would be recalled that earlier studies have indicated that the prevalence of STH infection was high in the tropical and sub-tropical regions such as Ghana (WHO, 2012; Mehraj et al., 2008); and the prevalence is extremely higher in developing countries than in developed countries (WHO, 2017). Despite this, only a few studies have examined the prevalence of STH in Ghana in general and the Presec Staff Primary School, in particular (Bensah et al., 2012; Ayeh-Kumi et al., 2016; Adu-Gyasi et al., 2018). Thus, this study was set out to determine the prevalence of STH among the school-children in upper primary classes at this school to fill the gaps in the literature.

The identifiable challenges associated with STH among children of school-going age impact negatively on the academic performance of these children (Hall et al., 2008; Pabalan et al., 2018; Quiroz et al., 2020). Nevertheless, only a few studies have assessed how children practising personal hygiene such as regular washing of hands with soap under running water before eating and after vising the toilet, avoiding walking barefooted and defecating openly could prevent STH infections (CDC, 2016; & WHO, 2019). However, none of these studies

was conducted at the Presec Staff Primary School. This study was important to understand how such practices could help to prevent the spread of STH among these school children to fill the gaps in knowledge.

Although studies on STH are well documented (Bogoch et al., 2019; Gall et al., 2017; Masaku et al., 2020), there is limited information on the prevalence of STH among Presec Staff Primal school pupils.

Although several studies have examined the types of STH in other settings (Bogoch et al., 2019; Gall et al., 2017; Masaku et al., 2020), there seemed to be no particular study done at the Presec Staff Primary School. This study was to address the gaps in the literature.

Although several studies have examined the association between the socio-demographic characteristics of school children and their guardian and the prevention of STH in other settings (Masaku et al., 2020; Wang et al., 2012), there seemed to be no particular study done at the Presec Staff Primary School. This study was to address the gaps in the literature.

Although several studies have examined the association between the level of knowledge of school pupils and the prevention of STH in other settings (Naish et al., 2004; Nasr et al., 2013), there seemed to be no particular study done at the Presec Staff Primary School. This study was to address the gaps in the literature.

Although several studies have examined the association between the measures against transmission and the prevention of STH in other settings (Dajaan et al., 2018, Xuan & Hoat, 2013, Essuman (2015), Jia et al., 2012; Mascarini-Serra, 2011), there seemed to be no particular study done at the Presec Staff Primary School. This study was to address the gaps in the literature.

Several studies have identified demographic characteristics of child and guardian and knowledge of STH such as causes and symptoms of STH to have an association with the prevalence of STH **(**Bogoch et al., 2019; Gall et al., 2017; Masaku et al., 2020).

It is in this light that the study sought to determine factors associated with the prevention of STH among school pupils at Presec Staff Primary School in the La Nkwatanang Municipality in the Greater Accra Region of Ghana. This was achieved by determining the prevalence and level of knowledge of STH among school pupils, as well as preventive measure put in place by the school authorities. This study was designed to inform future interventions such as measures to be undertaken in schools to promote personal hygiene among pupils such as regular washing of hands with soap under running water before eating and after vising the toilet, regularly provide educative programmes on nutrition, immunization, and de-worming to enhance the health of pupils by influencing the attitudes of parents towards preventing STH infection.

The findings would also aid the community, health sector, non-governmental organizations, and the government as a whole to formulate strategic measures to reduce the spread of STH infection among children. Furthermore, it would aid guardians of children to know the causes, symptoms, and preventive measures of STH. Moreover, this study would assist the La Nkwatanang Municipal Health Directorate in organizing educative and awareness programmes on the causes, symptoms, and preventive measures of STH.

Finally, the results of this dissertation could be used to strengthen future developments in STH among primary school children and to direct the Ghana Education Service in the La Nkwatanang Municipality in the Greater Accra Region of Ghana, other partner organizations in the nation and the country as a whole. Thus, this study would help the government and stakeholders in the educational sector in formulating measures to decrease the prevalence of STH infection among school children in sub-Saharan African and Ghana to be precise.

1.4 Objectives of the study

The objectives of the study were categorised into general and specific as outlined below.

1.4.1 General Objective

The general objective of the study was to determine factors associated with prevention and prevalence of STH among school pupils at Presec Staff Primary School in the La Nkwatanang Municipality in the Greater Accra Region of Ghana.

1.4.2 Specific Objectives

The specific objectives aimed at addressing the general objective were:

1. To determine the prevalence of Soil-Transmitted Helminths infections among school pupils at Presec Staff Primary School.
2. To identify the types of Soil-Transmitted Helminths likely to cause infection among school pupils at Presec Staff Primary School.
3. To assess the association between the level of knowledge of school pupils and prevention of Soil-Transmitted Helminths infections at Presec Staff Primary School.
4. To investigate association between measures against transmission and prevention of Soil-Transmitted Helminths infections among school pupils at Presec Staff Primary School.

1.4.3 Research Questions

The following questions helped to find answers to address the specific objectives:

1. What is the prevalence of Soil-Transmitted Helminths infections among school pupils at Presec Staff Primary School?
2. What types of Soil-Transmitted Helminths are likely to cause infection among school pupils at Presec Staff Primary School?
3. What is the association between level of knowledge and prevention of Soil-Transmitted Helminths infections among school pupils at Presec Staff Primary School?
4. What are the measures put in place against transmission and prevention of Soil-Transmitted-Helminths infections among school pupils at Presec Staff Primary School?

1.5 Conceptual Framework of Soil-Transmitted Helminths

The graphical representation of factors that are associated with the prevalence and prevention of STH can be seen in Figure 1.1. The framework comprises of the factors such as socio-demographic characteristics, level of knowledge of STH infections, and preventive measures against STH infections.

Studies have argued that children and parents' understanding of the types of STH could help prevent its spread or prevalence amongst school pupils (Sabin, 2017; Bogoch et al., 2019; Gall et al., 2017; Masaku et al., 2020). Therefore, school pupils' ability to identify the types of STH infection would go a long way to help prevent the spread of its infections.

The socio-demographic characteristics are sex of child, age of child, class, religion, toilet facility, type of residence, educational level of parents, and marital status of parents.

Generally, studies have shown that these socio-demographic characteristics of children and their parents have a significant association with the prevalence and prevention of STH (Masaku et al., 2020; Wang et al., 2012). The educational background of parents can influence a child's knowledge and awareness of STH and its mode of transmission. It is asserted that, educated parents who are well informed about the disease are more likely to inform their children of STH infections. Lack of improved source of drinking water, not wearing of shoes, and lack of toilet facilities have an association with the prevalence of STH (Masaku et al., 2020). Children who live in houses that do not have toilet facilities turn to defecate openly. Such unhygienic and insanitary practices result in increased soil contamination with infective eggs of helminths (Ojja et al., 2018). Knowledge of the transmission, causes and symptoms of STH infection has an association with the prevalence and prevention of STH. That is, knowledge of the causes of worm infection such as drinking dirty water, eating contaminated food with worm infection, and playing barefooted in the soil has an association with the prevalence of STH (Nasr et al., 2013). Additionally, a team of researchers proposed that knowledge of the symptoms of STH such as itching of the skin when the larvae are found in the bloodstream, dry cough, abdominal discomfort, general weakness and easy fatigability and vomitus had an association with the prevalence of STH (Naish et al., 2004; Nasr et al., 2013).

The preventive measures against STH infection such as regular handwashing with soap under running water before eating or after visiting the toilet, frequent and proper dumping of refuse, availability of toilet facilities, availability of clean water, periodic deworming to destroy infecting worms, and avoiding walking barefooted aids in the reduction of STH infection (Nasr et al., 2013).

In summary, the framework projects that there is an association between the socio-demographic characteristics and prevention of STH. However, this is based on the enhanced

knowledge of STH. This in turn influences the relationship between types of STH and preventive measures against STH. Finally, this increases the prevention and prevalence of STH. Hence, all these factors could have an association with the prevention and prevalence of STH, which this study sought to examine to confirm or otherwise as documented in the literature (Nasr et al., 2013).

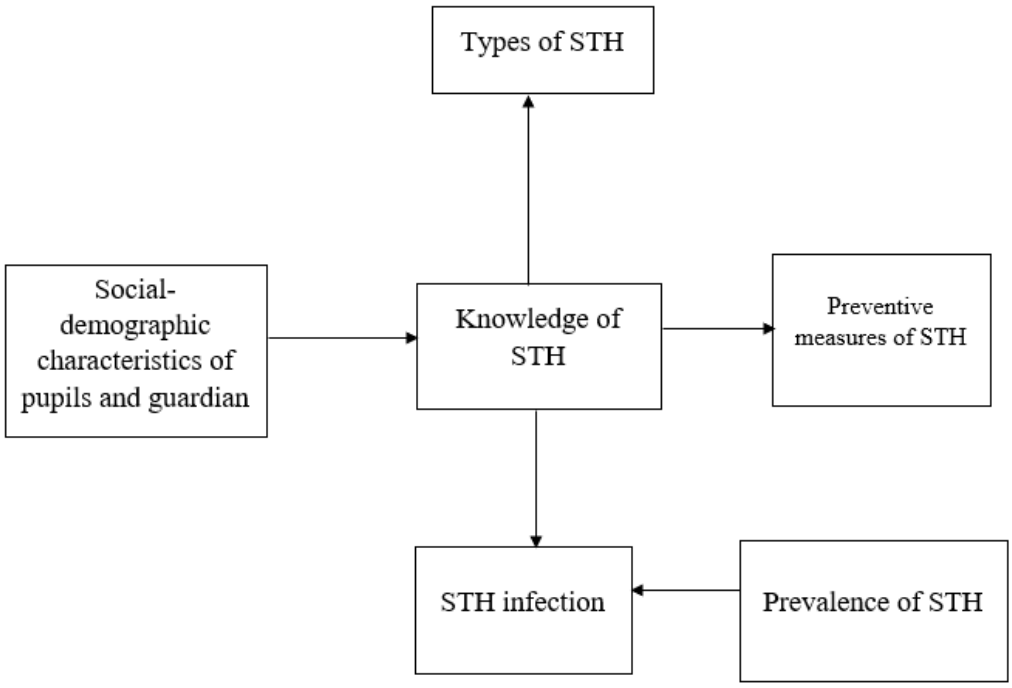


Figure 1.1: Conceptual Framework of Soil-Transmitted Helminths.

