# PREVALENCE OF HOOKWORM INFECTION AMONG PUPILS OF OBA ERESOYEN PRIMARY SCHOOL, BENIN CITY, EDO STATE

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**BENIN CITY.**

**JANUARY, 2023**

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**A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF MEDICAL LABORATORY SCIENCE, SCHOOL OF BASIC MEDICAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE AWARD OF BACHELOR OF MEDICAL LABORATORY SCIENCE DEGREE (BMLS) IN MEDICAL LABORATORY SCIENCE.**

**JANUARY, 2023**

## CERTIFICATION

This is to certify that this project work was carried out by Adejumo Odiname Ade (Mr) under the supervision of Dr (Mrs) Z. Omoruyi in the Department of Medical Laboratory science, Faculty of Basic Medical Sciences, University of Benin, Edo state.

_____ _____

**DR. (MRS) Z OMORUYI** **DATE**

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**PROF. (MRS) E. O. OSIME** **DATE**

Head of Department

_____ _____

**EXTERNAL SUPERVISOR** **DATE**

## DEDICATION

I dedicate this work to God almighty for his continuous strength, wisdom and understanding, and also to my family and friends for being supportive.

**ACKNOWLEDGEMENTS**

First and foremost, thanks be to almighty God for his blessings throughout this work to ensure its completion. I would like to express my deep and sincere gratitude to Prof. E.O. Osime, Head of Department, Department of Medical Laboratory Science, School of Basic Medical Sciences, University of Benin. Also to my supervisor Dr. (Mrs) Omoruyi for taking time out of her busy schedule and providing invaluable guidance throughout the period of this project. Her vision and motivation really inspired me. The help she provided and her constant thorough approach is part of the reason this project work came out successful and I am really grateful for that. I am very grateful to my parents for their love, prayers, care and sacrifices and for educating me and preparing me for my future. Their understanding and continuous support was a vital part of the success of this work. Finally, I am extremely grateful to my friends and course mates for their support and for giving me motivation to keep going.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## APPENDIX

**ABSTRACT**

Hookworm infection is one of the common parasitic infections in developing countries. They are mainly causing iron deficiency anaemia in exposed patients. It is estimated that up to one-fifth of the world's population is infected with hookworms. The aim of this study was to determine the prevalence of hookworm infection among pupils of Oba Eresoyen Primary School, Benin city, Edo State. A total of 203 stool samples were collected using multistage sampling method on study subjects with the aid of a pre-test questionnaire based on Knowledge of hookworm and known risk factors. The samples were examined using saline and Iodine microscopy. The result from this study shows an overall prevalence rate of 20.7% hookworm infestation among pupils of Oba Eresoyen Primary School. It was also observed that the prevalence of hookworm infection was higher in females (57.14%) than in males (42.9%) with a P-Value of 0.13 which

was not statistically significant. The prevalence rate across the age group also shows that, age group 8-9 years (61.9%) had the highest prevalence, followed by age group 10-11 (28.6%). Age group 12-13 years had the lowest prevalence (9.5%). The result showed that there was a significant association between age and the prevalence of hookworm infection (P=0.045). A significant association was also observed between some sociodemographic factors such as walking barefooted and handwashing in relation to hookworm infection ($p<0.0001$). In conclusion, Hookworm infection is more common in children, deteriorating both their psychological and physical development. Special attention should be given to treatment of children in the rural areas of the State by Ministry of Health or the Federal Ministry of Health, Nigeria.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of Study

Parasites are organisms which have adapted themselves to existence in, or on, another organism (the host) and live at the expense of the tissue and fluids of the host (Obeagu *et al.,* 2014). Parasitic diseases have contributed immensely in undermining the health status of people and jeopardizing the economic development of nations in the tropics (Adeyeba and Tijani, 2002). Hookworm infection is one of the common parasitic infestations in developing countries. They are mainly causing iron deficiency anaemia in exposed patients. This activity reviews the evaluation and management of hookworm infections and highlights interprofessional team members' role in collaborating to provide well-coordinated care and enhance patient outcomes (Hotez *et al.,* 2017). Hook worm is an endoparasite, a nematode worm that lives in the small intestine of its host, which may be a mammal such as a cat, dog or human. It belongs to the phylum Nematoda and family ancylostomatidae. Two common species of hookworm, *Ancylostoma duodenale* and *Necator americanus*, currently infect about 1.2 billion persons worldwide (Odebunmi *et al.*, 2017). Hookworm infection is widely distributed throughout tropical and subtropical regions of the world. Favourable conditions for the spread of infection include warm temperature, high humidity, shade and contamination of human faeces. (Bundy and Desilva, 2018).

It is estimated that up to one-fifth of the world's population is infected with hookworms. Humans harbour hookworm in their small intestine. The eggs are passed in faeces and will hatch within twenty-four to forty-eight hours when conditions are favourable. After hatching, the larva moults twice in soil and in approximately ten days, become

infective filariform larvae. When a bare foot human walks in soil contaminated, with the infective larvae, it pierces the human skin, enter the blood stream and reach the lungs, break through pulmonary capillaries into the alveoli and then tracheobronchial tree to the epiglottis. The larvae are then swallowed and reach the small intestine where they develop into adult worms. Eggs will appear in stool within one to three months of infection (Hotez *et al*., 2017).

According to Odebunmi *et al*. (2017) hookworm infection occurs both in adults and children but more common in children. This is because children are more likely than adults to come in direct contact with faecal contaminated soil containing infective larva. Diagnosis is made by finding the characteristic eggs in stool. Treatment involves the elimination of the worm, correction of anaemia and protein deficiency if present. Medications that are effective against hook worm include albendazole, mebendazole etc. Prevention of hookworm involves good sanitation systems and public education regarding the risks of contamination of soil with hookworms and importance of wearing shoes in endemic areas (Chin, 2017). In the intestine, hookworm uses buccal capsule to attach onto the small intestine and suck the blood of its host. Symptom associated with hookworm infestation includes abdominal pain, diarrhoea, weight loss, loss of appetite. In chronic infections, the patients may become anaemic as the worms feed on the individual's blood. The loss of blood leads to loss of iron and protein, causing difficulty in breathing, pale complexion, tiredness and fast Heartbeat (Albonico *et al*., 2018).

## 1.2 Justification of Study

Globally more than 740 million peoples are infected with hookworm. In sub-Saharan Africa, approximately 200 million people have been infected with hookworm; 90 million of them

were children (WHO, 2012). Although intestinal parasitic infections are known to cause retardation in growth, anaemia, low cognitive ability and diarrhoea which leads to pupils' absence in schools and low academic performance or even death. The prevalence in primary school-going children in Oba Eresoyen Primary School is not documented. However, because of their vulnerability, children in Nigeria have been documented to have a high prevalence of intestinal parasite infections. These parasites have a negative effect on the socio-economic and public health of the world's economically disadvantaged people particularly children in rural and remote areas. Most intestinal parasitic infections such as Ascariasis, Amoebiasis and Helminthiasis are transmitted through soil and faecal contamination of water. Some studies have indicated that low education level, lack of pit latrines/toilets, low socio-economic status, poor human excreta disposal and sanitation in households are associated with parasitosis. Oba Eresoyen Primary School is a sparsely populated area with shortage of clean water. Many school going children are frequently absent from school due to sickness characterized by diarrhoea.

### 1.3 Aim of Study

This study aimed at establishing the prevalence of hookworm infection among pupils of Oba Eresoyen Primary School, Edo State.

### 1.4 Specific Objectives

The specific objective is to;

1. To determine the prevalence of hookworm infection among pupils of Oba Eresoyen Primary School.

2. To ascertain age and sex preponderance of this parasite in the primary school children.
3. To determine factors predisposing pupils to hookworm infestation in Oba Eresoyen Primary School.

## 1.5 Research Questions

1. What is the prevalence of hookworm among primary school pupils?
2. What age and sex preponderance are at greater risk of hookworm infection?
3. What are the factors predisposing pupils to hookworm infestation in Oba Eresoyen Primary School?

