STUDIES OF INTESTINAL INFECTIONS AMONG PUPILS IN SEVEN PRIMARY SCHOOLS OF TAMBURAWA, DAWAKIN-KUDU LOCAL GOVERNMENT AREA, KANO STATE NIGERIA

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MARCH, 2015

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By

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(MSC/SCI/1453/2011-12)

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

DEPARTMENT OF BIOLOGICAL SCIENCES
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MARCH, 2015

DECLARATION

I, Rabiu Adamu declare that the work and findings in this thesis titled **"*STUDIES OF INTESTINAL INFECTIONS AMONG PUPILS IN SEVEN PRIMARY SCHOOLS OF TAMBURAWA, DAWAKIN-KUDU LOCAL GOVERNMENT AREA, KANO STATE NIGERIA*"** was carried out and completed by me under thoughtful and lighthearted supervision of Dr. (Mrs.) S. A. Luka and Prof. S. J. Oniye in the Department of Biological Sciences, Ahmadu Bello University, Zaria. All information arises and obtained from previous related literature has been acknowledged in accordance with APA format of citation and referencing. No part of this work was presented elsewhere for the same or different purpose.

Rabiu ADAMU _____ _____

Signature Date

CERTIFICATION

This research work titled **"STUDIES OF INTESTINAL INFECTIONS AMONG PUPILS IN SEVEN PRIMARY SCHOOLS OF TAMBURAWA, DAWAKIN-KUDU LOCAL GOVERNMENT AREA, KANO STATE NIGERIA"** meets the regulations governing the award of the Degree of Master of Science of Ahmadu Bello University, Zaria, and is approved for its contribution and inputs to knowledge and useful literature presentation.

Dr (Mrs.) S. A. Luka Chairman, Supervisory committee Department of Biological Sciences, Ahmadu Bello University, Zaria	_____ Signature	_____ Date
Prof. S.J. Oniye Member, Supervisory Committee Department of Biological Sciences, Ahmadu Bello University, Zaria	_____ Signature	_____ Date
Prof. A. K. Adamu Head of Department Department of Biological Sciences, Ahmadu Bello University, Zaria	_____ Signature	_____ Date
Prof. A. Z. Hassan Dean, School of Postgraduate Studies Ahmadu Bello University, Zaria	_____ Signature	_____ Date

DEDICATION

To the Nigerian children, may the high prevalence of Intestinal infections not deprive you your right for qualitative basic education

ACKNOWLEDGEMENTS

With all the abrupt confusion and dilemma I went through for the death of my senior children overnight, I remain thankful and loyal to God for the courage and mandate He gave me to see the end of this programme.

I have been fortunate to have the support, guidance and supervision of Dr. (Mrs.) S. A. Luka and Prof. S. J. Oniye, their understanding, diligence and objective criticism enable me to defeat my challenges. I pray that God will grant them and their families' the best in their professional carrier. I equally wish all the lectures in the department of Biological Sciences academic excellence throughout their service years in the University environment.

Suleiman Rabiu, Mrs. Kennedy Salomi and Alexandra Jatau were so closed to me the time I was not myself, their love, counseling and courage inspire my heart to the wisdom of Forget and Forgive, to me they are my missing family not classmates. Laboratory scientists at Parasitology and Microbiology laboratories helped in safe keeping, examining and safe disposal of samples in addition to that, the extra hours you spared everyday to allowed me finish the work within the shortest time possible and it is highly appreciated.

I am grateful to Dawakin kudu Local Government Education Secretary (ES) and his team of School Support Officers (SSO) of Tamburawa, Dantube and Darulhuda clusters, for their support and commitment to the work which helped in speedy collections of samples. I valued and respected various meetings held with Parent Teachers Association (PTA), village heads, emirate and local government representatives to educate parents on the purpose, procedure, and number of pupils to be enrolled and the benefits of the research findings to the community.

ABSTRACT

A study of the prevalence of Intestinal infection was conducted among pupils in seven primary schools in Tamburawa, Dawakin kudu local government Area of Kano State, between June, 2013 to January, 2014. Of the 560 samples collected and examined 420 (76.07%) were positive for single or multiple infections. The prevalence of occurrence of each parasite encountered in the study was 142 (25.4%) had Hookworm, 89 (15.9%) *Schistosoma mansoni*, 77 (13.75%), *Entameoeba coli*, 48 (8.57%) Ascaris species, 36 (6.4%) Taenia species, 17 (3.04%) *Trichuris trichiura*, 11 (1.96%) *Enterobius vermicularis* and *Entamoeba histolytica* had 6 (1.07%). The prevalence of the infection was significantly higher among males than females ($p < 0.05$). Children in the age group 10 – 12 years had highest prevalence (87.1%) of Intestinal infections and those between the ages of 4 – 6 years had (69.8%) the least infection. Those children who defeacate in bush were more likely to be infected than those who use modern toilet facility ($R = 0.6$). Analysis of the responses from the questionnaire shows that parents occupation, civil servant (odd ratio = 4.381) and business (odd ratio = 3.147) shows a strong relationship between prevalence of the disease and risk factor in the research area. Walking with bare foot (odd ratio = 2.142) especially in areas where the soil is dump and moist throughout the year exposed the subject to infection. Hand washing activities (odd ratio = 3.71) have statistical significant effect on the prevalence of the infection. Personal hygiene, public health enlightenment programme should be encouraged particularly among school age children.