Source: Author's conceptualisation (2018)

1.6 Outline of the dissertation

This dissertation is presented according to chapters. Chapter one presents the introduction where the background, problem statement, justification, objectives and questions of the study have been presented. In chapter two, the literature of related studies on the key concepts is

presented. Chapter three is where the methods applied to collect data for analysis have been explained. In chapter four, the results of the empirical study have been presented. Chapter five also presents a discussion of the findings in relation to existing literature in the field. In chapter six, the summary, conclusions and recommendations of the study have been presented.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Helminths are among the most common infections in the world and affects poorest people in disadvantaged communities. Helminth is generally used to represent intestinal or parasitic worms (Wakelin, 1996). Intestinal worms are considered parasites who feed on a host for survival. Soil-transmitted helminths form a classic example of this category of worms infesting the human being. There are several types of STH but the main types of public health and global health importance because they infect people are Roundworm (*Ascaris lumbricoides*), Hookworm (*Ancylostoma duodenale and Necator americanus),* and Whipworm *(Trichuris trichiura).* Among the three types of STH causing the infection, the commonest causes of STH infection is roundworm (CDC, 2016; WHO, 2019; Hotez et al., 2006).

The type of soil the worm eggs are living in (Both organic and inorganic factors in the soil) and the temperature of the particular environment contributes to the thriving of the worm eggs in the soil. Also, the eggs become viable in a humid environment (Cross, 1996). However, the dryness, texture of the soil, depth of the soil, and the soil pH contribute greatly to the development of the eggs (Amadi, 2010). The main source of nutrient for the helminths are the tissues of the host and blood which results in loss and absorption of protein and iron raising the chances of malabsorption of essential nutrients (Hall et al., 2008; Koski & Scott, 2001).

A person with STH is most probable to present with light or heavy infection. Both categories of infection vary with the symptoms being exhibited by the individual. A person with light STH infection is likely to have no or little symptoms associated with the infection. However,

the state of heavy infection of STH causes malabsorption of nutrient, abdominal discomfort and cramps, fatigue, malnutrition, cognitive impairment, and physical growth (CDC, 2016).

These STH causes a devastating effect on individuals' development, mostly leading to either physical or cognitive impairment. According to Pullan et al. (2014), the occurrence of these associated challenges to STH infection delays growth and development in people especially school pupils. The physical and cognitive delayed development probably lead to school absenteeism. However, certain species like the Ascaris lumbricoides can cause anorexia and, can affect the nutritional intake and the physical fitness of the individual (Opara et al., 2012; Stepek et al., 2006). In addition, the diminishing nutritional status of the person suffering from STH infection has a considerable influence on the individual's growth and development (WHO, 2017).

2.2 Prevalence of Soil-Transmitted Helminths, the Global perspective

The World Health Organization report on STH infection indicate that 24% of the world's population are infected with STH, with majority in low-and-middle income countries such as Asia (China, Southeast Asia, India) and the Tropical regions of Africa (sub- Saharan Africa countries such as Ghana) in 2019. Out of them, 30.3% were infection by hookworm, 32.0% were infection by *T. trichiura*, and 56.5% were infection by *A. lumbricoides* (Pullan et al., 2010). Among children attending school, over 267 million of preschool children and 568 million of the school-age children who are infected live-in areas where these parasites are heavily transmitted (WHO, 2019).

The high prevalence of neglected tropical diseases such as STH in the world is due to insufficient and absence of potable water, poor sanitation and sanitary practices, inappropriate hygiene lifestyles, little or no education of people, crowded habitats, inadequate and hard-to-reach health care service, financial status, per capita income and their socio-economic status,

(Benjamin-Chung, 2015; Hotez, 2014; Pasaribu et al., 2019; Kattula et al., 2014; Debalke et al., 2013).

2.3 Prevalence of Soil-Transmitted Helminths in Africa

Soil-transmitted helminth infections are among the most common infections in Africa and affect the poorest and most deprived communities (WHO, 2016). A global estimate reveals that in the sub-Saharan African region, 13.6% of the population were infected by hookworm, 11.6% of the population were infected by *T. trichiura*, and 13.6% of the population were infected by *A. lumbricoides* (Pullan et al., 2014). A study by Mathewos et al. (2014) in Ethiopia found that the prevalence of STH species were 4.9%, 6.1%, and 39.8% for hookworm, *T. trichiura*, and *A. lumbricoides* respectively. Also, according to Masaku et al. (2020), the overall prevalence of STH in Kenya was 17.0%. Specifically, the prevalence of STH species were 1.2%, 12.9%, and 8.3% for were of hookworm, *T. trichiura*, and *A. lumbricoides* respectively.

A study by Palmeirim et al. (2018) in Cote D'Ivoire shows that the prevalence of STH species were 14.4%, 2.6%, and 1.6% for hookworm, *T. trichiura,* and *A. lumbricoides* respectively. The prevalence of STH species were 74.5% and 25.1% for hookworm and Ascaris species respectively in Ibadan, Southwestern Nigeria (Oyebamiji et al., 2018). A study by Ojja et al. (2018) in Hoima district, rural western Uganda found that the overall STH prevalence was 26.5% with specific prevalence of STH species as 18.5%, 0.5%, and 9.8% for hookworm, *T. trichiura*, and *A. lumbricoides* respectively.

Sub-Saharan African's main contribution to the increase STH infection among school children can be attributed to the impoverished dwellings, poor socio-economic status, poor sanitation and personal hygiene such as untrimmed finger nail, not washing hands before a meal and after defecation, eating uncooked and unwashed vegetables and fruits, and access to basic

social amenities like a toilet and portable drinking water (Paller et al., 2014; Shumbej et al., 2015; Ojja et al., 2018).

2.4 Prevalence of Soil-Transmitted Helminths in Ghana

Ghana in the past years has recorded 1,433,020 cases of intestinal worm infection from 2012–2016 (GHS, DHIM2, 2016). A report by the Ghana Health Service in 2016 revealed that the major STH in Ghana are hookworm, *T. trichiura*, *A. lumbricoides, S. stercoralis, N. americanus,* and *A. duodenale* with high infection recorded in different regions, particularly, the Municipal and Metropolitan health directorates (GHS, 2013). Out of the 3 million school-age children selected for mass drug administration for STH, approximately 2.56 million school children had infection of STH (GHS, 2016). A study by Mirisho et al. (2017) found that the prevalence of hookworm was 17.3% followed by roundworm during a study conducted at the Princess Marie Louise Children's Hospital in the Greater Accra Region of Ghana. This is supported by studies conducted in Elmina by Dankwa et al. (2017) and Upper East region of Ghana by Sam et al. (2018) who found that the prevalence of hookworm was 12.5% and 0.25% respectively among school children. It is indicative that the geographical setting and the dwelling abode including certain environmental risk factors determine the prevalent STH infection that will be recorded (Brooker et al., 2015). The middle belt of Ghana in the past has recorded prevalence close to 45% parasitic intestinal worm infection being roundworm, whipworm, and hookworm (Adu-Gyasi, et al., 2018).

2.5 Classification of Helminths

Worms are classified based on their distinct characteristics, susceptible host or reservoir, and the mode of transmission of the worm (Castro, 1996). Thus, worms are classified into three categories, namely, Nematodes, Cestodes, and Flukes (Lucas & Gilles, 2007). This study focuses mainly on nematodes. Majority of these nematode worms are transmitted by eating

contaminated food with ova of worms. There are several types of Nematodes such as roundworm (*Ascaris lumbricoides*), whipworm (*Trichhuris trichiura*), hookworm (*Ancylostoma duodenale* or *Necator americanus*), *Strongyloides stercoralis,* and *Enterobius vermicularis* (Lucas & Gilles, 2007; Stepek et al., 2006; Cross, 1996). This study focuses on only three types of nematodes, namely, hookworm, whipworm (*Trichhuris trichiura*), and roundworm (*Ascaris lumbricoides*).

2.5.1 Roundworm (Ascaris lumbricoides)

An estimated 819.0 million people have roundworm infection globally (WHO, 2019). These are parasitic pathogens found in humans and are the dominant soil-dwelling helminths. The number of infections contributes immensely to the global burden of disease, leading to 600 000 mortalities being recorded annually from Ascariasis (CDC, 2016). The mode of transmission is often through the soil. The worm in its adult stage lives in the small intestine and embryonate in soil. The productive ova mature and become infectious approximately 18 days to several weeks, depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed, the larvae hatch, invade the intestinal mucosa and are carried via the portal, then systemic circulation to the lungs. 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. Upon reaching the small intestine, they develop into adult worms. 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. In instances where there is open defecation, usage of faeces as fertilizer, eating unwashed vegetables or improperly cooked food, children become high risk of Ascariasis (CDC, 2016; Cross, 1996).