## 1.6 Research Hypothesis

**Null Hypothesis**

- There is a low prevalence of hookworm infection among pupils of Oba Eresoyen primary school.
- There is a high prevalence of hookworm infection among pupils of Oba Eresoyen primary school.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1. Concept of Hookworm Infection

Hookworm infection is one of the most common diseases in Nigeria, infecting people at certain periods of lifetime with far reaching disabling and debilitating effects on the individual victims and on the socio-economic development of nations. The causative organisms of the common hookworm infection are the strongylid nematodes, *Necator americanus* and *Ancylostoma duodenale* (Udonsi, 2014). hookworm disease is caused by hookworms, which are nematode parasites that can live for a long time in the small intestine of their human hosts. Hookworms can cause iron deficiency anemia (IDA) in people who have moderate to high numbers of adult worms in their bodies (Brown, 2016). Hookworm infection affects almost 500 million people in the tropical regions of the world, accounting for 3.2 million disability adjusted life years (DALYs) lost annually and ranking among the most important of the neglected tropical diseases in terms of causes of morbidity (Brown, 2016). Alternative and newer estimates indicate that hookworm infection results in 4.1 million DALYs lost, as well as possibly over US$100 billion in global economic losses (Brown, 2016).

Hookworms are nematode parasites that usually get transmitted through infested soil. They usually affect the poorest individuals in tropical and subtropical areas. Two species are mainly responsible for human infections, *Ancylostoma duodenale* and *Necator americanus*. They can cause chronic infection of the intestinal tract, suck their host blood, leading to iron deficiency anaemia in most cases. Moreover, pulmonary manifestations might occur by the effect of larval migration. While multiple medications are available to treat hookworm

infections, prevention is still vital to fight complications (Loukas *et al*., 2016). An estimated 576-740 million people are infected with hookworms globally. Despite the fact that the majority of persons affected show no symptoms, some may develop anemia and other consequences. Hookworms may remain in the host for a long time and harm children's physical and intellectual development as well as the community's economic growth. Hookworm infections are usually asymptomatic; symptoms vary depending on the stage of the life cycle, from cutaneous ground itch to respiratory symptoms until the main feature of iron deficiency anaemia and, on rare occasions, intestinal bleeding. (Global health 2020).

WHO (2012) observed that the geographical distribution of the two main Hookworms, *N. americanus* and *A. duodenale*, used to be restricted and relatively distinct, the former being more prevalent in Europe and South Western Asia, and the latter in Tropical Africa and in the Americas. However, over the past decades, both parasites have become widely distributed throughout the tropics and rigid demarcations are no longer tenable. Hookworm infection in Nigeria is markedly seasonal because of the influence of climate on the free-living larval stages of the parasites. Nwosu and Anya (2015), suggested that this factor could be of serious economic consequences if the period of heavy infection or high incidence, coincides with busy period in the agricultural communities in the country. In the past, the poorest citizens of the least developed countries have been disproportionately afflicted by hookworm infection. This is partly due to the lack of access to clean water, sanitary conditions, and health education. Despite the frequent lack of symptoms, hookworm illness significantly raises the risk of anemia and malnutrition in impoverished countries. The rural tropical and subtropical regions of Asia, sub-Saharan Africa, and Latin America are where it occurs most frequently (Anna, 2013). Treatment for individual hookworms includes iron

supplementation and anti-helminthic medication. Even with intense, yearly, school-based programs, community eradication has proven challenging. Failure to remove infection from adults with high worm burdens may contribute to the problem. Despite this, successful hookworm control and eradication is a worthwhile objective for innovative techniques that could help much of Africa and Asia economically and socially (Albonico *et al*., 2018).

## 2.2 Empirical Review

Worm infestation describes the condition of acquisition of parasitic infection as a consequence of being a primary or intermediate host in the life cycle of a worm. Pediatricians, general practitioners, community health specialists and primary health care workers need to understand worm infestations considering the preventable childhood morbidity and mortality inflicted by them (Jemima and Sumathy, 2021). The study, which included middle school students in the 7th grade from two government higher secondary schools in Kirumamapakkam and Thananpalayam, Puducherry, India, used a true experimental design to compare the effectiveness of structured teaching plans and child-to-child teaching programs by measuring the students' levels of knowledge about worm infestation before and after each intervention. The two groups, each with 30 kids, were formed. Students from Kirumampakkam made up Group 1 and received a structured lesson plan, whereas students from Thananpalayam made up Group 2 and received the child-to-child teaching intervention. According to reports, the majority of individuals in Groups 1 and 2 had inadequate or only moderately adequate understanding about hookworm before intervention, respectively (Jemima and Sumathy, 2021).

They carried out a cross-sectional study in western Côte d'Ivoire in May 2014. In order to identify infections with soil-transmitted helminths, 2498 children between the ages of 9 and 12 were submitted to three successive stool tests using duplicate Kato-Katz thick smears. A total of 2498 children supplied stool samples, with 1922 (76.9%) providing three, 472 (18.9%) providing two, and 104 (4.2%) providing just one. Results of the questionnaires were available for 2283 children. However, 358 youngsters (15.7%) were only included in the parasitological analysis since they had never heard of parasitic worms (Palmeirim, 2018). 852 (44.3%) of the 1922 children with complete parasitological data were female. 1035 children (53.8%) were between the ages of 9 and 10; the remaining 887 youngsters (46.2%) were between the ages of 11 and 12. *S. mansoni, T. trichiura,* and A. lumbricoides prevalence rates were 14.4, 8.9, 2.6, and 1.6%, respectively. Only a third (34.8%) of the children were deemed to have good knowledge based on the general knowledge scores that were generated (Palmeirim, 2018).

In a cross-sectional study to determine the prevalence of intestinal parasitosis among under-five children, and assess maternal awareness about it in Shesha Kebkele, Wondo Genet, Southern Ethiopia involving 288 under-five children, stool samples were collected and examined for intestinal parasites using Kato-Katz and formol-ether concentration methods. Of the 288 children, 245 (85.1%) were found infected with one or more intestinal parasites. The prevalence of hookworm infections as determined by Kato-Katz was 5.9% (Nyantekyi *et al.,* 2010). Erosie *et al.* (2012) conducted a cross sectional survey to assess the prevalence rate of intestinal parasites with emphasis on hookworm infection on apparently healthy 421 elementary school children of Boloso Sorie woreda. The prevalence of hookworm among the studied children was found to be 26.8%. Low level of hemoglobin was not significantly

associated with hookworm infection. A study was conducted to estimate the prevalence of hookworm infestations among school children in Kaski District of Western Nepal. A total of 2091 stool samples were collected from school children selected from 11 rural and eight urban schools. The stool samples were examined for evidence of parasitic infections by direct microscopic examination. Prevalence of hookworm was found to be 21.3% (Chandrashekhar *et al*., 2020).

Also, according to the research of Chandrashekhar *et al*. (2020), there was no significant difference in the prevalence of intestinal parasites according to age and gender of the school children. Prevalence was highest in the 6–10 years age group (22.7%), while prevalence was 21.5% and 21.04% among male and female children respectively. In another study aimed at identifying and investigating the epidemiology of intestinal parasite infections in tertiary care hospital, Dahod, Gujarat. A total of 664 stool samples were collected and tested between the years 2018 to 2020. Stool samples were collected in wide mouth container and it was placed for routine microscopic examination by wet mount technique. A total of 60 samples were found positive for the various parasites by stool microscopic examination contributing a positive rate of 9.03%. Male were more susceptible for infection (66.66%) in comparison with female (33.33%). Majority of cases were seen in age group of 21-30 years (26.66%) (Kishori *et al*., 2021).

Erosie *et al.* (2012) conducted a cross sectional survey to assess the prevalence rate of intestinal parasites with emphasis on hookworm infection on apparently healthy 421 elementary school children of Boloso Sorie woreda. Results revealed that more than 75% (85/113) of the hookworm infected students were Male (Odds ratio=1.50, 95% CL=0.89<OR<2.54). The high proportion of hookworm infection among children aged

between 9 and 12 years could be explained by the fact that children in this age group having high outdoor activities such as helping in farming, playing at the back yard in moist soil etc., resulting in higher exposure to infective egg and filariform larvae in the soil. Between June and July 2015, a survey on the prevalence of soil-transmitted helminthic infections and related risk factors among students in elementary schools was conducted. For the poll, four primary schools were specifically chosen (2 public and 2 private). A total of 243 students between the ages of 5 and 15 were recruited for the study, and of those, 207 (85.2%) participated and provided stool samples that could be examined. Infection prevalence was 34.8% overall (males 36.8%, females 33%). The infection rate between men and women did not differ significantly (p=0.6), and neither did the infection rate between the various age groups (p=0.7) (Adewale *et al*., 2017).