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ABBREVIATIONS

%	= Percentage
ABU	= Ahmadu Bello University
CDC	= Child Development Centre
DALY	= Disability-adjusted Life Years
DEC	= di-ethyl-carbamazine citrate
ECC	= Early Child Centre
epg	= Egg per gram
GDP	= Gross Domestic Product
HIV	= Human-immune virus
IDM	= Intensified Disease Management
LF	= *Lymphatic filariasis*
NCCLS	= National Committee for Clinical Laboratory Standards
NFHS	= National Family Health Survey
NTD	= Neglected Tropical Diseases
OD	= Odds Ratio
PCT	= Preventive Chemotherapy
Rpm	= Revolution per minute
spp	= Species
STH	= Soil Transmitted Helminth
UNICEF	= United Nations International Children's Fund
WHA	= World Health Assembly
WHO	= World Health Organization
WSP	= Water and Sanitation Programme

aCHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

The soil-transmitted helminths (STH) are group of parasitic nematode worms that causes human infection through contact with parasite eggs or larvae that thrive in warm and moist soil of the world's tropical and subtropical countries (Ukoli, 1997; Steven *et al*., 2003; WHO, 2004). Soil-transmitted helminths refer to the intestinal worms infecting humans and are transmitted through contaminated soil. Examples of such helminths include; *Ascaris lumbricoides* (sometimes called roundworm), whipworm (*Trichuris trichiura*), and hookworm (*Ancylostoma duodenale* and *Necator americanus*) (Abdullahi and Abdulazeez. 2000). A large part of the world's population is infected with one or more of these soil-transmitted helminths: approximately 807-1,121 million with *Ascaris*, approximately 604-795 million with whipworm and approximately 576-740 million with hookworm (Adeyeba and 2002).

Soil-transmitted helminth infection is found mainly in areas with warm and moist climates where sanitation and hygiene are poor, including temperate zones, during warmer months. These STHs are considered Neglected Tropical Diseases (NTDs) because they inflict tremendous disability and suffering yet can be controlled or eliminated (Albonico *et al*., 1999).

Soil-transmitted helminths live in the intestine and their eggs are passed in the faeces of infected persons. If an infected person defecates outside (near bushes, in a garden, or

field) or if the faeces of an infected person are used as fertilizer, eggs are deposited on soil. *Ascaris* and hookworm eggs become infective as they mature in soil (Akogun, 2012). People are infected with *Ascaris* and whipworm when eggs are ingested. This can happen when hands or fingers that have contaminated dirt on them are put in the mouth or by consuming vegetables and fruits that have not been carefully washed, cooked or peeled (Adeyeba and Tijani, 2002). Hookworm eggs are not infective; they hatch in soil, releasing larvae (immature worms) that mature into a form that can penetrate the skin of humans. Hookworm infection is transmitted primarily by walking barefooted on contaminated soil. One kind of hookworm *Ancylostoma duodenale*, can also be transmitted through the ingestion of larvae (Okon and Oku, 2001).

Soil-transmitted helminth infections are among the most common infections worldwide and affect the poorest and most deprived communities. They are transmitted by eggs present in human faeces which in turn contaminate soil in areas where sanitation is poor (Tarafder *et al*., 2010). The main species that infect people are the roundworm (*Ascaris lumbricoides*), the whipworm (*Trichuris trichiura*) and the hookworms (*Necator americanus* and *Ancylostoma duodenale*).

It is estimates that almost 2 billion people are infected with one or more of these soil-transmitted helminths, accounting for up to 40% of the global morbidity from infectious diseases, exclusive of malaria (Bundy, 1995). The greatest numbers of soil-transmitted helminth infections occur in tropical and subtropical regions of Asia, especially China, India and Southeast Asia, as well as Sub-Saharan Africa. Of the 1-2 billion soil-transmitted helminth infections worldwide, approximately 300 million infections result in

severe morbidity, which are associated with the heaviest worm burdens (Bundy, 1988). The public health importance of STH infections ranked highest in morbidity rate among school aged children who often present much heavy worms infections because of their vulnerability to nutritional deficiency (Leykun, 2001). These infections have been shown to impact negatively on the physical fitness and cognitive performance of the pupils. Intestinal obstruction, anaemia, malnutrition, dysentery syndrome, fever, dehydration, vomiting and colitis are the major complications associated with STH infections (Chigozie *et al*., 2007). STH infections affect most frequently children in developing countries and are associated with poor growth, reduced physical activity and impaired learning ability (Adams *et al*., 1994).

According to WHO (1994) more than 1.5 billion people or 24% of the world's population are infected with soil-transmitted helminth infections worldwide. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China and East Asia. Over 270 million preschool-age children and over 600 million school-age children live in areas where these parasites are intensively transmitted, and are in need of treatment and preventive interventions (WHO, 1998). A total of 89.9 million African school–aged children are infected with any species of soil transmitted helminths and forty four per cent of the infections are concentrated in Nigeria, the Democratic Republic of Congo, South Africa and Tanzania (Brooker *et al*., 2009).

In Nigeria, a considerable amount of human and animal wastes are discharged into the soil daily leading to the contamination of the soil with STH eggs and larvae (Ahmed *et al*., 2002). Infection may be direct or indirect through secondary sources such as food, water, vegetables and fruits since most STH infections are acquired through the faecal - oral route. Observations in Zaria, Northern Nigeria showed that 70% of the soil samples collected in a school compound was contaminated with STH eggs showing the level to which the soil can be contaminated with faeces (Nock *et al*., 2007).