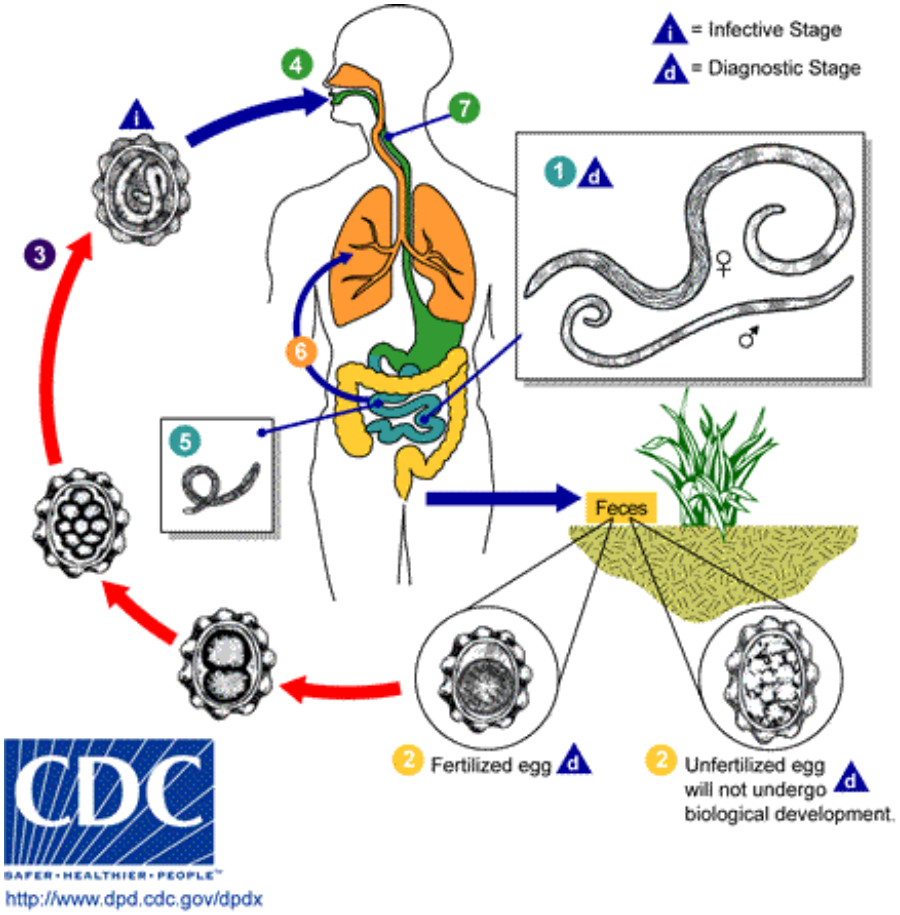


Figure 2.1: The life cycle Roundworm (*Ascaris lumbricoides*)

Source: www. CDC.com

2.5.1.1 Diagnosing Ascariasis lumbricoides

The standardised method for diagnosing Ascariasis is by identifying Ascaris eggs in a stool sample using a microscope (Kumar, 2012). Also, diagnosis can be done when the matured worm is passed in faeces. The use of the microscope is ideal for determining the eggs in the stool because eggs of worms are difficult to find with the naked eye in light infections, compared with matured worms in stools for heavy infection (CDC, 2016). The direct smear fair helps to identify the ova of *A. lumbricoides* as a result of their characteristic morphology (Lucas & Gilles. 2007). Again, further diagnosis can be made using X-rays, CT scan, endoscopy, MRI, and ultrasound (Healthline, 2019).

2.5.1.2 Treatment of Ascariasis lumbricoides

The World Health Organization recommends the use of anthelminthic medications to purge an individual of parasitic worms such as Ascariasis. These drugs include albendazole, mebendazole, and ivermectin. Infection is generally treated within 1-3 days. The drugs are potent and seem to have little side effects (CDC, 2016).

2.5.1.3 Prevention and Control of *Ascariasis lumbricoides*

Infection and re-infection of Ascariasis can be prevented through improved hygiene, proper sanitary practices of disposal of both human and animal excreta. That is, it can be prevented when children refrain from ingesting contaminated soil with faeces, avoiding the use of human excreta as fertilizer on the farm, hand washing before eating or after visiting the toilet. Also, children must be educated to wash hands with turbid free water and soap always either at home or in school, in areas where manure is predominantly used on the farm. Furthermore, fruits and vegetables must be washed, peeled or cooked before eating (CDC, 2016; Healthline, 2019). Also, the approach to controlling infestation of *A. lumbricoides* among children is through to mass-chemotherapy for a fair-term and improved sanitation for a longer duration (Lucas & Gilles, 2007).

2.5.2 Hookworm (Necator americanus or Ancylostoma duodenale)

An estimated 438.9 million people have hookworm infection globally (WHO, 2019). The types of hookworms found in human beings include *A. duodenale* or *Necator americanus*. Hookworms are commonly found in tropics and warmer climatic conditions (Lucas & Gilles. 2007). Hookworm infection is not transmitted from one person to another because the worm requires more time to mature in the soil (CDC, 2016). Ova of hookworms are found in excreta of the infected person, and under conducive environment thus (moisture, warmth, shade), the larvae can hatch within 1 to 2 days. When contact is made with the human host,

the larvae inoculate the skin and are passed through the blood vessels to the heart and then to the lungs of the person.

The larvae enter into the pulmonary alveoli, ascend through to the bronchial tree to the pharynx, and are swallowed. The larvae enter the small intestine, where they live and develop into adults. The disability adjusted life years associated to hookworm is estimated to be 1.8 million (Sabin, 2017). The presence of hookworms in the gastrointestinal tract causes internal blood loss leading to acute anaemia among vulnerable groups like pregnant women and children. It also leads to malnutrition and delayed cognitive development. The cognitive impairment affects the level of concentration in class especially among children leading to impaired growth development (CDC, 2016; Drake et al., 2000; Stephenson et al., 2000).

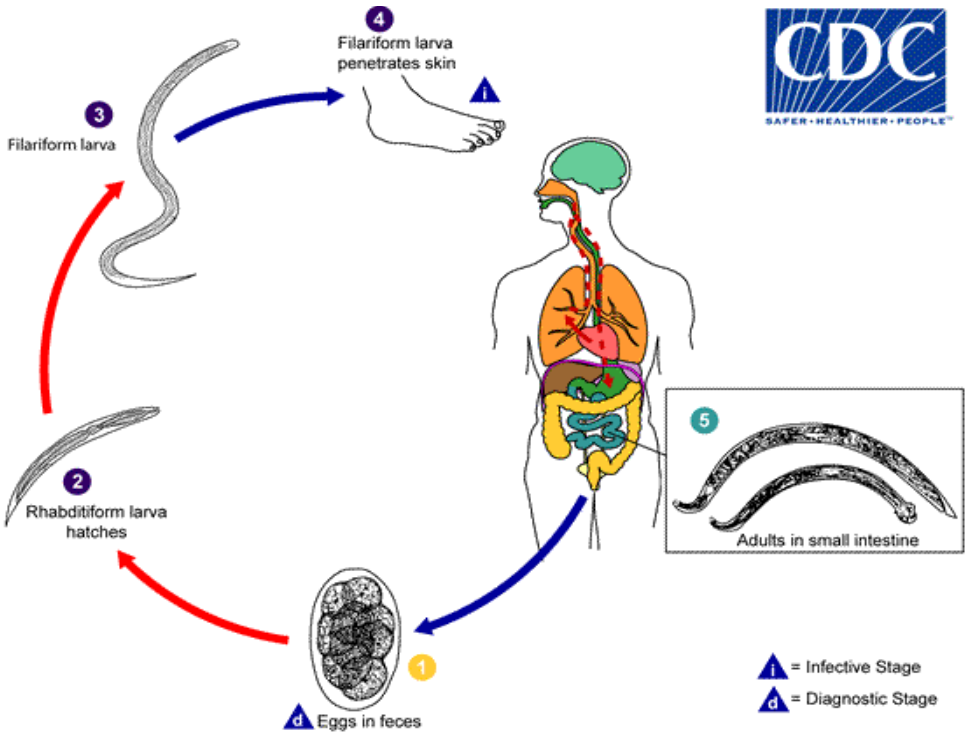


Figure 2.2: The life cycle of Hookworm (*Necator americanus or Ancylostoma duodenale*) Source: www. CDC.com

2.5.2.1 Diagnosis

The regular means of diagnosing hookworm infection is through the examination of a stool sample. Furthermore, in light infections, a microscope is recommended for the identification of the ova in a prepared stool concentration (CDC, 2016). The use of a microscope is to determine the intensity of infection, and or matured worms. A large number of eggs counted on the slide is an indication of heavy infection whereas a single egg or worm is considered light infection. (Lucas & Gilles. 2007).

2.5.2.2 Treatment of Hookworm

The drugs recommended for treatment of hookworm infection are Anthelminthic medications such as albendazole and mebendazole. Infection is generally treated for 1-3 days. The use of recommended anthelminthic are effective and happen to have little side effects being reported. However, Iron supplements may also be prescribed for persons given the anthelminthic if the infected person has anaemia (CDC, 2016).

2.5.2.3 Prevention and Control of Hookworm

The ways of preventing hookworm infection are avoiding walking barefooted in areas where hookworm or open defecation is common and having improved and effective sewage disposal systems. Also, avoid skin contacts with such soil and ingesting it (CDC, 2016). The use of the hookworm vaccine can equally be used in the prevention of hookworm infection and its being piloted in some African countries. An improvement in the disposal of faeces will possibly result in reduced risk of the infection. The use of chemotherapy such as anthelminthic and iron supplementation is an option to curb infestation of hookworms and can lead to the correction of anaemia among children (Lucas & Gilles, 2007).