In order to determine the prevalence of intestinal parasite infection and related risk factors among children at Dona Berber Primary School in Bahir Dar, Ethiopia, a school-based cross-sectional study was carried out between October 2015 and June 2016. A total of 359 students participated in the study by contributing stool samples and thorough personal data. 235 (65.5%) of the 359 students who took part in the study had intestinal parasite infections. Students had rates of single parasitic infections of 49.6% and double parasitic infections of 16.2%, respectively. *E. histolytica/dispar* (24.5%) was the most common parasite found in the study, followed by hookworm (22.8%). Among the different variables assessed in the study, family size of 6, irregularly shoe wearing habit and unclean finger nail were independently predict intestinal parasitic infections. Student drinking well water and unclean finger nail were strongly associated with *E. histolytica/dispar* infection. Likewise,

irregular shoe wearing habit was strongly associated with hookworm infections (Hailegebriel, 2017).

A cross-sectional survey of 460 children was conducted in 2003 as part of another study to identify some common behavioural risk factors for hookworm in nursery and primary school children in Enugu. The findings from this study revealed that the prevalence of intestinal helminthiasis was significantly impacted by various behavioural risk factors. With diverse practices of washing fruits before eating ($X2 = 52.79$; $df = 2$; $p = 0.001$) and hand washing after defecation ($X2 = 75.77$; $df = 2$; $p = 0.001$) among the students, the rate of helminthic infection differed significantly. Also, there was a significant relationship between the source of drinking water and the rate of helminthic infection ($X2 = 55.12$; $df = 3$; $p = 0.01$), water boiling habits ($X2 = 40.89$; $df = 2$; $p = 0.001$), use of footwear after school hours ($X2 = 30.72$; $df = 2$; $p = 0.001$). Sites utilized for defecation by the pupils ($X2 = 80.25$; $df = 3$; $p = 0.001$) also significantly influenced the rate of helminthic infection (Ikechukwu *et al*., 2010). A survey of prevalence of soil-transmitted helminthic infections and associated risk factors among pupils of primary schools was carried out between June and July 2015For the poll, four primary schools were specifically chosen (2 public and 2 private). A total of 243 students between the ages of 5 and 15 were recruited for the study, and of those, 207 (85.2%) participated and provided stool samples that could be examined. The findings showed that a significant number of students engaged in risky behaviours, including irregular hand washing (28.5%), cutting fingernails with teeth (58.5%), and eating unhygienically (41.4%). The majority of students (71.5%) were unaware of the school's deworming program, and 35.8% of those students tested positive for infection. Additionally, 56 students, or 39.3% of the total,

tested positive for infection, including those who used pit latrines and defecated in the open (Adewale *et al*., 2017).

**2.3 Epidemiology**

Worldwide, about 470 million people have hookworm infections. Infection predominates within developing countries and leads to huge losses of economic productivity due to anaemia worsening the already existing poverty and disease. The most common cause of hookworm infections worldwide is *Necator americanus,* while *Ancylostoma duodenale* is often native to the Mediterranean region, northern India, and China (Udonsi, 2014). The three primary hookworm species that infect humans, *Ascaris lumbricoides*, *Trichuris trichiura,* and other soil-transmitted helminths (STHs) are the most prevalent species (*N. americanus, Ancylostoma duodenale* and *Ancylostoma ceylanicum*). The most common human hookworm, N. americanus, is found throughout the world and is particularly prevalent in southern China, Southeast Asia, the Americas, and the majority of Africa. *Ancylostoma duodenale* is more focally endemic in the Mediterranean region, in northern regions of India and China and in North Africa. In some parts of Africa, China, India and elsewhere, it is not uncommon to find mixed human infections with *N. americanus* and *Ancylostoma duodenale*. A third minor species, *Ancylostoma ceylanicum*, which was thought to be primarily a canine parasite, has recently been identified as a highly prevalent species of hookworm in humans in a few focal regions in Southeast Asia, such as Malaysia and Indonesia, where it is also often co-endemic with *N. americanus* (Traub, 2016).

Since the parasite thrives in tropical and subtropical regions, where moisture and temperature are perfect for larval growth outside the host, climate and soil structure are

important drivers of hookworm prevalence. The distinct distribution of the several hookworm species is not always present; individuals frequently develop mixed infections. In 2010, there were an estimated 438.9 million cases of hookworm worldwide (95% credible interval: 406.3-480.2 million), with Southeast Asia and sub-Saharan Africa having the highest numbers of cases (Npankaew *et al*., 2014). Rural areas sometimes have higher rates of hookworm infection due to the confluence of favourable tropical or subtropical ecologies with poverty and inadequate sanitary facilities. In middle-income nations like China, newly urbanized economies, rapid economic development (particularly in eastern China), and, in some areas, widespread availability of anthelmintic medications all contributed to the drop in the prevalence of hookworm infection. During the early 20th century, these developments were also extremely important in reducing the frequency of hookworm infection in the southern United States (Hotez, 2018).

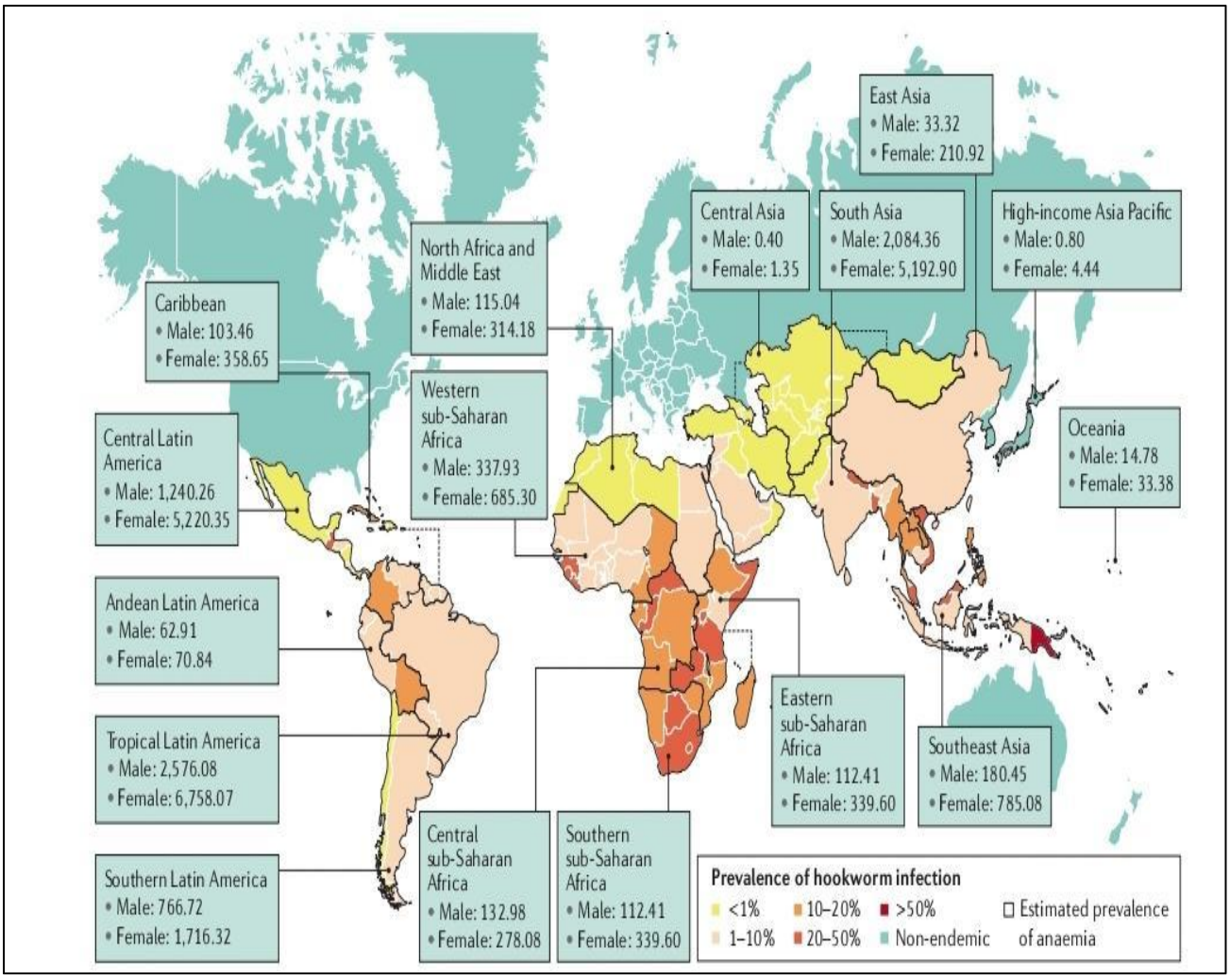


**Fig. 2.1:** Distribution of hookworm infection and estimated prevalence of anaemia due to hookworm infection (Hotez, 2018).