In Nigeria, a lot of work has been carried out over the years in different parts of the country on the prevalence of intestinal helminthes and its associated diseases among many groups of people. Ahmed, *et al*., (2003) reported that 30.8% of students in Katsina were infected with at least one intestinal helminthes. Also, prevalence of intestinal helminthes in some patients in Zaria has been reported to be 1.67% for *Strongyloids stercoralis* only and 62.7% of other helminthes (Abdullahi and Abdulazeez, 2000). However, little is known about the infection status of intestinal helminthes among primary school children in Tamburawa, Dawakin-kudu Local Government Area, Kano State. This study aimed to survey the prevalence of intestinal infections among pupils in seven primary schools of the Local Education Authority (LEA) in Dawakin-kudu Educational district.

1.2 Statement of the Research Problems

Intestinal infections are a major health problem in many developing countries. It is estimated that more than one billion of the world's population, including at least 400

million school-age children are chronically infected with soil-transmitted helminths such as *Ascaris lumbricoides*, *Trichuris trichiura*, and the hookworms, *Ancylostoma duodenale* and *Necator americanus* (WHO, 2014). School-age children infected with soil-transmitted helminths usually have malnutrition, growth stunting, intellectual retardation, and cognitive and educational deficits (WHO, 2010a). Clearly, soil-transmitted helminth infections remain an enormous public health problem in the 21st century. Soil-transmitted helminths are also known to be an important cause of morbidity and sometimes mortality in developing tropical countries, particularly among pediatrics age group (WSP, 2012).

Although a lot of work has been done on the prevalence of intestinal infections in most parts of Nigeria, to the best of my knowledge studies on prevalence of intestinal infections among pupils in seven primary schools in Tamburawa, Dawakin-Kudu Local Government Area, Kano State, Nigeria has not been investigated.

1.3 Justification

The research will provide a baseline information on the status of Intestinal infections among pupils in seven primary schools of Tamburawa, Dawakin-Kudu Local Government Area, Kano State, Nigeria from which the magnitude of the infection will be defined towards prompt intervention to save the lives of primary school pupils of Tamburawa, Dawakin-Kudu Local Government Area, Kano State, Nigeria thereby reducing the rate of transmission.

1.4 Aim

The aim of the study was to assess the prevalence of Intestinal infections among pupils in seven primary schools of Tamburawa, Dawakin-Kudu Local Government Area, Kano State, Nigeria.

1.5 Objectives

The objectives were to determine the following:

1. Prevalence of Intestinal infections among pupils in seven primary schools of Tamburawa.
2. Association between Intestinal infections and age and sex of pupils in seven primary schools of Tamburawa.
3. The association between Intestinal infections and risk factors.

1.6 Hypotheses

The study was designed to test the following hypotheses;

1. Intestinal infection is not prevalent among pupils in seven primary schools of Tamburawa, Dawakin-Kudu Local Government Area, Kano State.
2. There is no significant association between Intestinal infections and age and gender

3. There is no significant association between Intestinal infections and risk factors.

1.7 Significance of the Study

The study will provide useful information on Intestinal infections of human among pupils in seven primary schools of Tamburawa village in Dawakin-kudu distinct of Kano State. The study will also help in making appropriate intervention program and as well enables decision makers to institute possible preventive measures in the village, however, the data obtained will serve as firsthand information useful for further research study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 An Overview of Intestinal Infections

Intestinal infections refers to a group of parasitic diseases in humans caused by intestinal roundworms such as hookworms (*Ancylostoma duodenale* and *Necator americanus*), ascaris (*Ascaris lumbricoides*), and whipworm (*Trichuris trichiura*), collectively called soil-transmitted helminths (STHs), which are transmitted through contaminated soil. It has become the most common parasitic infection of humans worldwide. Approximately two billion people (about a third of global population) are infected as of the latest estimate, and four billion at risk, surpassing even the all-time most prevalent parasitic disease, malaria (WHO, 2013). The largest numbers of cases occur in impoverished rural areas of Sub-Saharan Africa, Latin America, Southeast Asia, and China (WHO, 2001). It is regarded as one of the world's most important causes of intellectual and physical retardation (Bethony *et al.*, 2006).

The helminthic disease is so named because the infection is transmitted through ingestion of the nematode eggs in the soil, which is contaminated through excrements. Therefore, the disease is most prevalent in warm and moist climates where sanitation and hygiene are poor and waters are unsafe, including the temperate zones during warmer months. STH is categorised among Neglected Tropical Diseases because it inflicts tremendous

disability and suffering, which can be clinically treated, yet negligible attention has been given for many years. It is now among the target diseases of *London Declaration on Neglected Tropical Diseases* (launched on 30 January 2012) to be controlled/eradicated by 2020 (London Declaration, 2002).

2.2 Types of Intestinal Infections

Soil-transmitted helminths are caused by four major groups of nematodes, namely

- Ascaris (*Ascaris lumbricoides*)
- Whipworm (*Trichuris trichiura*)
- Hookworms (*Ancylostoma duodenale* and *Necator americanus*)
- Pinworm/Threadworm *Strongyloides stercoralis* (Harhay *et al*., 2010).