2.5.3 Whipworm (Trichuris trichiura)

An estimated 464.6 million people have *T. trichiura* infection globally (WHO, 2019). *Trichuris trichiura*, also referred to as human whipworm causes trichuriasis in human. The worm is commonly found in humid, warm and the tropical climatic zones. Whipworm infection is very common in children. Children being susceptible is as a result of the risk of them often playing in the soil which may be contaminated with eggs of whipworm. The transmission of whipworm occurs when a person ingests food with contaminated soil or soil particles containing egg of worms (CDC, 2016; Viswanath & Williams, 2019). The trichuriasis infection occurs in the large intestines of an infected person. After swallowing soil-contaminated hands or food, the eggs that are ingested are hatched and deposit larvae that mature and transform themselves as adults in the gut of the host (Cross, 1996).

The adult worms are roughly 4 cm in length reside in the cecum and ascend through the gut. The females begin to lay 60 to 70 days after infection. Female worms in the cecum release roughly 3000 to 20 000 eggs within a day. The female whipworm (35 – 50 mm long) is usually larger than the male (30 – 45 mm). The whipworm can live in a person approximately 1 year. However, when the eggs are deposited in the soil, it takes roughly two to three weeks for the eggs to become embryonated ineffective eggs (CDC, 2016; Ghaffar, 2015). A person who has trichuriasis infection caused by whipworm is likely to be experiencing bloody diarrhoea, painful or frequent defecation, abdominal pain, nausea, vomiting, headaches, sudden and unexpected weight loss, faecal incontinence, or the inability to control defecation. A heavy trichuriasis infection can lead to delayed growth development and retardation, and impaired cognitive impairment (CDC, 2016; Cross, 1996).

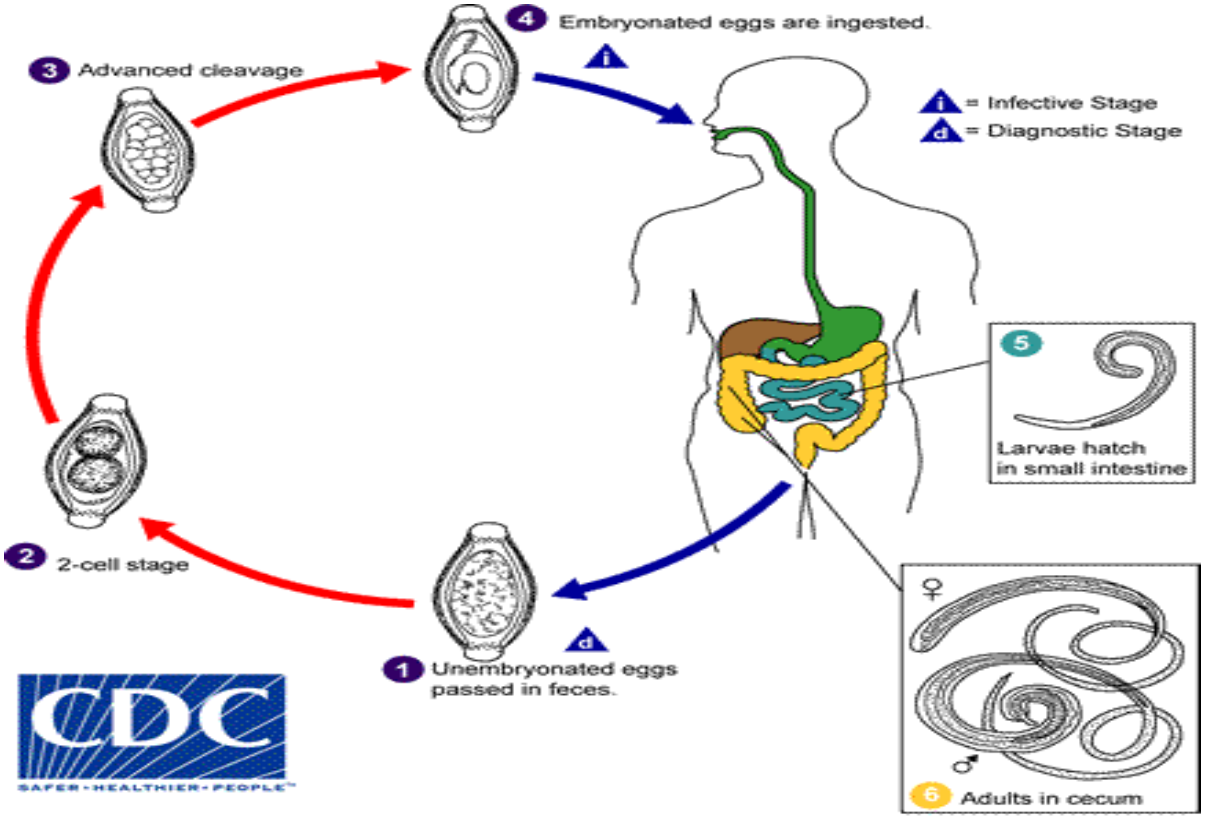


Figure 2.3: The life cycle of Whipworm (*Trichuris trichiura*)

Source: www.CDC.com

2.5.3.1 Diagnosis of Whipworm (*Trichuris trichiura*)

To diagnosis whipworm infection, it is standardised to use the microscope to identify the eggs and worms in the faeces of the person suffering from the infection. The ova of whipworm can be identified through wet smear preparation placed under a microscope to identify eggs of whipworm. The wet concentration method is recommended because the eggs cannot be identified with an eye (CDC, 2016; Cross, 1996).

2.5.3.2 Treatment of Whipworm (*Trichuris trichiura*)

Anthelminthic medications such as albendazole and mebendazole, are the first choice of drugs for treatment of whipworm infection. Infection is generally treated for 3 days. A repeat of stool examination may be done after treatment to determine whether there is still the

existence of eggs in the faeces. Iron supplements may also be given to persons who have had the infection to increase their iron level and reduce the occurrence of anaemia (CDC, 2016).

2.5.3.3 Prevention and Control of Whipworm (*Trichuris trichiura*)

It appropriate to properly dispose of faeces using the approved and improved sanitary measures adopted in faecal matter disposal (Cross, 1996). In addition, the use of wastewater contaminated with eggs of worms, should not be used as fertilizer to increase crop yield. Handwashing with soap and water has a high chance of reducing the contamination on the hand. Again, hands must be washed with soap and water before handling food which is eaten raw including fruits and vegetables. It is imperative to educate children and especially those of school-going age the importance and benefits associated with handwashing (CDC, 2016).

2.6 Knowledge level of school children on Soil-transmitted Helminths

It is important for school children to have a good knowledge and understanding on STH: its mode of transmission, prevention and control measures. Children having good knowledge on health, hygiene practices, and sanitation such as washing hands with soap before eating and after visiting the toilet, use of latrine for defecation, and avoiding walking barefooted might stimulate behaviour change which would aid in the reduction of STH infections, hence, delaying or preventing reinfection (Asaolu & Ofoezie, 2003; Mascarini-Serra, 2011).

Palmeirim et al. (2018) investigated the effect of knowledge that children receive at school or home, without any particular health education intervention, on helminths infection in western Côte d'Ivoire. They found that there is lower prevalence of hookworm among children with good knowledge about hygiene such as use of latrine for defecation. Also, they found that children are more likely to use latrines when that perceive open defecation as an unaccepted behaviour in society.

A study by Ojja et al. (2018) to assess the factors related to STH infection among preschool-age children in Hoima district in Uganda found that insufficient knowledge about transmission and prevention were factors related to STH infection among preschool-age children. Children being at a higher risk of STH infections, educative programs on STH organized at schools are a cost-effective approach of providing interventions, which is an accepted strategy by WHO through their launch of the Global School Health Initiative (Montresor et al., 2002; Tomono et al., 2003; Bieri et al., 2013). Failure to educate people especially children about the modes of transmission of these parasitic helminths is likely to lead to the rise of infection and infection (Dawaki et al., 2015).

The knowledge of parents or guardians on STH such as mode of transmission and prevention also plays a role in children being affected by STH. That is, children are likely to be aware of Soil Transmitted Helminths and its infection including the mode of transmission if parents or guardians to an extent have fore-hand knowledge on the infection. In Zimbabwe, a parent who has knowledge on STH infection and its mode of transmission can teach his child in the third grade on STH and the transmission modes including the preventive measures associated with the infection (Midzi et al., 2011).

2.7 Measures to prevent the transmission of Soil Transmitted Helminths infections

2.7.1 Personal Hygiene Practices

STH infection can be present when school children are encouraged to have personal hygiene practices such as regular handwashing with soap under running water before eating or after visiting the toilet. Hand washing practices is a core means of breaking the mode of transmission of certain communicable diseases (Dajaan et al., 2018). Washing of hands frequently and appropriately turns to reduce pathogen on the hands of an individual. This practice of washing hands is very essential among children because of their vulnerability in

being infected with certain pathogens (USAID, 2010). It is considered the most cost-effective an individual can access to prevent the spread of diseases through contamination of surface and through food. Usually, these pathogens are picked during activities such as playing in the soil, using the toilet, touching raw fruits and vegetables, and ingesting the eggs of the parasites unknowingly in food (Majorin et al., 2014). Worm infections happen to be part of the numerous infections that spread through contamination and failure in washing hands (Majorin et al., 2014).

In the year 2015, there was a study conducted in various countries and it was established that roughly 38.7% of the population wash hands appropriately using all needed materials (WHO & UNICEF, 2018). Regular hand washing with clean water, soap and drying hands with clean towels or paper tissue contribute to lowering the risk of a child being infected with a worm, the child has a high chance so growing well since the core preventive measure is interrupted through hand washing (UNICEF, 2018; Xuan & Hoat, 2013). In other studies, school children can equally educate peers on the knowledge gained in hand washing practices with soap and clean water to improve their health (Vindigni et al., 2011).