## 2.4 Aetiology

According to (Albonico and Savioli, 2017), Organisms that have been shown to cause hookworm disease include the following:

- *Necator americanus*
- *Ancylostoma duodenale*
- *Ancylostoma ceylanicum*
- *Ancylostoma caninum*
- *Ancylostoma braziliense*

The sole species of its genus known to infect humans, *N. americanus*, is the most common human hookworm in the world. Adult males and females of this tiny cylindrical, off-white worm measure 7-9 mm and 9-11 mm, respectively. 2019 (Brooker and Bundy) A. duodenale, one of numerous anthropophilic species in the genus *Ancylostoma*, is more regionally constrained than *N. americanus*. Although it can exist in the small intestines of cats and dogs, the characteristic hookworm sickness it causes predominantly affects humans. Although slightly larger, *A. duodenale* resembles *N. americanus* in appearance. Adult males measure 8-11 mm, while adult females measure 10-13 mm (Bouchery, *et al*., 2020).

*A. ceylanicum* mainly affects dogs and cats, but it can also cause a lesser form of typical hookworm illness in humans. The term "*Brasiliense*" refers to canine and feline hookworms that induce cutaneous larva migration, also known as creeping eruption, in humans. This self-limiting condition is distinguished by serpiginous burrows that form when the larvae move through the epidermis. The canine hookworm *A. caninum* primarily causes eosinophilic enteritis in humans (though it also causes cutaneous larva migrants in a minority of cases) (Bouchery *et al*., 2020).

## 2.5 Life Cycle of Hookworm

Before becoming infectious, rhabditiform (early) larval hookworms undergo two moults in the first stage (L1 and L2) in the soil (L3). L3 build up in grass or soil before being exposed to human skin, which they can then penetrate (typically the hands, feet, or buttocks). When L3 reach the peripheral vasculature, they are passively carried through the bloodstream to the pulmonary vasculature and subsequently to the right side of the heart (Figure 2.2). L3 leave the alveolar capillaries of the lungs and ascend the bronchial tree to reach the pharynx, where they then enter the digestive system to complete their migration to the small bowel Immature L5 hookworms employ the cutting plates (*Necator spp.)* or "teeth" (*Ancylostoma spp*.) that line their buccal capsule to lacerate the mucosa and anchor themselves in place to facilitate feeding and prevent being ejected by gut peristalsis after they reach the duodenum. Juvenile worms develop into sexually dioecious adult parasites once they start eating blood. Female hookworms can lay up to 10,000 eggs each day after mating with mature adult males. The faeces stream serves as the host's means of egg expulsion. *Necator americanus* requires roughly 6-8 weeks from L3 invasion to patency (egg production), and *Ancylostoma duodenale* may require a comparable amount of time.

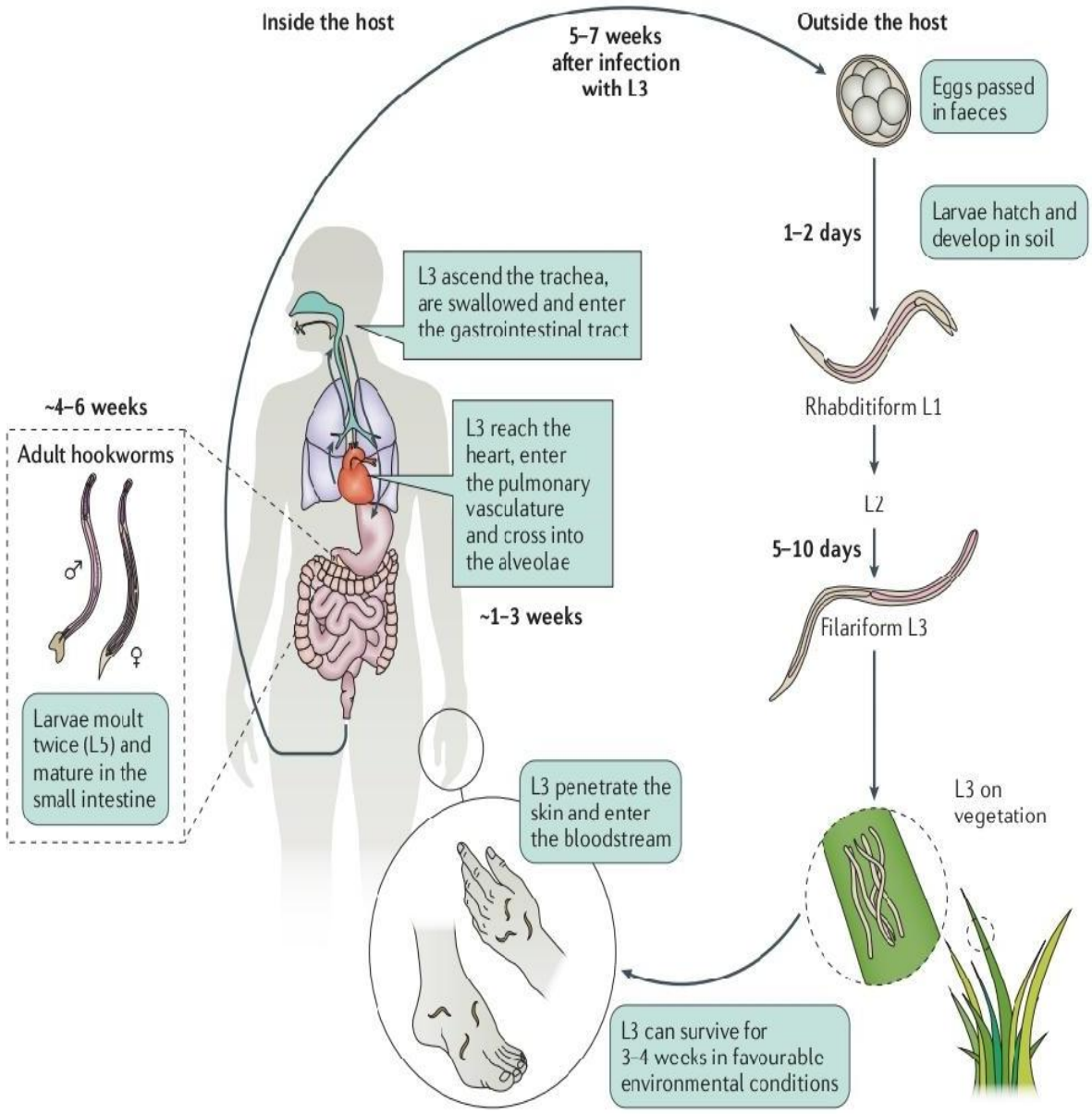


**FIG 2.2: Life cycle of *Necator americanus*** (Brooker, Bethony and Hotez 2014).

## 2.6 Pathophysiology

In soil, the hookworm eggs hatch, and first-stage larvae called rhabditiform L1 larvae develop in few days. They moult twice to become the infective filariform L3, which is about 0.5 to 0.6 mm in length and can live for 3 to 4 weeks if suitable conditions were available. It waits in soil or on the grass until it comes into contact with human skin and initiates an infection. The infection starts when larvae penetrate the victim's skin in a process that requires about 30 minutes to 6 hours to complete, according to species as shown in Figure 2.2. Occasionally, larvae might use buccal mucosa to invade the host and make their way down to the circulation. Cutaneous penetration usually goes unnoticed but sometimes might cause what is called 'ground' itch. Skin penetration occurs under a chemical process that starts with the production of proteolytic enzymes from certain glands in the larvae (Brooker, Bethony and Hotez 2014).