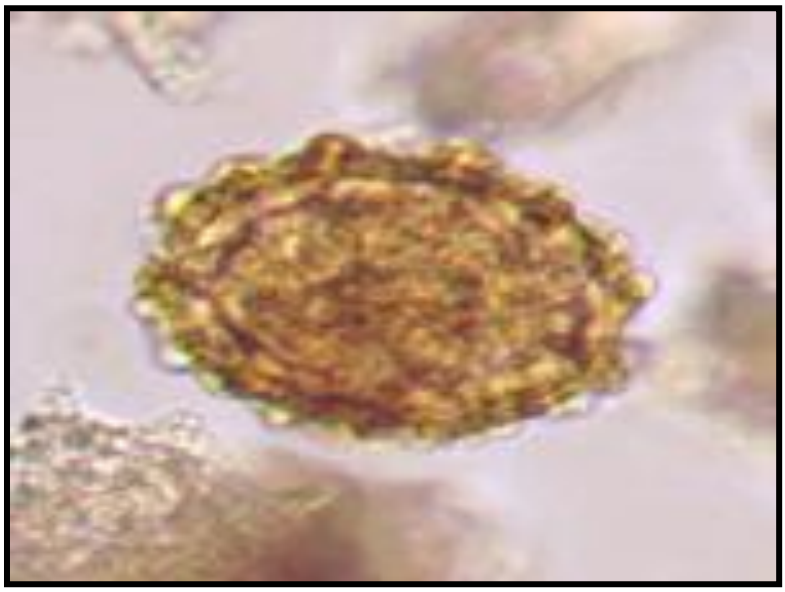
2.2.1 Roundworms (*Ascaris lumbricoides*)

Ascaris lumbricoides is the giant roundworm of humans, growing to a length of up to 35 cm (Figure 1). An ascarid nematode of the phylum Nematoda, it is the largest and most common parasitic worm in humans, responsible for the disease ascariasis. One-sixth of the human population is estimated to be infected by *A. lumbricoides* or another roundworm. Ascariasis is prevalent worldwide, especially in tropical and subtropical countries (Harhay *et al*., 2010). *Ascaris lumbricoides*, a roundworm that infects in humans occur when an ingested fertilised egg (Figure 2A and 2B) becomes a larval worm that penetrates the wall of the duodenum and enters the blood stream. From here, it is carried to the liver and heart, and enters pulmonary circulation to break free in the alveoli, where it grows and molts. In 3 weeks, the larvae pass from

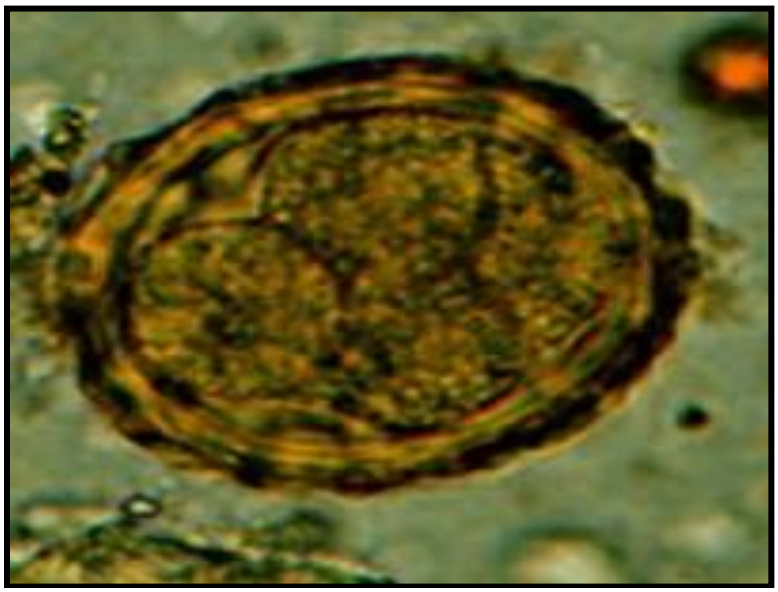
the respiratory system to be coughed up, swallowed, and thus returned to the small intestine, where they mature to adult male and female worms.

Source: WHO 2010

Figure 1; Adult geohelminths



A



B

Figure 2: *Ascaris lumbricoides* egg
A; Embryonated egg
B; Unembryonated egg
Source: Hotez *et al.*, 2009

Fertilization can now occur and the female produces as many as 200,000 eggs per day for a year. These fertilized eggs become infectious after 2 weeks in soil; they can persist in soil for 10 years or more (Murray *et al*., 2005).

The eggs have a lipid layer which makes them resistant to the effects of acids and alkalis as well as other chemicals. This resilience helps to explain why this nematode is such a ubiquitous parasite Fertilized eggs are oval to round in shape and are 45-75 micrometers long and 35-50 micrometers wide with a thick outer shell. Unfertilized eggs measure 88-94 micrometers long and 44 micrometers wide (Roberts *et al*., 2009).

Ascaris lumbricoides is characterized by its great size. Males are 2–4 mm in diameter and 15–31 cm long. The males' posterior end is curved ventrally and has a bluntly pointed tail. Females are 3–6 mm wide and 20–49 cm long. The vulva is located in the anterior end and accounts for about a one third of its body length. Uteri may contain up to 27 million eggs at a time with 200,000 being laid per day (Piper, 2007).