2.7.2 Improved Sanitation

Improved sanitation such as avoiding open defecations and availability of latrine or toilet at home is a measure to prevent STH infections. World Health Organization (2008) defines open defecation as depositing of faeces in open places, bushes, forest, fields, water bodies and other open places in the environment. This indiscriminate disposal of excreta in the environ has increased risk factors of certain diseases and infection including worm infection. Geetha and Kumar (2014) established that every excreta deposited in the soil had a pathogen that could cause infection to a person. Disposal of human excreta is very essential in the human environment, where children play and where food is being sold. South and Southeast Asia,

sub-Saharan African region have contributed to the increase in open defecation burden, however, reports from WHO and United Nations International Children's Emergency Fund (UNICEF) states that: approximately, 2.5 billion people globally do not have any form of improved sanitation in the community and their private homes (WHO, 2008). In a report by UNICEF (2012) cited in Essuman (2015), there has been an increase in the number of people without proper sanitation from about 2.5 billion to 3 billion. In India, open defecation is a common practice, an estimated 60% of the global population have no improved sanitation (Geetha & Kumar, 2014).

2.7.3 Health Education

One approach found to minimize re-infection after children have received deworming treatment is health education which focuses mainly on teaching sanitary behaviours and personal hygiene practices (Jia et al., 2012; Mascarini-Serra, 2011; Asaolu & Ofoezie, 2003). World Health Organization (2002) recommends adding health education on STH into school-based programs. This is because knowledge and behavioural changes of children will decrease exposure to STH infections and delay re-infection (Mascarini-Serra, 2011). Health education strategies are identified to decrease cost of drugs such as deworming, and increase the overall health knowledge and acceptability of interventions such as deworming within the community (Lansdown et al., 2002). Studies (Nasr et al., 2013; Gyorkos et al., 2013) have identified that increased attention and research on health hygiene education programs can maximize the possible benefits. As school children are most at risk of infection with these parasites, and have the highest infection intensity, control programmes involving health education on exposure of STH should be implemented in schools (Palmeirim et al., 2018).

2.8 Conclusion

The purpose of this study was to review studies conducted pertaining to Soil-Transmitted Helminths. The review was aimed at understating the prevalence of STH in the Global perspective, African perspective, and the Ghanaian perspective among school pupils. The level of knowledge on STH among children and the preventive and control measure adopted to reduce the occurrence of STH infection. It was evident that STH prevalence was high among children and especially those of school-going age. It is important more studies are conducted among school pupils on STH in Ghana, to ascertain the prevalence targeted at reducing all associated risk factors of the infection.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the methodological plan of the study. It outlines the study area, study population, study design and data collection. The instrument used for data collection, sampling and sampling procedure, sample size calculation, the technique for data analyses are also reported. Other relevant sections include pretesting of instruments and challenges during the fieldwork are also presented in this chapter. The chapter further discusses the study variables, inclusion and exclusion criteria, collection of stool samples, preparation of stool samples, laboratory investigations, quality control measures, assessment of knowledge level of children on soil-transmitted helminths, ethical consideration, data storage and management.

3.2 Study area and Study Population

The study was conducted at the Presec Staff Primary School, Accra. The school is located in the La-Nkwantanang Municipality. The school has a total population of 862 pupils. The target group for the study comprised pupils in the Upper Primary. Pupils in classes four to six males and females were recruited. These upper primary classes were selected for the study, because of the structured questionnaire administered, and these class group could read and understand the set of questions being asked. The total number of pupils from class four to class six, from whom a sub-sample of 217 was selected were 555. Class four pupils have a population of 240, class five with a total population of 180 and class six with a class size of 135 as presented in Table 3.1.

3.3 Study Design

A cross-sectional study using quantitative methods was adopted for this study. Cross-sectional study design is a study design type where data is collected from a sample or representative of the target population at a particular point in time. This design was used to determine the prevalence of soil-transmitted helminth, knowledge level on soil-transmitted helminths and identify the preventive measure in place in the school.

3.4 Study Variables

These are the phenomenon used in measuring and understanding how the study will be achieved.

3.4.1 Outcome Variable

The main outcome variable for this study was Soil-Transmitted Helminths infection status of the study participants. To determine the infection status of each participant, a laboratory result was obtained using the stool samples collected from the children. A stool sample which did not have either ova or worm was coded 0 for no infection: while the stool sample containing either ova or worm was coded as 1 indicating an infection.

The second outcome measure was knowledge level on worm infection of the study participants. This was measured with set of multiple-choice questions covering all areas of causes, symptoms and effects. The questionnaire used for the study was developed by the principal investigator. Correct answer was allotted 1 point while the wrong answer was allotted 0 points. The total score which is the sum of the responses to the eight questions was computed as the measure of their knowledge level. Finally, a Likert scale was used to determine the total score of the knowledge. The knowledge level was categorized as follows using the Likert scale: low "0-2 points", fair "3-5 points" and high "6-8 points".

3.4.2 Independent Variables

The independent variables for this cross-sectional study comprised age, sex, class, religion, educational level of parent or guardian, the occupation of parents or guardian, marital status of parent or guardian, wearing of shoe, type of residence, place of defecation, availability of latrine or toilet at home and hand washing.

Table 3.1: Classes and number of pupils on roll

Class	Number on roll
Class Four	240
Class Five	180
Class Six	135
Total	555

3.5 Sample Size Calculation

A sample size of 217 school pupils for the study was obtained based on the Cochrane formula (1977),

$$n = \frac{Z^2\frac{\alpha}{2} \times P \times (1 - P)}{e^2}$$

Where:

n = Sample size

α = significance level = 0.05

Z = z-score =1.96

e = margin of error = 5%

P = prevalence of STH (estimated proportion) = 0.17 (Mirisho et al., 2017).

$$n = \frac{(1.96)^2 \times (0.17) \times (1 - 0.17)}{(0.05)^2}$$

$$n = 217$$

Therefore, the required minimum sample size for the study was estimated at 217.

3.6 Sampling Procedure

The total pupils in the three classes of the Presec Staff Primary School, thus class four to six were five hundred and fifty-five pupils. This total population of the pupils were selected for the study. They were further sampled proportionally using a proportionate sampling method to allocate pupils in the various classes of the school. All pupils in the selected classes were given equal opportunity to be selected for the study.

Table 3.1 shows the number of respondents allocated to each class. The number of respondents was based on proportion to size of the class. After obtaining the required sample size for a class, a simple random sampling method was used in selecting the participant. To obtain sample from specific class, the total number of pupils in that particular class was divided by the total number of pupils from class four to six; and then multiplied by the sample size required for the study.

Each member of the class had an equal opportunity of being part and selected for the study. The lottery method was applied to obtain the required sample size in each class. For example, in class four there was a total number of 94 “Yes” and 146 “No” on pieces of papers folded for pupils in the class to pick respectively. These papers were then mixed for each member in the class to pick a single paper. All participants who picked Yes were recruited for the study,

while those with No were not part of the study. The same procedure was followed in recruiting other participants from the remaining classes.

Table 3.2: Class and sample size obtained after calculation was derived using the formular below

Class	Class size	Sample selected per class
Four	240	94
Five	180	70
Six	135	53
Total	555	217

Where:

Cs = Class size

TCP = Total class population

S = Sample size

$$\frac{\text{Cs}}{\text{TCP}} \text{ x S}$$

Class four:

$$\frac{240}{555} X\ 217 = 94 \text{ pupils}$$

Class five:

$$\frac{180}{555} \text{X } 217 = 70 \text{ pupils}$$

Class six:

$$\frac{135}{555} X\ 217 = 53 \text{ pupils}$$

3.6 Consenting process

The participants were given an informed consent form, for their parents or guardian to complete and consent to their child's participation in the study.

3.7 Inclusion Criteria

Participants in the upper primary whose parents or guardian consented their participation and who had not taken any anthelminthic currently within three months before the study started.

3.8 Exclusion Criteria

The study excluded any participant who met the inclusion criteria but was absent on the day of the study, or whose parent refused to consent to their participation and who had taken an anthelminthic within the past three weeks prior to study.

3.9 Data Collection Tools

A structured questionnaire was used to collect information for the study. The structured questionnaire was categorized into themes. The first section of the questionnaire asked questions on their demographic characteristics. The second part, focused on the level of knowledge of participants on STH infection. A checklist was developed by the investigator to identify the preventive measures put in place by school authorities to prevent STH infection among the pupils. Specimen bottles were distributed to participants to collect stool samples for laboratory investigations. An informed consent form was given to the participants for their parent to give their consent. Participants made available stool samples and signed informed consent form, for laboratory investigation to begin.

3.10 Pre-testing

A pre-test of questionnaires for the study was done in 2 other schools within the La Nkwatanang Municipality. Redco and Pantang Primary Schools were selected for the pre-test. The focus for this pre-test, was to determine the level of understanding by their classmates in

different schools. Generally, the questions were understood by pupils where the pre-test was done.

3.11 Data Collection Technique

A rapport was established by the principal investigator with the participants to create a cordial research environment. The purpose of the study was made known to them and why the study is being conducted in their school. Consent forms were given to study participants who were randomly selected. There was no bias in the selection of the participants because they all had equal chances of being selected by virtue of picking a folded paper with either Yes or No. A self-developed questionnaire were administered to participants who submitted their informed consent forms signed by parents or guardian. The questionnaire had information on their demographic background, their level of knowledge on soil transmitted helminths. The principal investigator read and explained the questions to the participants for better understanding and answering of the questionnaire. After completing the questionnaire, specimen bottles were distributed to the participants for their stool sample pending laboratory investigations.