*Necator americanus* produce proteases that could break connective tissue components such as collagen and elastin. On the other hand, *Ancylostoma* larvae produce hyaluronidase enzyme, which cracks the dermal integrity and allows the larvae to migrate through the skin. One of the significant larval secretions is called *Ancylostoma* secreted proteins (ASPs), which are pivotal in developing the parasite, representing about one-third of its secreted proteins (Parija *et al.*, 2017). After skin penetration, the larvae migrate passively through the bloodstream to the right side of the heart and hence to the pulmonary vasculature. During pulmonary migration, it might cause a type-1 hypersensitivity reaction within the alveoli (Loeffler syndrome). They penetrate the alveoli and migrate through the bronchial tree to the pharynx and then to the intestinal tract. Once the larvae reach the duodenum, and after molting twice, they become L5 immature worms that can use their teeth or cutting plates that

line their buccal capsule to get fixed into the host's intestinal mucosa (Parija *et al.*, 2017). Digestion of blood is helped by metalloproteases and anticoagulant peptides, which maintain the flow of liquid blood through mucosal injury. However, the process by which haemoglobin gets consumed in the parasite gut is poorly understood. Worms mature in 4 to 6 weeks into adult sexually differentiated worms. After mating, the female produces up to 30000 eggs per day, which exit the host with faeces to continue the life cycle (Parija *et al.*, 2017). Blood loss in heavily infected persons could reach up to 9.0 mL/day and occurs by two mechanisms. The first is through consumption of the parasite, which accounts for a small portion of blood loss. The second and the main loss occur through the attachment site by leakage around it (Hotez *et al*., 2014). Iron deficiency anaemia occurs when the host becomes unable to compensate for blood loss, especially in heavy infections and nutritionally deprived individuals. The major risk factor for anaemia is the worm burden, though, in children, anaemia could occur with a lower worm burden. Simultaneous protein loss might occur and result in symptomatic hypoalbuminemia and hypoproteinaemia, leading to anasarca and worsen malnutrition (Hotez *et al*., 2014). Parasites can last for years in the host, and accordingly, it had to develop multiple strategies to ensure survival. The parasite uses broad-spectrum protease inhibitors to neutralize the effect of the host's immune defences. While it helps the parasite protect itself from proteolytic enzymes, it worsens the host's malnutrition by interfering with absorption (Hotez *et al*., 2014). Moreover, it induces apoptosis of T-lymphocytes and, consequently, inhibition of local immune response. The down-regulated immune response to the parasite is mainly due to parasite-specific T cell hypo responsiveness secondary to altered function of antigen-presenting cells, T-cell apoptosis, and cytokines modulation (Hotez *et al*., 2014). Interestingly, in individuals with

hookworm infections, same as other helminths, patients tend to have a wider variety of gut microbiota. This observation, along with immune regulatory mechanisms in hookworms, prompted research into the potential use of hookworms to treat immune-mediated gastrointestinal diseases like celiac disease and inflammatory bowel disease (Jiraanankul *et al*., 2017).

## 2.7 Types of Hookworm Infection

Hookworm infection gives rise to the following 3 clinical entities in humans:

**Classic hookworm disease** - This is a gastrointestinal (GI) infection characterized by chronic blood loss that leads to iron-deficiency anaemia and protein malnutrition; it is caused primarily by *N. americanus* and *A. duodenale* and less commonly by the zoonotic species *A. ceylanicum* (Brooker *et al.,* 2014)

**Cutaneous larva migrans** - This is an infection whose manifestations are limited to the skin; it is most commonly caused by *A. braziliense*, whose definitive hosts include dogs and cats. In cutaneous larva migrans, the infective larvae of zoonotic species such as *A. braziliense* do not elaborate sufficient concentrations of hydrolytic enzymes to penetrate the junction of the dermis and epidermis. The larvae thus remain trapped superficial to this layer, where they migrate laterally at a rate of 1-2 cm/day and create the pathognomonic serpiginous tunnels associated with this condition. Larvae can survive in the skin for about 10 days before dying (Loukas *et al*., 2016).

**Eosinophilic Enteritis** - This is a GI infection characterized by abdominal pain but no blood loss; it is caused by the dog hookworm *A caninum*. In eosinophilic enteritis, *A caninum* larvae typically enter a human host by penetrating the skin, though infection by oral ingestion

is also possible. Most of the time, these larvae remain dormant in skeletal muscles and create no symptoms. In some individuals, larvae may reach the gut and mature into adult worms (Hotez *et al*., 2015).

According to (Hotez *et al.,* 2015), the clinical manifestation of hook work infection includes;

- Itching and a localized rash
- Cough or wheezing
- Abdominal pain
- Loss of appetite
- Diarrhoea
- Weight loss
- Fever
- Nausea
- Fatigue

### 2.8. Risk Factors

Poor sanitation, limited access to clean water, and low income and educational attainment are well-documented risk factors for hookworm infection. High-risk populations include international travellers, refugees, international adoptees, recent immigrants, and young children who have contact with soil or sand (Nadia, 2017). Favourable environmental conditions are conducive to the development of hookworm disease. Children and pregnant women are at the highest risk. Optimal conditions for eggs include ambient temperatures of 20-30°C, although *A. duodenale* is better adjusted to lower temperatures than *N. americanus*, and warm, moist, well-aerated soil that is shielded from sunlight (McKenna *et al*., 2017). These conditions occur during cultivation of numerous agricultural products; hence,

hookworm infections occur primarily in rural areas. Larvae fail to develop in temperatures below 13°C and fully hatched eggs and new larvae are destroyed by temperatures below 6-8°C and above 45°C. They are also killed by drying and direct sunlight.

## 2.9 Diagnosis of Hookworm Infection

Stool microscopy is the mainstay tool for diagnosis but with some limitations. It is useful in identifying and quantifying hookworm eggs. In hospitals, labs tend to use formol-ether concentration techniques, while for screening and public health control, simple tests as Kato-Katz techniques; stool sample examinations need 3 slides and use a light microscope. The investigator takes about 42 mg stool sample and places it in a 200 μm Kato-Katz screen mesh. The stool is transferred into a 6 millimetres hole of a template on the microscopic slide. A glycerol- soaked cellophane strip covers the stool. The investigator then examines the stool sample (Brooker *et al.*, 2014). Eosinophilia raises suspicion of hookworm infection but non-specific. Systemic and mucosal eosinophilia is widely present in hookworm infections. It is detectable in the blood even before reaching the intestine and peaks after adult worms reach intestinal mucosa (Loukas *et al*., 2016).

## 2.10. Treatment

Most cases of classic hookworm disease can be managed on an outpatient basis with anthelmintic and iron therapy, complemented by appropriate diet. Patients with anaemia and malnutrition may require both iron supplements and nutritional support (including folate supplementation). Some patients with severe anaemia and congestive heart failure may require hospitalization (Reddy *et al*., 2017). Blood transfusion is indicated in rare cases of acute severe gastrointestinal (GI) haemorrhage. In patients with chronic anaemia, blood transfusions (packed red blood cells [RBCs]) should be administered slowly and are usually

followed by a diuretic to prevent rapid fluid overload (Reddy *et al*., 2017). The main drugs used for hookworm infections are mebendazole and albendazole. Data support 400 mg single-dose albendazole therapy over a 500 mg single dose of mebendazole. Three consecutive daily doses of either drug demonstrate superior cure and egg reduction rates, but it is less convenient for mass treatment campaigns. Alternatively, a 3-day regimen of 100 mg twice daily, mebendazole, is suitable for stable uncomplicated cases. Also, pyrantel pamoate 11 mg/kg (up to a maximum of 1 g) orally daily for three days could be an option (Adeyeba and Tijani 2002).

Treatment efficacy varies according to the severity of infection, geographical distribution, and age groups. Both mebendazole and albendazole are usually safe with few transient side effects such as dizziness, headache, and abdominal upset (Hotez, 2016). Pregnant and lactating women have an increased risk of anaemia from hookworm infections. Albendazole and mebendazole were both pregnancy category C under the prior FDA system; data on their use in pregnant women are limited. It is not known whether albendazole or mebendazole gets excreted in human milk. While albendazole requires caution in breastfeeding, the WHO allows the use of mebendazole in lactating women (Brooker *et al.,* 2018) Pyrantel pamoate and levamisole are alternative treatments, but neither has equal efficacy with albendazole. Cutaneous larvae migrans is usually self-limited and confined to the skin. However, treatment is sometimes needed, and it responds well to oral albendazole or ivermectin. Co-administration of deworming and iron supplementation has a greater impact on anaemia, especially in nutritionally deficient populations (Friis, *et al*., 2015).