More than 2 billion people are affected by this infection (Murray *et al*., 2009). In the United States there is a reported prevalence of 0.8% of the total population as of 1987. *Ascaris lumbricoides* eggs are extremely resistant to strong chemicals, desiccation, and low temperatures. The eggs can remain viable in the soil for several months or even years

(Roberts *et al*., 2009). Eggs of *A. lumbricoides* have been identified in archeological coprolites in the Americas, Europe, Africa, the Middle East, and New Zealand, the oldest ones being more than 24,000 years old (Dridelle, 2010).

Ascariasis is a disease caused by the parasitic roundworm *Ascaris lumbricoides*. Infections have no symptoms in more than 85% of cases, especially if the number of worms is small (Dold *et al*., 2011). Symptoms increase with the number of worms present and may include shortness of breath and fever in the beginning of the disease (Al-Eissa *et al*., 2011). These may be followed by symptoms of abdominal swelling, abdominal pain and diarrhea. Children are most commonly affected, and in this age group the infection may also cause poor weight gain, malnutrition and learning problems (Anthony *et al*., 2013).

Infection occurs by eating food or drink contaminated with *Ascaris* eggs from faeces. The eggs hatch in the intestines, burrow through the gut wall, and migrate to the lungs via the blood (Hagel and Giusti, 2010). There they break into the alveoli and pass up the trachea, where they are coughed up and swallowed. The larvae then pass through the stomach for a second time into the intestine where they become adult worms (WHO, 2010b).

Prevention is by improved sanitation, which includes improving access to toilets and proper disposal of faeces (Hagel *et al.*, 2010). Hand washing with soap appears protective. In areas where more than 20% of the population is affected, treating everyone

at regular intervals is recommended (Dold and Holland, 2011). Reoccurring infections are, however, common there is no vaccine. Treatments recommended by the World Health Organization are medications albendazole, mebendazole or levamisole. Other effective agents include tribendimidine and nitazoxanide (Hotez *et al*., 2010). About 0.8 to 1.2

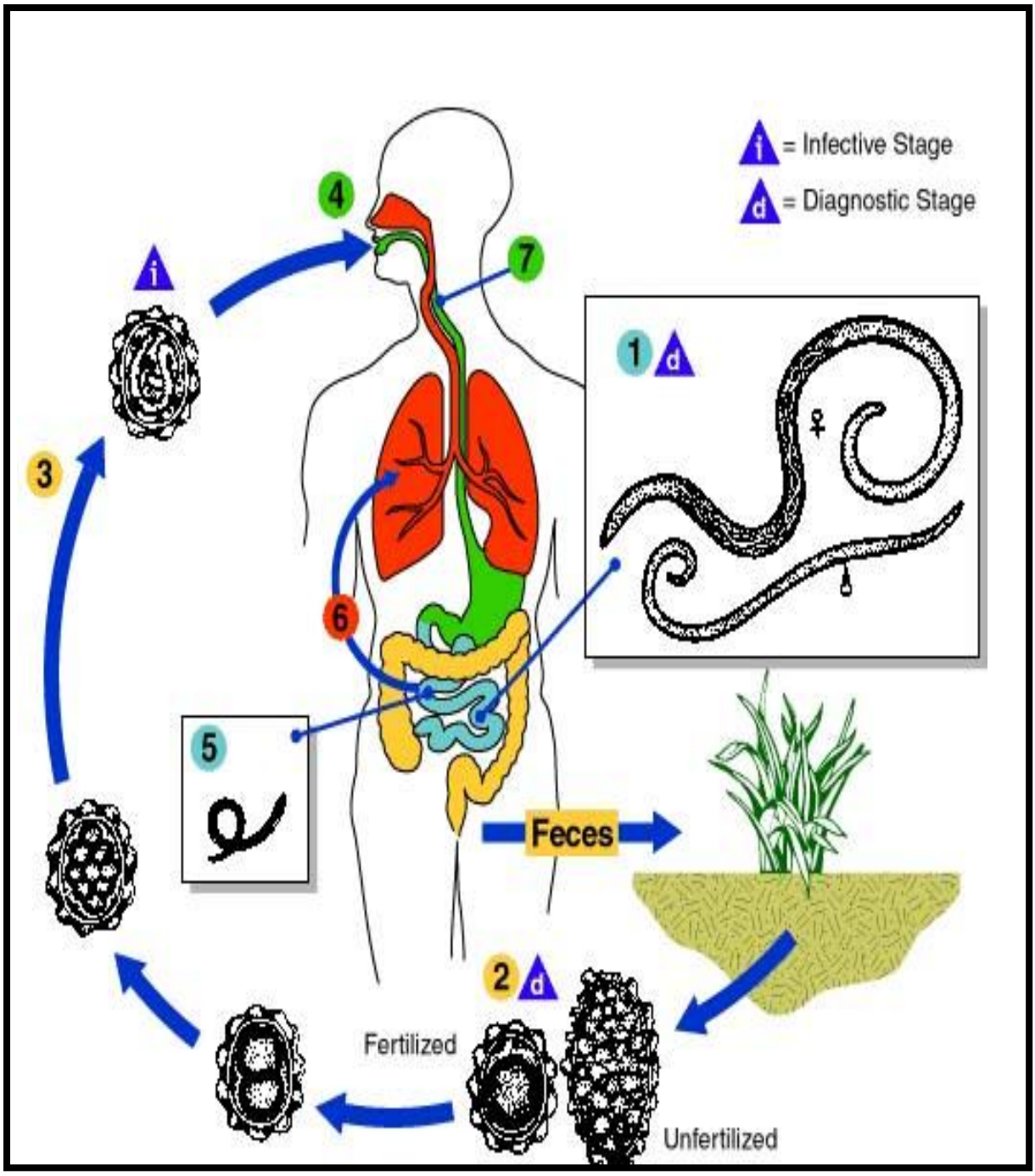


Figure 3; Life cycle of *Ascaris lumbricoides*

Source: De Silver *et al.*, 2003

billion people globally have ascariasis with the most heavily affected populations being in sub-Saharan Africa, Latin America, and Asia. This makes ascariasis the most common form of soil-transmitted helminthiasis. As of 2010 it caused about 2,700 deaths down from 3,400 in 1990. Another type of *Ascaris* infects pigs (WHO, 2012).