3.12 Collection of Stool Sample

Stool samples were collected from participants and labelled with unique identification numbers. For example, STH4-1 represented class four number one student. Same identifications were given to participants in the other classes. For example, STH5-1 for first student in class five and STH6-1 for first student in class six. The stools collected were emulsified with normal saline added to the stool and transported to the laboratory same day for processing and examination for parasites infection status.

3.13 Preparation of stool sample

The wet preparation for stool examination was used during the laboratory investigation. The stool samples ready for the laboratory investigation were mixed with formal-ether to keep the eggs, or worm viable for the examination. At least 10mls of stool was collected using a spatula.

3.14 Laboratory analysis of stool samples

Approximately, 10mls of stool was put into a centrifuge tube, then inserted into a centrifuge for spinning. The investigations were done under a light microscope by laboratory technicians at G2 Medical Laboratories. The wet preparation technique was used to examine the stool for any ova or STH in the stool, and the McMaster technique was adopted for re-examining the stools and egg counting.

The wet preparation is considered the fastest, yet the simplest procedure in providing quick results when positive. The preparation of stool samples can either be made straight from faecal materials or from concentration specimen using a centrifuge. The wet preparation, requires tools to make the procedure complete. This includes: microscopic slides, coverlids, fresh stool samples, gloves, normal saline, Lugol's iodine, and a spatula for mixing the stool samples. One to two drops of normal saline were placed on the slide at both ends, a small amount of faeces can be collected using the spatula and added to the normal saline on the slide. The normal saline and the stool were mixed together using the spatula. A drop of iodine was added to the mixture of stool sample on the slide. The coverlids were carefully be placed on the slide containing the stool sample and then placed under the microscope for magnification and identification of ova and STH.

The McMaster technique requires the use of fresh stool samples or stool samples refrigerated at four degrees Celsius. This technique, however, requires the preparation of a floatation

solution best prepared twenty-four hours before the procedure is undertaken and stored at room temperature. The material needed to undertake the McMaster technique include two beakers, spatula, scale to weigh stool sample contained in the beaker, a strainer, pipette, floatation solution, measuring cylinder, and a compound microscope.

3.24 Observational checklist

An observational study checklist was developed by the principal investigator. The checklist had set of indicators, which was to help the investigator identify the preventive and control measures in the school. These indicators include: availability of toilet, dustbin, Veronica bucket with water, soap for hand washing, hand towels, school canteen and availability of refuse dumpsite. Open defecation is a major risk factor of STH infection. Adequate number of toilets and its usage, will possibly reduce any form of open defecation on the school compound. The use of dustbin in the school to collect refuse and proper disposal of refuse, will reduce the risk of soil-transmitted helminths infection. Veronica bucket with water and using of soap in washing of hands, is a primary medium of breaking the mode of transmission of the STH infection among school children. Using clean hand towel or single use paper towels, prevent children from rubbing their hand in their dirty clothes after washing their hands. Having a school canteen, turn to regulate what the school children eat during school hours. The canteen will relatively be hygienic compared to food sold outside the school. A controlled refuse dumpsite, prevents any form of indiscriminate disposal of refuse leading to poor sanitation on the school compound.

3.15 Data Entry and Analysis

Data collected for the study was coded and entered into Microsoft Excel spreadsheet and cleaned. Data was then imported into STATA version 15 for analysis. Descriptive statistics were reported in terms of frequencies and percentages for categorical variables while that of

continuous variables were reported in terms of means and standard deviations. Test of association between categorical independent variables and the outcome variable was done using the chi-square or Fishers' exact test of independence. The Welch t-test was used to compare the mean ages among children with and without STH infection. Logistic regression analysis was used to determine the effect of independent variables on the prevalence of STH infection. All statistical tests were conducted with 5% level of significance and a 95% confidence interval

3.16 Quality Control Measure

Questionnaires were administered for both pre-testing and the actual research study participants. Data entry into Microsoft Excel spreadsheet was done independently. In addition, parasite types and densities were read twice to ensure accuracy of findings. Information obtained from participants were exclusive to the principal investigator.

3.17 Ethical Consideration

Ethical clearance was obtained from the Ghana Health Services Ethics Review Committee (GHS-ERC) with approval number GHS-ERC048 and 02 and 18. In addition to the approval from Ghana Health Services, permission was also obtained from the La-Nkwatanang Municipal Education Directorate. Informed consent was given by parents or guardians of all participants.

3.18 Possible risk and Discomforts

Any form of risk regardless of its magnitude was not anticipated before and during the study. Inasmuch as risk is not anticipated, possible discomforts may occur during collecting the stool samples, and the odour of stool samples, the emulsification of the stool samples by the principal investigator and the laboratory technician during the laboratory investigation.

3.19 Possible Benefits

The study findings will benefit the community and the entire population. A long-term policy change by policymakers who seek to improve the health of the vulnerable: thus, school children, through administration of mass drug chemotherapy should be of great importance. The use of single dose Albendazole 400mg or Mebendazole 500mg either annually or biannually will help reduce the burden of infection. In addition, health education, and health promotional activities considering behavioural change and personal hygiene practices will improve health of the children.

3.20 Privacy and Confidentiality

The information shared by participants during the study was solely confidential to the principal investigator of the study. In view of this, participants were given identification numbers instead of using their names respectively. There was no circumstance whereby the information obtained was shared with others.

3.21 Voluntary Participation and Right to Leave the Research

Being part of this study was not compulsory, participants were free to withdraw from the study any time they intended.

3.22 Compensation

Participants were not given any form of compensation.

3.23 Data Storage and Management

All data collected for the study was stored electronically on pen drives, external hard disk drive, Google Drive and Dropbox which served as a backup source of data recovery. The password to all account to the electronic media was exclusive to the principal investigator. The data stored shall be discarded after the dissertation is submitted and approved by the graduate school.

3.10.8 Treatment

Anthelmintics are used as regimen for helminthiasis. Albendazole 200mg and Mebendazole 400mg tablets can be administered during routine and mass drug administration programs.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter presents the findings of the study. This study used primary data collected from pupils attending Presec Staff Primary School in the Greater Accra Region of Ghana to determine factors associated with prevalence of STH among school pupils at Presec Staff Primary School in the La Nkwatanang Municipality in the Greater Accra Region of Ghana.

4.1 Demographic characteristics of study participants

A total of two hundred and seventeen (n=217) pupils participated in the study. The demographic characteristics of participants are shown in Table 4.1. From Table 4.1, there were more females (62.2%) in the study than males (37.8%). The mean age of participants was 10.8 (± 0.86) years, with a minimum of 9 years and a maximum of 13 years. Most of the participants for this study 113 (52.1%) were in class 5. More than two-thirds 188 (86.6%) of the pupils were Christians. Eighty-three percent of the pupil's parents were married and 51.6% of them lived in compound houses. Majority of the parents of pupils 101 (46.5%) were tertiary school graduates while 69 (31.8%) of them were Junior High School graduates. Most of the participants 215 (99.08%) indicated that private toilet was the main sanitation facility and 112 (51.6%) of the participants lived in compound houses as shown in Table 4.1.

Table 4.1: Demographic characteristics of study participants

	Frequency	**Percent**
Age (Mean ± SD)	**10.82** ± 0.86	
Sex of child		
Male	82	37.8
Female	135	62.2
Class		
Four	56	25.8
Five	113	52.1
Six	48	22.1
Religion		
Christianity	188	86.6
Islam	29	13.4
Marital status of guardian		
Unmarried	37	17.1
Married	180	83.0
Toilet facility		
Private	215	99.1
Public	2	0.92
Type of residence		
Compound house	112	51.6
self-contained	105	48.4
Educational level of guardian		
Primary	10	4.6
JHS	69	31.8
Secondary	37	17.1
Tertiary	101	46.5

4.2 Prevalence of Soil-Transmitted Helminth infection among study participants

Three types of helminths were identified in the stools of the pupils. These helminths were roundworm, hookworm, and whipworms. The prevalence of roundworm was 12.4%, hookworm 1.8%, and whipworm 1.8%. The overall prevalence of soil-transmitted helminth among the pupils was 16% (95% CI: 11.9 - 22.2) as shown in Table 4.2

Table 4.2 Types and Prevalence of STHs identified among pupils

Soil Transmitted Helminth	Prevalence (%)	95% Confidence interval
Round worm	12.4	8.4 - 17.6
Hook worm	1.8	0.5 - 4.7
Whip worm	1.8	0.5 - 4.7
Total	16	11.9 - 22.2

4.3 Knowledge level on worm infection among study participants

In assessing the knowledge levels of the school children on worm infection, several questions ranging from the causes, symptoms, preventions and effects were asked as presented in Table 4.3. Almost all the pupils 206 (94.9%) correctly defined worms as living organisms. Overall, the average knowledge score of the children was 16.59 ± 2.16 with a range of 12 to 21 points. About one-third of the pupils 74 (34.0%) had high knowledge of worm infection with less than ten percent of them having low knowledge (7.0%, n=15). For knowledge on causes of worm infection, while majority of the participants stated that drinking dirty water (n=153, 70.51%) and eating contaminated food with worm eggs were causes of worm infection (n=114, 52.53%), others stated that breathing dust polluted air (n=198, 91.24%), failure to exercise everyday (n=210, 96.77%), bathing cold water (n=216, 99.54%), and playing

barefooted in soil (n=150, 69.12%) were not a cause of worm infection. For knowledge on symptoms of worm infection, majority (n=184, 84.79%) of the participants stated that they have knowledge on the possible symptom of worm infection.