## 2.11. Prognosis

Hookworm infection tends to cause morbidity rather than mortality. In adults, anaemia and malnourishment lead to reduced productivity with subsequently increased poverty. In pregnancy, demand increases for iron, and subsequently, the risk is higher in this class of patients with an effect on both the mother and her foetus's wellbeing. School children are at risk of a decline in cognitive function and school achievement. In contrast, preschool children suffer less from the threat of anaemia and malnutrition (Speich *et al*., 2016). There are growing concerns regarding treatment failure, especially after mass drug administration campaigns. There is no sufficient data to illustrate the effect of deworming interventions on quality of life. Additionally, there is a need to develop a new generation of broad-spectrum agents and further assess the efficacy of combination therapy on the outcome (Brooker *et al.,* 2018). Reinfection is another challenge in the treatment of hookworms. Moderate reinfection rates post-treatment supports the concept of repeated drug regimens in highly endemic areas. A study of 405 school children, at 18 weeks follow-up post-treatment, showed that the reinfection rate was 25.0 % for hookworms (Brooker *et al.,* 2018).

## 2.12. Complications

According to (Sharma *et al*., 2017), the complications from untreated hook worm infection include;

- Iron deficiency anaemia
- Intestinal blood loss
- Malnutrition
- Gastrointestinal bleed
- Cutaneous larvae migrans
- Eosinophilic pneumonia
- Protein deficiency
- Intestinal blockage
- Ascites

## 2.13 Prevention of Hookworm Infection

Mass drug administration campaigns are effective in reducing the prevalence and burden of the infection. However, after stopping the medication, reinfection rates are usually high. Prevention is mainly through health education campaigns regarding food sanitation, safe drinking water, hand washing, and footwear (Jourdan *et al*., 2018). Reduction of poverty and increased economic development have done more to eliminate hookworm infection than any other factor, but obviously, that would not be easy (Hotez *et al*., 2014). If significant improvements in socioeconomic conditions, cleanliness, education, and the accessibility of footwear cannot be made, community control of hookworm infection will be challenging. Programs that have been successful have included economic, hygienic, and mass-treatment

elements. The current WHO recommendations for treating hookworm infection include mass albendazole or mebendazole therapy administered annually (in communities where prevalence is above 20%) or bi-annually (in communities where prevalence is above 50%) to reduce the overall worm burden until conditions allow for a multifaceted physical and educational program. The WHO's guidelines should be taught to community leaders (Bethony *et al*., 2016).

# CHAPTER THREE

# MATERIALS AND METHODS

## 3.1. Study Area

The study was conducted in Eresoyen primary school, Esogban community, Edo state. Edo State is located in the South-South geopolitical zone of Nigeria. It occupies a strategic position as the gateway to eastern, western, southern and northern parts of Nigeria. Ikpoba-okha Local government area has its headquarters are in the town of Idogbo. It has an area of 862 $km^2$ and a population of 371,106 at the 2006 census. Ikpoba-okha LGA lies within latitudes 6°9'53.52"N and longitudes 5°41'16.35"E with an average elevation of 38.3 meters above sea level.

## 3.2. Study Population

This research was carried out in Eresoyen primary school. This serves as the only primary educational facility within the community. The ages of the pupils' range between six to thirteen years of age. The classrooms have an average population of sixty persons per class with just a teacher to each classroom. Two hundred and three pupils were selected for this research within the school population.

**3.2.1. Inclusion criteria**: All children present in school on the day of the survey and who volunteered were eligible to participate.

**3.2.2. Exclusion Criteria**: Pupils with mental problem and non-volunteers were excluded from the study.

### 3.2.3 Ethical Approval

An approval from State Health Research Ethics Committee and permission from Edo State Ministry of Health was obtained, so as to have a legal access to the school. Informed

consent from the parents and assent from the children was obtained along with permission from the headmaster of the school. The purpose and process of the study was also clearly conveyed to study subjects.

### 3.3. Research Design

A cross sectional study design were employed to study the prevalence of intestinal hookworm among Oba Eresoyen Primary School pupils in Ogbeson community of Ikpoba-Okha LGA.

### 3.4. Sample Size

Sample size was determined using single population proportion estimate considering the level of significances at 5% and the prevalence of hookworm from three previous studies conducted elsewhere was found to be 14.4%, 5.9%, and 26.8% (Nyantekyi *et al.,* 2010; Erosie *et al.* 2012; Palmeirim, 2018).

$$\text{Mean Prevalence} = \frac{14.4\% + 5.9\% + 26.8\%}{3\%} = 15.7\%$$

The sample size for this study was obtained using Cochrane Formula as described by Erosie *et al.* (2012).

$$N = \frac{Z^2 P (1 - P)}{D^2}$$

N = required sample size

Z = confidence level at 95% (standard value of 1.96)

P = Overall mean prevalence of microfilaria rate across Nigeria (15.7% = 0.157)

D = margin of error at 5% (standard value = 0.05)

$$N = \frac{1.96^2 \times 0.157(1-0.157)}{0.05^2}$$

$$\frac{3.8416 \times 0.157(0.843)}{0.0025}$$

N = 203 minimum sample size

Therefore, stool samples will be collected from 203 consenting pupils in the school

### 3.5. Sampling Technique

Multistage sampling method was used to select the study subjects. Classes were first selected by simple random sampling technique and then the sampled children were selected by systematic random sampling using class roster (students list) as a sampling frame, and proportional allocation was employed to select pupils from each selected section.

**Questionnaire:** A pre-test questionnaire based on Knowledge of hookworm and known risk factors was developed and modified. The questionnaire includes information such as age, sex, walking barefooted, handwashing, apartment type and yes or no choice questions for outdoor activities.

### 3.6. Sample Collection and Examination

i) **Parasitological Examination:** After being interviewed, the pupils were supplied with labelled stool containers with tight covers bearing serial numbers of the subjects and were requested to bring about 3 g of stool. All the stool samples were received at the spot at an organized central place. Stool samples were transported to laboratory within one hours of collection and processed immediately.

ii) **Macroscopic Examination:** Macroscopic examination was done by looking for color, consistency, presence of mucus and blood, and presence of adult larvae or adult form of hookworm.

iii) **Microscopic Examination:** For microscopic examination, saline wet mount and Lugol's iodine wet mount was prepared. Saline wet mount was done to detect protozoan trophozoites and Helminthic eggs or larvae and iodine wet mount was done to detect cysts and eggs.

iv) **Formal-Ether Concentration:**

One gram of Stool sample was mixed in a 7ml conical tube containing 10% formalin. It was emulsified properly and kept at room temperature for 10 minutes. It will then filter through gauge piece; filtrate was then collected with 15ml conical centrifuge tube. After addition of 3ml ether to the mixture, it was mixed vigorously. The solution was then centrifuged at 2000 rotation per minute for 2 minutes. With the help of wooden stick, debris and other fatty material were kept aside and supernatant fluid was decanted. Final sediment was used to prepare wet mount for stool microscopy examination using saline and iodine mount technician under 10X and 40X objective lens. Averages of egg count on pair of slides per sample was taken and conversions into eggs per gram (egg) of stool was done by a factor of 24 (Crompton and Nesheim, 2002).

### 3.7. Data Processing and Analysis

Data was coded and analysed using SPSS version 22 software package for statistical analysis. Different variables were described and characterized by frequency distribution percentages. Chi square test of statistical significance was applied to study the association between prevalence of intestinal parasites and the demographic factors. P value $<0.05$ was considered as significant.