Most infected people have no symptoms. It is common to find that most people are infected by a small number of worms, while a small number of people are heavily infected, something that is characteristic of many worm infections (Dridelle, 2010). Clinical features depend on the affected body site. As larval stages travel through the body, they may cause visceral damage, peritonitis and inflammation, enlargement of the liver or spleen, and an inflammation of the lungs. Pulmonary manifestations take place during larval migration and may present as Loffler's syndrome a transient respiratory illness associated with blood eosinophilia and pulmonary infiltrates with radiographic shadowing (WHO, 2013). The worms in the intestine may cause malabsorption and anorexia which contribute to malnutrition. The malabsorption may be due to a loss of brush border enzymes, erosion and flattening of the villi, and inflammation of the lamina propria (Bethony *et al.*, 2006). The worms can occasionally cause intestinal blockage when large numbers get tangled into a bolus or they may migrate from the small intestine, which may require surgery. More than 796 *Ascaris lumbricoides* worms weighing up to 550 g [19 ounces] were recovered at autopsy from a 2-year-old South African girl. The worms had caused torsion and gangrene of the ileum, which was interpreted as the cause of death (WHO, 2013). Bowel obstruction may occur

in up to 0.2 per 1000 per year (Chigozie *et al.*, 2007). Sometimes the worm blocks the Ampulla of Vater or goes into the main pancreatic duct resulting in acute pancreatitis with raised serum levels of Amylase and Lipase. Occasionally they can travel through the billiary tree and even into the gallbladder causing acute cholangitis or acute cholecystitis (WSP. 2012).

Ascaris takes most of its nutrients from the partially digested host food in the intestine. There is some evidence that it can secrete anti-enzymes, presumably to protect itself from digestion by the hosts' enzymes. Children are often more severely affected (Akogun, 2012). Ascariasis may result in allergies to shrimp and dustmites due to the shared antigen, tropomyosin, though this has not been confirmed in the laboratory. *Ascaris* have an aversion to some general anesthetics and may exit the body, sometimes through the mouth (Ziegelbauer *et al*., 2012).

2.2.2 Hookworm (*Ancylostoma duodenale* and *Necator americanus*)

Ancylostoma duodenale is small cylindrical worm, greyish-white in color. It has two ventral plates on the anterior margin of the buccal capsule. Each of them has two large teeth that are fused at their bases. A pair of small teeth can be found in the depths of the buccal capsule. Males are 8 mm to 11 mm long with a copulatory bursa at the posterior end. Females are 10 mm to 13 mm long, with the vulva located at the posterior end; females can lay 10,000 to 30,000 eggs per day. The average lifespan of *Ancylostoma duodenale* is one year (Nock *et al.*, 2007).

When a filariform larva (infective stage) penetrates the intact skin, the larva enters the blood circulation. It is then carried to the lungs, coughed up, and swallowed back into the

small intestine. The larva later matures into an adult in the small intestine and female worms can lay 25,000 eggs per day. The eggs are released into the faeces and reside on soil. Embryonated eggs on soil will hatch into juvenile 1 stage (rhabditiform or noninfective stage) and mature into filariform larvae. The filariform larvae can then penetrate another exposed skin and begin a new cycle of infection (Tarafder *et al*., 2010).

Ancylostoma duodenale is prevalent in southern Europe, northern Africa, India, China, and Southeast Asia, small areas of United States, the Caribbean islands, and South America. This hookworm is well known in mines because of the consistency in temperature and humidity that provide an ideal habitat for egg and juvenile development. It is estimated 1 billion people are infected with hookworms. Transmission of *Ancylostoma duodenale* is by contact of skin with soil contaminated with larvae (Adeyeba and Tijani, 2002).

Hookworm disease**,** also called ancylostomiasis, or uncinariasis, a parasitic infestation of humans, dogs, or cats caused by bloodsucking worms living in the small intestine sometimes associated with secondary anemia (Chigozie *et al*., 2007). Several species of hookworm can cause the disease. *Necator americanus,* which ranges in size from 5 to 11 millimeters (0.2 to 0.4 inch), is responsible for about 90 percent of human hookworm infections that occur in tropical and subtropical regions of the world (Keiser *et al*., 2008). *Ancylostoma duodenale* 8 to 13 millimeters long is found on all continents but is most prevalent in warm regions (Anthony *et al*., 2013). *A. braziliense,* from 8 to 11 millimeters long, is normally parasitic in dogs and cats; man, however, is sometimes

infected by this species in the southern United States, South America, and Asia (WHO, 2010a).