Table 4.3: Knowledge about the causes of worm infection and prevention

	Frequency	**Percent**
Worms are living things	206	94.9
Worms cause infection	214	99.5
Causes of worm infection		
Drinking dirty water	153	70.5
Eating contaminated food with worm eggs	114	52.5
Breathing dust polluted air*	198	91.2
Bathing cold water*	216	99.5
Failure to exercise everyday*	210	97.8
Playing barefooted in soil*	150	69.1
Symptoms		
Possible symptom of worm infection	184	84.8
Prevention and control		
What to do when one has worm infection	213	98.2
Correct time to deworm	181	84.9
Washing hands with soap and water	160	74.0
Eating warm foods	50	23.1
Drinking clean water	150	69.4
Avoid walking barefooted	150	69.4
Washing vegetables before eating	139	64.3
Overall Knowledge level		
Mean ± SD	16.59 ± 2.16	
Low	16	7.3
Fair	127	58.5
High	74	34.1

*these were negative statements

For knowledge on prevention and control of worm infection, majority of the participants had knowledge on what to do when one has worm infection (n=213, 98.16%), correct time to deworm (n=181, 84.98%), washing hands with soap and water (n=160, 74.07%), eating warm foods (n=50, 23.15%), drinking clean water (n=150, 69.44%), avoid walking barefooted (n=150, 69.44%), and washing vegetables before eating (n=139, 64.35%).

4.4 Association between background characteristics of study participants and Soil-Transmitted Helminth infection

Type of residence was statistically associated with soil transmitted helminth infection ($X^2 = 7.34, \mathrm{p} = 0.007$). The proportion of children living in a compound house who were infected with soil-transmitted helminth was 13.6% more than those living in self-contained houses (23.2% vs 9.5%). Averagely, children with the soil-transmitted helminth infestation were older than those without the infestation but the difference was not statistically significant (10.81 ± 0.84 vs 10.83 ± 0.94). Comparatively, children of unmarried parents (21.6%) had a higher prevalence than those of married parents (15.6%) but this difference was not statistically significant ($X^2 = 0.08, \mathrm{p} = 0.981$). Although relatively children with high (16.22%) and moderate knowledge (18.11%) on worm infestation recorded the high prevalence of infestation than those with a low level of knowledge (6.25%) the differences were not statistically significant ($X^2 = 1.46, \mathrm{p} = 0.483$). Details of the associations are shown in Table 4.4.

Table 4.4: Association between background characteristics and Soil Transmitted Helminth infection

	Soil Transmitted Helminth Infection			
	No	**Yes**	**chi-square**	**p-value**
Sex of child				
Male	74(90.24)	8(9.76)	**4.45**	**0.035***
Female	107(79.26)	28(20.74)		
Class				
Four	46(82.14)	10(17.86)		
Five	94(83.19)	19(16.81)	**0.21**	**0.901**
Six	41(85.42)	7(14.58)		
Marital status of guardian				
Unmarried	29(78.38)	8(21.62)		
Married	152(84.44)	28(15.56)	**0.08**	**0.981**
Type of residence				
Compound	86(76.79)	26(23.21)		
Self-contain	95(90.48)	10(9.52)	**7.34**	**0.007****
Educational level of guardian				
Primary	8(80)	2(20)		
JHS	53(76.81)	16(23.19)		
Secondary	32(86.49)	5(13.51)	**3.52**	**0.319**
Tertiary	88(87.13)	13(12.87)		
Knowledge level				
Low	15(93.75)	1(6.25)		
Fair	104(81.89)	23(18.11)	**1.46**	**0.483**
High	62(83.78)	12(16.22)		

*p<0.05, **p<0.01, ***p<0.001, %: represents row percentage.

4.5 Effect of study participants' Knowledge level on Soil-Transmitted Helminth infection

From the unadjusted binary logistic regression model, the odds of getting infected with soil-transmitted helminth among children living in compound houses was about three times the odds of those living in self-contain houses and this relation was statistically significant (COR: 2.86, 95% CI: 1.32- 6.25, p=0.008). The odds of having helminth infestation was 1.5 times higher among children with unmarried parents compare to those with married parents (COR: 1.49, 95% CI: 0.62- 3.57). However, this effect was not statistically significant (p>0.05).

After controlling for all other variables, children who lived in compound houses had 3.6 times higher odds of getting helminth infection compared to those who lived in self-contain houses (aOR: 3.57, 95% CI: 1.49-8.33). This effect was statistically significant (p<0.05). From both the unadjusted and adjusted binary logistic regression model, pupils with fair and high knowledge on worm infestation had higher odds of being infected with helminth compared to those with low knowledge after controlling for other covariates. However, this effect thus fair and high knowledge in both cases were not statistically significant (p>0.05) as shown in Table 4.5.

Table 4.5: Effect of participants' background characteristics on Soil Transmitted Helminth infection

Characteristics	cOR	95% CI	p-value	aOR	95% CI	p-value
Age (Mean + SD)	1.03	0.68-1.57	0.892	1.41	0.75- 2.63	0.286
Sex of child			0.039*			0.059
Male	ref			ref		
Female	2.42	1.05-5.61		2.39	0.97- 5.88	
Class			0.901			
Four	ref			ref		0.155
Five	0.93	0.4-2.16		0.46	0.14- 1.48	
Six	0.79	0.27-2.25		0.2	0.04- 1.03	
Marital status of guardian			0.369			
Unmarried	ref			ref		
Married	0.67	0.28-1.61		0.53	0.2 - 1.41	0.204
Type of residence			0.008**			0.004**
Compound	2.85	1.32-6.25		3.57	1.49-8.33	
Self-contain	ref			ref		
Educational level of guardian			0.329			0.493
Primary	ref			ref		
JHS	1.21	0.23-6.27		0.63	0.1 - 3.75	
Secondary	0.63	0.1-3.83		0.31	0.04- 2.28	
Tertiary	0.59	0.11-3.09		0.42	0.07- 2.53	
Knowledge level			0.516			0.288
Low	ref			ref		
Fair	3.32	0.42-26.4		5.65	0.61- 52.3	
High	2.9	0.35-24.1		6.63	0.62- 71.0	

*p<0.05, **p<0.01, ***p<0.001, %.

4.6 Observation of preventive measures for soil-transmitted helminths on the school compound

An observation was done at the study site. This was purposed at knowing if the school authorities had put in place adequate measures and facilities to reduce the mode of transmission of soil-transmitted helminths. It was observed that, there was availability of toilet facility, handwashing facility. The four toilet facilities were used by both lower and upper primary pupils, same applied to all other facilities. The school however, did not have hand or paper towels. The number of these items observed are reported in Table 4.6.

Table 4.6: Observational checklist results for assessing preventive measures of soil-transmitted helminths on school compound

Preventive Measures	Quantity(s)
Availability of toilet	4
Availability of Veronica bucket with water	5
Availability of soap for handwashing	5
Availability of hand towels	0

* (n=1) number of study site

CHAPTER FIVE

DISCUSSION

5.1 Introduction

Over the years, STH infection has been a challenge to many school pupils all over the world. This has generated public interest especially in finding out the causes and how this challenged could be minimised. This situation has called the initiation of programmes such as proper hand washing teaching, provision of hand washing materials and toilet facilities by the Ghana Health Service, Ghana Education service, NGOs and other corporate institutions to be used by these pupils. The present study was undertaken to assess the knowledge level of school pupils on Soil-Transmitted Helminths, determine the types of Soil-transmitted helminths likely to cause infection among school pupils and assess the measures in place to prevent transmission of Soil-Transmitted Helminths.

5.2 Prevalence of soil-transmitted helminths

The overall prevalence of STH infection for this study is 16% among school children in the upper primary classes at Presec Staff Primary school in the La Nkwantanang Municipality in the Greater Accra Region of Ghana. The prevalence is slightly lower than the global overall prevalence of STH infection (24%) but higher than the overall prevalence in sub-Saharan African region (13.6%) found by Pullan et al. (2014). For studies conducted in Sub-Saharan Africa, this overall prevalence is lower than the prevalence in a study by Masaku et al. (2020) who found that the overall prevalence of STH in Kenya was 17.0%. Also, the prevalence is lower than the overall prevalence in a study by Ojja et al. (2018) in Hoima district, rural western Uganda who found that the overall STH prevalence was 26.5%. In Ghana, previous and recent studies have shown different trends of STH infection prevalence. This study STH prevalence is lower than the STH infection prevalence of 19.3% recorded in Kintampo in the

Brong Ahafo region (Adu-Gyasi et al., 2018) and 17.3% recorded at the PML hospital in the Greater Accra Region (Mirisho et al., 2017) but lower than the STH prevalence reported in Elmina (8%) (Dankwa et al., 2017).

The difference in STH infection prevalence reported in different parts of Ghana can be linked to the differences in the health education on the causes and effects of worm infection, mode of transmission, measures to prevent and control the infection, and hygiene practices including hand washing in primary schools in Ghana.

This study also found that the prevalence of specific STH species was 12.4% for roundworm, 1.8% for hookworm, and 1.8% for whipworm. This is slightly lower than the specific prevalence of STH species in Sub-saharan Africa such as hookworm (13.6%), *T. trichiura* (11.6%), *A. lumbricoides* (13.6%) found by Pullan et al. (2014). Also, apart from the prevalence of hookworm (4.9%) which is lower than the prevalence found in this study, the prevalence of *T. trichiura* (6.1%) and *A. lumbricoides* (39.8%) were higher in a study by Mathewos et al. (2014) in Ethiopia. Also, apart from the prevalence of hookworm (1.2%) which is lower than the prevalence found in this study, the prevalence of *T. trichiura* (12.9%) and *A. lumbricoides* (8.3%) were higher in a study by Masaku et al. (2020) in Kenya. Furthermore, apart from the prevalence of *A. lumbricoides* (1.6%) which is lower than the prevalence of *A. lumbricoides* found in this study, the prevalence of hookworn (14.4%) and *T. trichiura* (2.6%) were higher in a study by Palmeirim et al. (2018) in Cote D'Ivoire. Apart from the prevalence of *T. trichiura* (0.5%) which is lower than the prevalence of *T. trichiura* found in this study, the prevalence of hookworn (18.5%) and *A. lumbricoides* (9.8%) were higher in a study by Ojja et al. (2018) in Hoima district, rural western Uganda.