# CHAPTER FOUR

## 4.0. RESULTS

Hookworm was recovered from a total of 42 samples revealing a prevalence rate of 20.7%. Fig 1 shows the total prevalence of Hookworm infection. Prevalence of Hookworm was higher in females (57.14%) when compared to males (42.9%) although it was not statistically significant (p=0.13, OR-1.55, 95%CI-0.76-1.83) (Table 4.1)

The highest prevalence for hookworm infection was found in age group 8-9 (61.9%) years, closely followed by 10-11 years (28.6%) and 12-13 years with lowest prevalence rate (9.5%); while 14 – 16 had no positive case (Table 4.1). This result was significant (p=0.045). It was observed that participants who walked barefooted had a higher prevalence of hookworm infection (71.4%) when compared to those who do not walk barefooted at any instance (28.6%) (Table 4.2). This was statistically significant (p<0.0001).

Participants that rarely wash their hands had the highest prevalence (71.4%), followed by those that seldomly practice handwashing (19.0%). Those that frequently wash their hands had the lowest prevalence (9.5%) (Table 4.2). This result was significant (p<0.0001). Playing outdoor games and the apartment type of participant had no significant relationship to the prevalence of Hookworm infection (p=0.992) (Table 4.2).

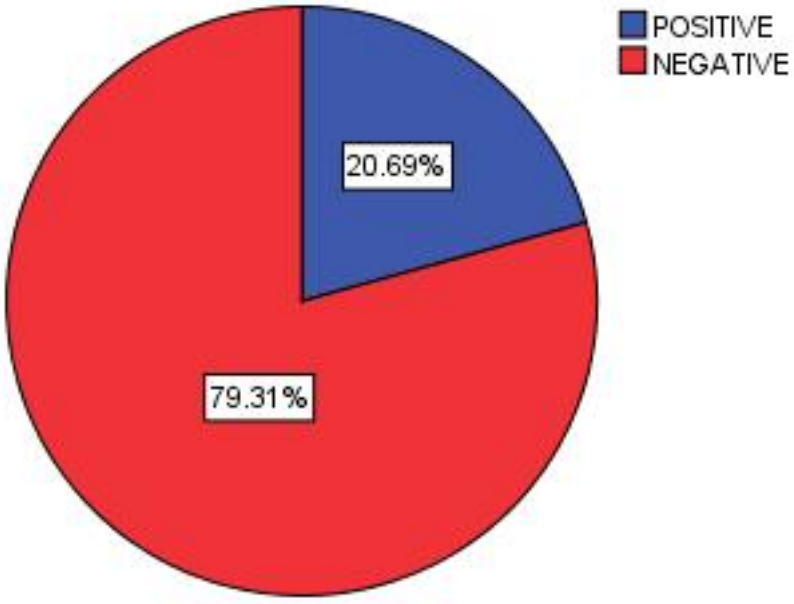


FIG4.1 The prevalence of hookworm infection among pupils of Oba Eresoyen Primary School.

**Table 4.1: Distribution of Hookworm Infection by Sex and Age group**

| Variable | No. Examined | No. Infected (%) | OR | 95%CI | P value |
|---|---|---|---|---|---|
| **Sex** | | | | | |
| Males | 100 | 18 (42.9) | 1.55 | 0.76-1.83 | 0.13 |
| Females | 103 | 24 (57.14) | | | |
| **Age Group(years)** | | | | | |
| 8-9 (years) | 74 | 26 (61.9) | | | 0.045 |
| 10-11 (years) | 72 | 12 (28.6) | | | |
| 12-13 (years) | 46 | 4 (9.5) | | | |
| 14-16 (years) | 8 | 0 (0) | | | |

**Table 4.2: Distribution of Hookworm Infection in Relation to Socio-demographic Characteristics**

| Variable | No Examined | No Infected (%) | OR | 95%CI | P value |
|---|---|---|---|---|---|
| **Walk Barefooted** | | | | | |
| Yes | 42 | 30 (71.4) | 30.83 | 8.74-108.74 | <0.0001 |
| No | 161 | 12 (28.6) | | | |
| **Outdoor games** | | | | | |
| Yes | 96 | 20 (47.6) | 1.005 | 0.34-2.63 | 0.992 |
| No | 107 | 22(52.4) | | | |
| **Hand Washing** | | | | | |
| Rarely | 58 | 30 (71.4) | | | <0.0001 |
| Frequently | 74 | 4 (9.5) | | | |
| Seldomly | 71 | 8 (19.0) | | | |

# CHAPTER FIVE

## 5.1 DISCUSSION

This study has shown that hookworm infection has an overall prevalence rate of 20.69%. Hookworm is a parasitic nematode that lives in the small intestine of its host, which may be a mammal such as dog, cat or human (Markell et al., 2006). Two species of hookworm commonly infect humans, *Ancylostoma duodenale* and *Necator americanus*. Hookworms are thought to infect more than 600 million people worldwide. Both *A. duodenales* and *N. americanus* are found in Africa, Asia and America (Markell et al., 2006). Infection by hookworm is the second most common human helminth infection after ascariasis. In contrast to most intestinal helminthiasis, where the heaviest parasitic loads tend to occur in children, hookworm prevalence and intensity can be higher among adult males. Indeed, in most endemic areas Hotez et al. (2005) reported that adult women are the most severely affected by anaemia, mainly due to their much higher need for iron as a result of menstruation and repeated pregnancy in addition to the fact that customarily they have access to much poorer food than men. Hotez et al. (2005) added that majority of the infected individuals live in poverty-stricken areas with poor sanitation. The overall prevalence of hookworm in this study is however high when compared with findings of Odebunmi *et al*. (2007) which showed 3.2%. This could be attributed to the poor personal hygiene observed among subjects in the study area and unsanitary conditions such as inadequate sanitation facilities. This results in the contamination of the soil with eggs and larva of the parasite to which the children are exposed.

Infection was not significantly different between the two sexes, although females were more infected than males. This disagrees with the work of Odebunmi et al., (2007) who reported a

significant difference between males and females. The non-significant difference in the rate of infection between the two sexes, observed in this study, may be due to the position and customary division of labour between the sexes in the society. Also, cultural and religious factors come into play here as males are given unrestricted freedom for play time thereby exposing them to the soil that harbours the third stage larva, while females are not given such liberties. Results obtained in this study showed that the different ages were infected to varying degrees. The age distribution of Hookworm infection among the various age groups showed a significant association between age and infection with children between the age group 8-9 years having the highest prevalence. This could be due to the fact that younger children move about more frequently, playing in pools of water barefooted, while older ones wear shoes. This disagrees with the works of Fawole and Arinola (1995) who showed that hookworm infection increases with age. However, findings from this study agrees with the work of Ejezie (1981) in his study of feacal samples from 810 primary school children in Lagos state and found that ages between 6 and 9 years had the highest prevalence of Hookworm infection. It disagrees with Ugbomoiko and Ofoezie (2006) who reported the disease to be age-specific with peaks in the 11 – 15 age brackets. The high infection rate in children found in this study could be attributed to their adventurous way of life, which could expose them to the infective third stage larvae.

The common habit of working and walking barefoot results in higher exposure of these children to the infective larvae. In this study, it was observed walking barefooted was directly related to the prevalence of hookworm infection.

Most of the children generally eat with dirty and unwashed hands most times especially after playing games. Moreso, most of them do not know the importance of washing their hands

after defecating and most of them keep some fairly long and dirty finger nails and since most of these intestinal helminthes are transmitted faeco-orally, the children are likely to easily contaminated themselves, either while eating or while biting finger nails. This also agrees with the findings of Holland et al. (1989). The study revealed that hookworm infestation among primary school pupils used in this study was high.

## 5.2 CONCLUSION

The overall prevalence of hookworm in this study was 20.7%, this is suggestive of severe complications if it is left untreated. Hookworm is a common infection in children and the infection reduces psychological and physical development with symptoms like poor growth, mental retardation, emaciation and pains. From this study hookworm had a higher prevalence in females than males, with children within the age range of 8 and 9 years also showing a higher infection rate.

Therefore, special attention should be given to the treatment of children and regular basic health education programmes should be carried out in schools located in the rural areas of the state by the state Ministry of Health as well as the Federal Ministry of health.

## 5.3 RECOMMENDATIONS

Environmental factors such as provision of adequate and safe water, introduction of basic sanitation practices for children and immense governmental support have to be involved if the infection must be tackled.

Improvement of personal and community hygiene practices.

Local health workers should visit the schools regularly for routine health education of pupils.

People should also be informed about the signs and symptoms as well as prevention methods of the infection.