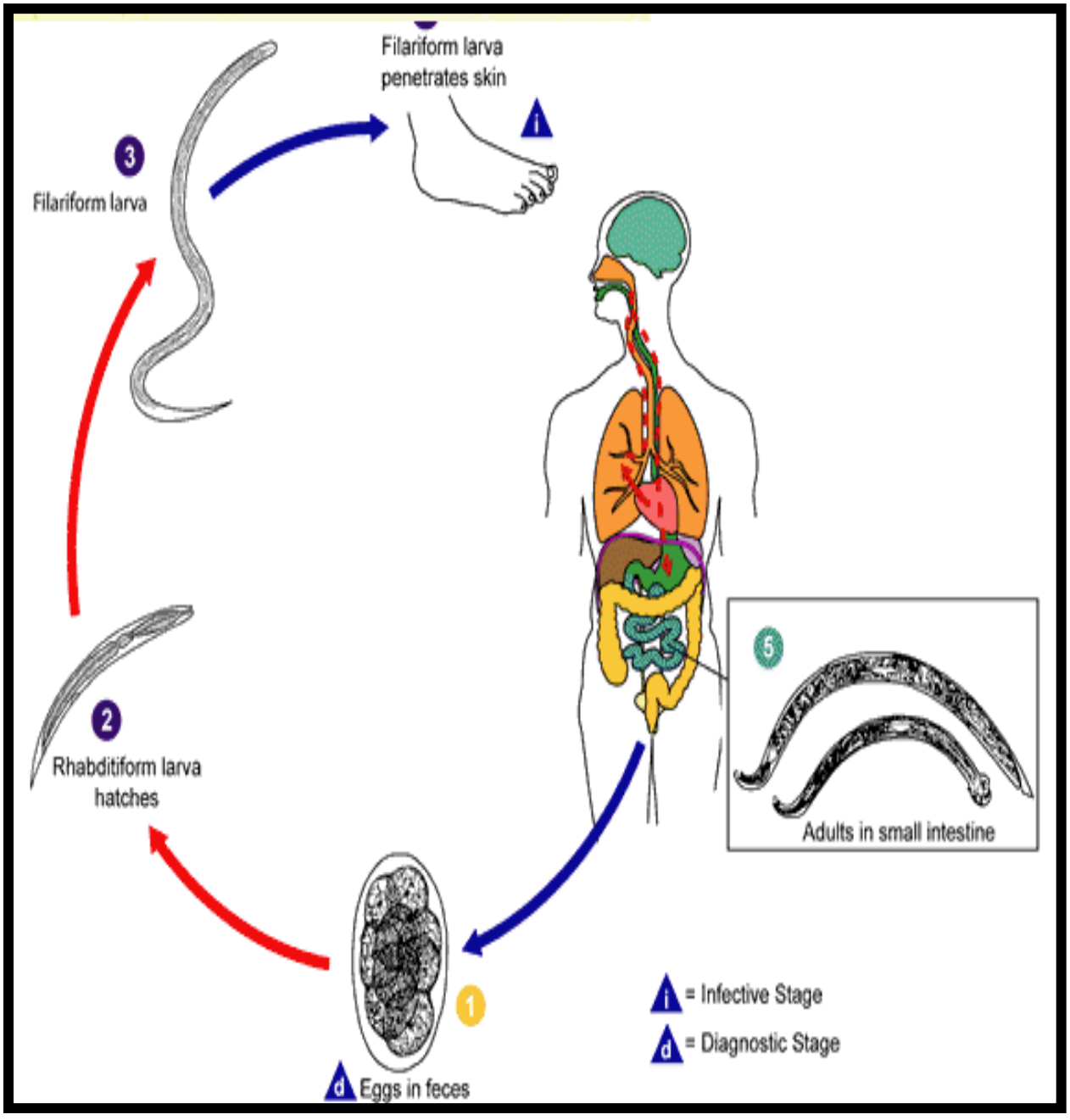


Figure 4; Life cycle of Hookworm (*Ancylostoma duodenale* and *Necator americanus*)
Source: NCCLS, 1997

A. ceylanicum, normally parasitic in dogs, is sometimes found in man in South America and Asia. *A. duodenale* possesses four hooklike teeth in its adult stage, and *N. americanus* has plates in its mouth rather than teeth (Bundy, 1995). Both species of hookworm have similar life cycles. The adult worm attaches itself to the mucosal tissue lining the small intestine, where the female may produce several thousand eggs a day, which are passed in the faeces (Andrade *et al*., 2012). If the fecal matter reaches suitable soil, the eggs are hatched, and the infective, threadlike larvae may penetrate human skin, usually that of the foot, by way of the sweat glands and hair follicles (Marsh, 2002). They then invade the lymph and blood vessels, reach the lungs, and pass up the respiratory tree to reach the mouth, where they are swallowed and sent to the small intestine; there they mature and start a new reproductive cycle. The intestinal parasites are reputedly long-lived, with a lifetime that may span some 10 years (Keiser, 2008).

The symptoms of hookworm disease ordinarily begin with ground itch, an itchy skin irritation caused by the larvae when they penetrate the skin and marked by papules and vesicles that are often located between the toes (Genta and Woods, 2009). In passing through the lungs, the larvae may produce coughing and fever. In the intestine, the mature worm sustains its life by blood sucking, and persistent feeding by many worms over many years result in secondary anemia (Hotez *et al*., 2010). In heavy infestations (which may involve more than 500 larvae), the general symptoms include pallor of the skin and mucous membranes, fluid retention in the face and extremities, constipation

alternating with diarrhea, abdominal tenderness, increased appetite for bulky or strange substances (*e.g.,* clay), delayed puberty and stunted growth, fatigue, dullness, and apathy.