Sub Saharan African's main contribution to the increase STH infection among school children can be attributed to the impoverished dwellings, poor socio-economic status, poor sanitation and personal hygiene such as untrimmed finger nail, not washing hands before a meal and

after defecation, eating uncooked and unwashed vegetables and fruits, and access to basic social amenities like a toilet and portable drinking water (Paller et al., 2014; Shumbej et al., 2015; Ojja et al., 2018).

Boys in this current study were largely affected with the worms this was in line with studies conducted at Elmina (Dankwa et al., 2017), and a similar study at PML hospital (Mirisho et al., 2017). In addition, class four pupils had high infection compared with other classes. Perhaps the older classes may be more knowledgeable and exhibit proper personal hygiene and handwashing practices.

5.3 Knowledge of soil-transmitted helminth infection

This study recorded fair knowledge pertaining to soil-transmitted helminth infection and the possible complications associated with the disease. However, a similar study conducted in Côte d'Ivoire also reported a fair level of knowledge of children on STH infection (Palmeirim et al., 2018). However, a study by Nath et al. (2018) and Auwal, Hejar and Minhat (2017) found a high knowledge of STH infection children in Bangladesh and Malaysia respectively. This high knowledge could be attributed to the health education given the children by teachers and parent. Some of these health educations were benefits of handwashing with soap and clean water, wearing of footwear when playing, handwashing before eating and after visiting the toilet, and avoiding the use of faeces as fertilizer. Children in this current study and in a study by Lu et al. (2015) showed a level of knowledge on the mode of transmission of soil-transmitted helminths. Nevertheless, some children have minimal knowledge on the transmission route of the helminths (Acka et al., 2010).

5.4 Preventive measures in the school against soil-transmitted helminths

This study found that the school authorities had instituted measures to reduce the mode of transmission and the occurrence of the disease among the school children. Handwashing practices and equipment to aid proper handwashing was provided. A Veronica bucket containing water and soap was made available to support frequent handwashing by pupils. In a similar study conducted in Vietnam, Xuan and Hoat (2013), established that handwashing was an effective way of breaking the mode of transmission of the helminths which will lead to improvement in their health, growth and development. Improved personal and environmental sanitary practices are an essential way of improving the health of children (Auwal et al., 2017).

However, open defecation should be prevented while taking into account the appropriate and sanitary means of disposing of excreta, proper excreta disposal contributes greatly to the social-economic progress, and health of the people (Geetha & Kumar, 2014). In environments where sanitation and hygiene practices are not regarded a priority of the people, there is high risk related to infection among the people and in instances where open defecation is a common behaviour (Schmidlin et al., 2013).

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This study sought to determine the prevalence of STH and associated factors among school pupils in the upper primary classes at Presec Staff Primary school in the La Nkwatanang Municipality in the Greater Accra Region of Ghana. To achieve this objective, a school based quantitative cross-sectional study was conducted and a simple random sampling technique was used to select the participants. A structured questionnaire was administered to descriptive and analytical was used to analyse the data. This current study has reported a quite relatively lower prevalence of soil-transmitted helminths among school children, with a prevalence of 16% as compared with 17.3% prevalence in a similar study conducted at the Princess Marie Louise Children's Hospital in Accra. There were three main species of helminths that were identified during the study. Ascaris lumbricoides was the prevalent helminth with a prevalence rate of 12.4% and the remaining species being Ancylostoma duodenale and *Trichuris trichiura* had a prevalent rate of 1.8% each. There was a statistically significant association between STH infection and males, and those who lived in a self-contain dwelling with a ($p<0.05$).

The study concludes that soil transmitted helminths are prevalent among school children in the upper primary classes at Presec Staff Primary school in the La Nkwatanang Municipality in the Greater Accra Region of Ghana. Also, the author concludes that school children in the upper primary classes at Presec Staff Primary school have fair knowledge pertaining to soil-transmitted helminth infection and the possible complications associated with the disease. Finally, the author concludes that proper preventive measures against soil transmitted helminths infection such as handwashing with soap under running water equipment have been

provided by the school authorities to reduce the mode of transmission and the occurrence of the disease among the school children.

6.2 Recommendation

This current study seeks to figure out some intervention plans and programs to be instituted in aid of curbing the occurrence of the disease, especially among school children. School children in the Presec Staff primary school serve as a classic example for controlling helminths infection, through the distribution of anthelminthic.

There should be a continuous distribution of mass chemotherapy distribution among school children the municipality and the entire region coupled with a national distribution program.

Furthermore, community mobilization, sensitization, education relating to environmental sanitation and personal hygiene practices should be improved among community members. In addition, community members should be educated on the risk factors associated with helminth infection. However, it is imperative for parents and teachers should ensure children wash their hands after playing, before eating, after visiting the toilet: wearing shoes when playing, and not ingesting soil. Variety of teaching methods such as discussions, experiments, hands-on activities, audio-visual aids, and role-plays should be used at this level.

School Health Education Programme should be strengthened through collaboration with Ghana Health Service to bring health education and related service to school children. The SHEP should promote good health and well-being, monitor, prevent, treat and offer prompt referral of pupils with peculiar conditions to the appropriate quarters for management.

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Appendix

Appendix A: Questionnaire

I am Asare Kojo Asante a student of the School of Public Health, University of Ghana Legon, and my research topic is: **"Soil-transmitted helminths among School Pupils"**. This exercise will be an opportunity to assess your knowledge on worm infestation, risk factors, mode of transmission, preventive and control measures. Please give adequate information to the under listed questions. Your identity will not be disclosed in any way. Information gathered would be used only for the purpose of this research.

Section A

Demographic data

Age [ ]

Sex [ ]

Class [ ]

Religion:

Christian [ ] Muslim [ ] African Indigenous religion [ ]

Other, …….

Occupation of parent or guardian …….

Educational level of parent or guardian

Primary level [ ]

JHS level [ ]

Secondary level [ ]

Vocational level [ ]

Tertiary level [ ]

Marital status of parent or guardian

Single [ ]

Married [ ]

Type of residence

Compound house [ ]

Self-contained [ ]

Section B

Knowledge on worm infection

Do you have any idea on worm infection?

Yes [ ] No [ ]

1. What are worms?
   Living things [ ]

   Non-living things [ ]

   Meat [ ]

2. How do worms get into our body?
   By drinking contaminated water [ ]

   Eating contaminated food with worm eggs [ ]

   Breathing polluted air with dust [ ]

   Bathing cold water [ ]

   Failure to exercise the body [ ]

   Playing barefooted in the soil [ ]

3. Can worms cause infection?
   Yes [ ] No [ ]

4. What are some of the sign and symptoms of worm infection?
   Loss of appetite [ ]
   Stomach cramps [ ]
   Bitterness of the mouth [ ]
   Skin rashes [ ]
   Weight loss [ ]
   Headache [ ]

5. What do you do when you have worms?
   Take a dewormer [ ]
   Drink plenty water [ ]
   Drink palm oil [ ]

6. When can you take a dewormer?

   Once every 3 months [ ]
   Once every 6 months [ ]
   Once every year [ ]

7. When do you wash your hands?
   After visiting the toilet [ ]
   Before eating [ ]
   After eating [ ]
   After urinating [ ]
   Before and after bathing [ ]

8. How can you prevent worms from entering into your body?
   Wash hands with soap and water [ ]
   Eat warm food [ ]
   Drink clean water [ ]
   Avoid walking barefooted in the soil [ ]
   Wash vegetables before eating [ ]

Appendix B: Informed consent form

Informed Consent for your Participation.

Research topic: Soil-transmitted helminths among School children at Presec Staff Primary School.

Principal investigator: Asare Kojo Asante

Address: School of Public Health

Department of Biological Environmental and Occupational Health

University of Ghana.

Contact: 0242949117

My name is Asare Kojo Asante. I am currently a student of the University of Ghana, School of Public Health conduction a research on "Soil-transmitted helminths among school children." Any personal information that will make you identifiable will not be used in this study. Questionnaires that will be administered will bear no name of participants and thus anonymous completely to prevent any form of identification by either the researcher or other persons.

You are invited to participate in the research undertaken in your school. The research is for academic and public health purposes. It will require less than 15 minutes of your precious time to complete the task.

Parent and Guardian's name and signature and thumbprint Date

Name ……..…… …….

Signature/Thumbprint……

Telephone number……

Appendix C: Checklist for assessing preventive measure on the school compound

A checklist to assess the preventive measures on the school compound. This checklist is design only for this study purpose to ascertain measures put in place by the school authorities to prevent soil-transmitted helminths infection.

This checklist will be used only by the principal investigator.

Name: Asare Kojo Asante.

Institution: University of Ghana, School of Public Health, Department of Biological Occupational and environmental Health.

Items	**Yes**	**No**	**Quantity**
Availability of toilet			
Availability of Veronica bucket with water			
Availability of soap for handwashing			
Availability of hand towels			

Appendix D: Ethical clearance approval letter

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com

MyRef. GHS/RDD/ERC/Admin/App 15/241
Your Ref. No.

4th May, 2018

Asare Kojo Asante
University of Ghana
School of Public Health
Legon, Accra

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC048/02/18**
Project Title	Soil-Transmitted Helminths among School Pupils at Presec Staff Primary School
Approval Date	4th May,2018
Expiry Date	3rd May, 2019
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report **after completion** of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)