Cases should be reported to the hospitals on time for prompt and proper management of cases.

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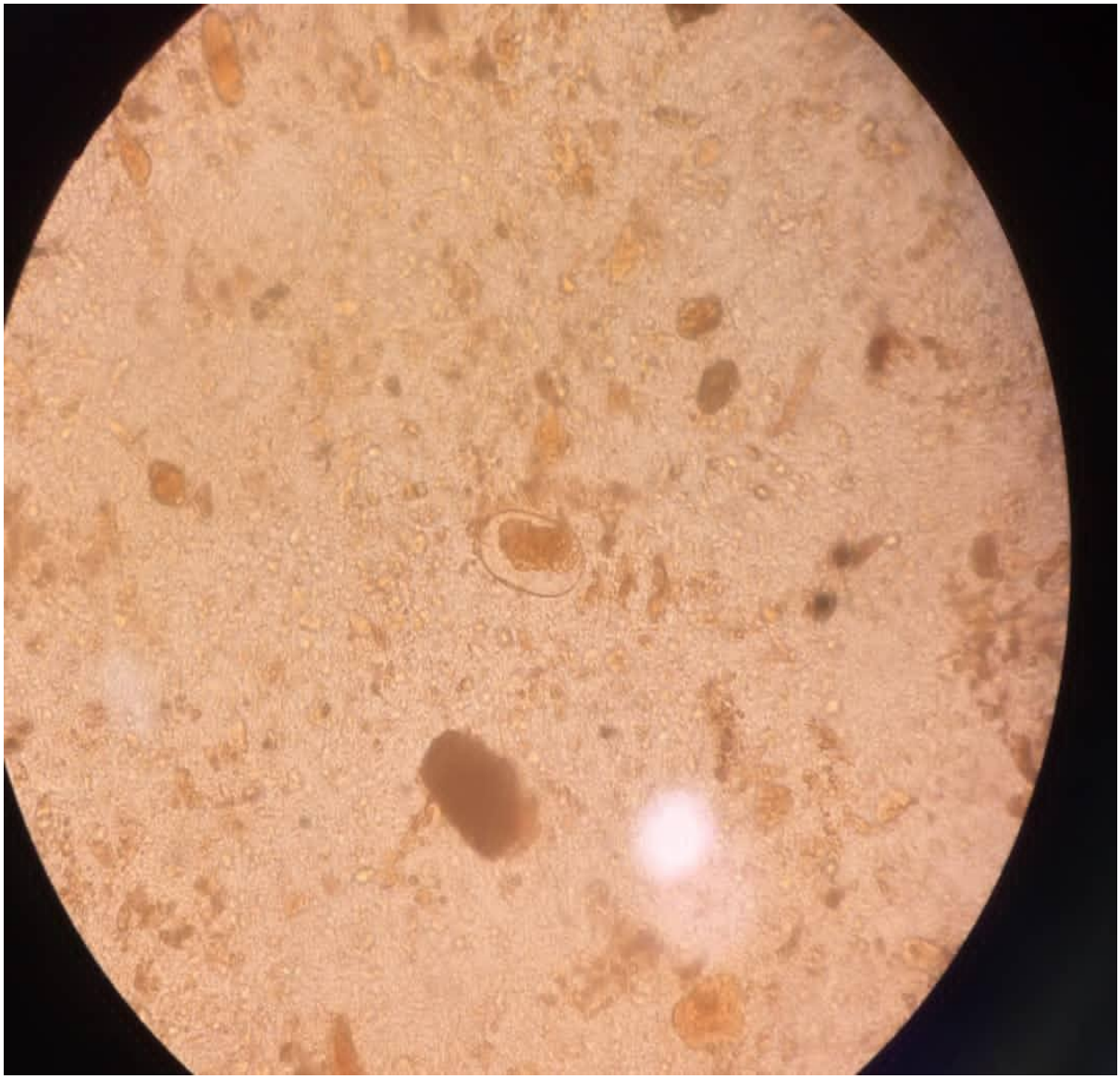
# APPENDIX I


**Stool Samples in Preparation for Microscopic Analysis**

## APPENDIX II

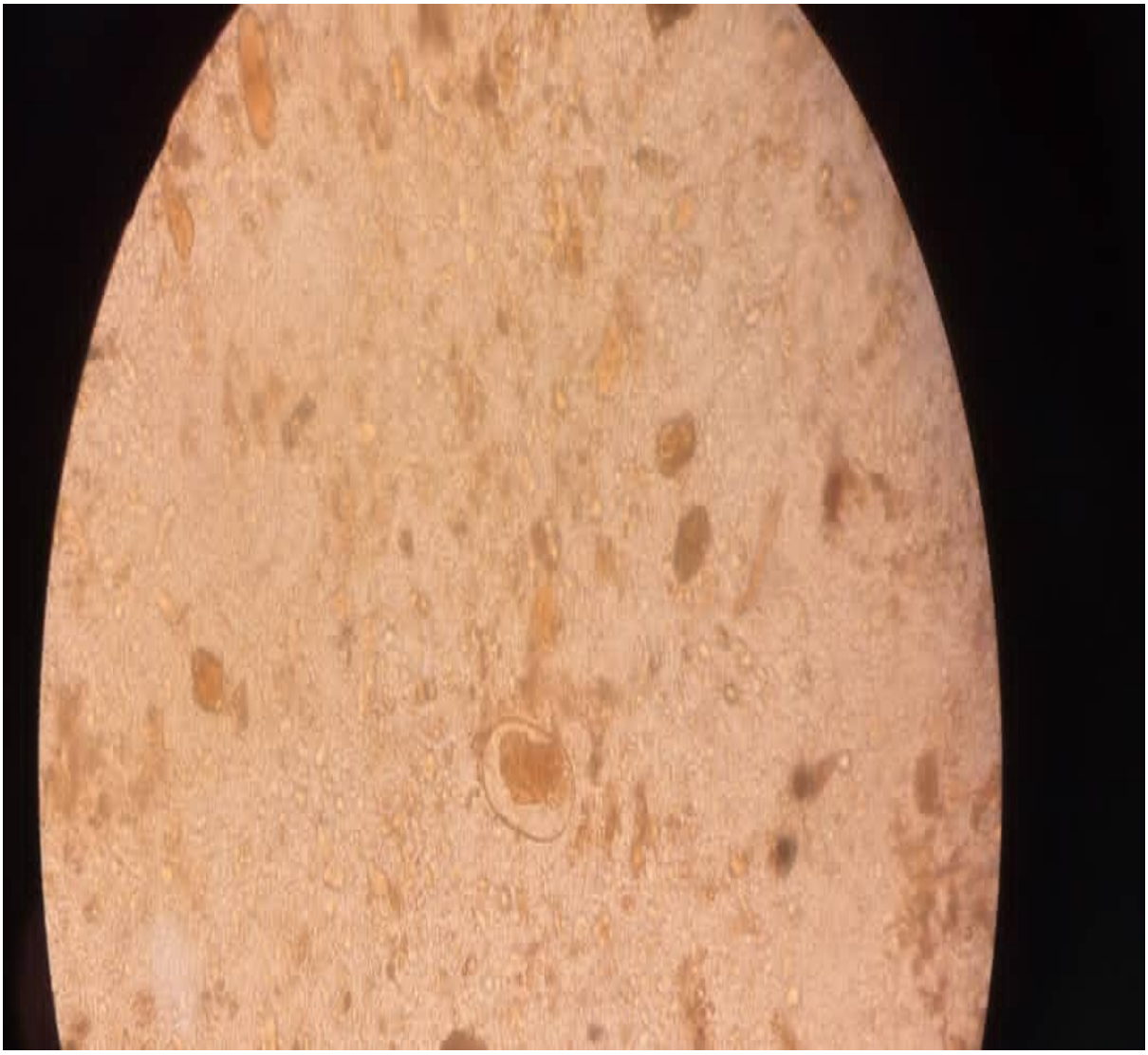

**Stool Samples in Preparation for Microscopic Analysis**

**APPENDIX III**



**A Positive Slide Revealing the Ova of *Ancylostoma Duodenale* in X40 Objective during Research Experiment on Target Samples**

## APPENDIX IV



**Another Positive Slide Revealing the Ova Of *Ancylostoma Duodenale* in X40 Objective during Research Experiment on Target Samples**