Hookworm infestation tends to be constantly widespread in tropical and subtropical regions of the world; moisture, warmth, loose soil, promiscuous defecation, and absence of shoes are the chief factors responsible for infection (Gilles, 1996). One single oral dose of tetrachlorethylene on an empty stomach will remove about 90 percent of the *Necator*. Bephenium hydroxynaphthoate is especially effective against *Ancylostoma*. Iron supplements and a diet high in protein will speed recovery. Immediate prognosis is good, but the likelihood of reinfection constitutes a major health problem (WHO, 2012). Periodic mass treatment of the population has been used in some hookworm control programs. The prevention of hookworm disease consists of ensuring the sanitary disposal of human excreta (Genta and Woods, 2009).

Estimates of the number of people in the world infected with blood-sucking hookworms ranges from 800 million to 1.25 billion people (WHO, 2012), with at least 1.6 million suffering from significant anemia and 65,000 deaths annually. Forty-four million pregnant women are infected with hookworms, increasing their risk of iron deficiency anemia and related adverse effects on fetal growth, prematurity, and below normal birth weight (Pritchard *et al*., 1990). Despite these staggering statistics, there is reason for hope, since hookworms are readily eradicated by albendazole, mebendazole and other anthelmintics. Spectacular results reported by the WHO (2012) in Zanzibar, where over 99% of children harbor hookworms, prove that regular deworming increases their weight and height, improves iron stores, and reduces iron deficiency anemia, preventing the loss

of 250 ml of blood per child per year at a cost of only 15 U.S. cents. By the year 2,000 intestinal helminth control programs should be implemented in at least 50% of endemic countries (WSP, 2012).

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

Probably the earliest references to hookworm disease go back to the papyrus papers of ancient Egypt (1600 B.C.), where it was described as a derangement characterized by anemia. Avicenna, a Persian physician of the 11th century, discovered the worm in several of his patients and related it to their disease. During the 19th century, the relationship between hookworms and anemia was established, and the disease became a focus of special concern in 1880 when it caused several fatal epidemics among miners in France and Germany. In 1897, it was established that the skin was the principal avenue of infection and the life cycle of the hookworm was clarified (Carroll and Grove, 1986). In 1899, Stiles discovered that the "progressive pernicious anemia" seen in the southern United States was caused by *Ancylostoma duodenale*, and at the same time he defined two distinct species of hookworm capable of infecting man: *Uncinaria (Ancylostoma) duodenale* (the Old World hookworm) and *Uncinaria (Necator) americanus* (the New

World hookworm). This newly found American species undoubtedly originated in Africa and was brought to the Americas during the slave trade (Carroll and Grove, 1986).

2.2.3 Whipworm (*Trichuris trichiura*)

The human whipworm (*Trichuris trichiura or Trichocephalus trichiuris*) is a round worm that causes trichuriasis when it infects a human large intestine. It is commonly known as the *whipworm* which refers to the shape of the worm; it looks like a whip with wider "handles" at the posterior end (Hayes, 2010).

The female *T. trichiura* produces 2,000–10,000 single-celled eggs per day (Hayes, 2010). Eggs are deposited from human faeces to soil where, after two to three weeks, they become embryonated and enter the “infective” stage. These embryonated infective eggs are ingested and hatch in the human small intestine exploiting the intestinal microflora as hatching stimulus (Comption, 1999). This is the location of growth and molting. The infective larvae penetrate the villi and continue to develop in the small intestine. The young worms move to the caecum and penetrate the mucosa and there they complete development to adult worms in the large intestine.

The life cycle from time of ingestion of eggs to development of mature worms takes approximately three months. During this time, there may be limited signs of infection in stool samples due to lack of egg production and shedding. The female *T. trichiura* begin to lay eggs after three months of maturity (WHO, 2012). Worms can live up to five years, during which time females can lay up to 20,000 eggs per day (Comption, 1999).

Recent studies using genome-wide scan revealed two quantitative trait loci on chromosome 9 and chromosome 18 may be responsible for genetic predisposition or susceptibility to infection of *T. trichiura* by some individuals. *Trichuris trichiura* has a narrow anterior esophageal end and shorter and thicker posterior anus. These pinkish-white worms are threaded through the mucosa. They attach to the host through their slender anterior end and feed on tissue secretions instead of blood. Females are larger than males; approximately 35–50 mm long compared to 30–45 mm (De Silva *et al*., 2003). The females have a bluntly round posterior end compared to their male counterparts with a coiled posterior end. Their characteristic eggs are barrel-shaped and brown, and have bipolar protuberances.

There is a worldwide distribution of *Trichuris trichiura*, with an estimated 1 billion human infections. However, it is chiefly tropical, especially in Asia and, to a lesser degree, in Africa and South America. Within the United States, infection is rare overall but may be common in the rural Southeast, where 2.2 million people are thought to be infected. Poor hygiene is associated with trichuriasis as well as the consumption of shaded moist soil, or food that may have been fecally contaminated. Children are especially vulnerable to infection due to their high exposure risk. Eggs are infective about 2–3 weeks after they are deposited in the soil under proper conditions of warmth and moisture, hence its tropical distribution (De Silva *et al*., 2003).

Trichuriasis also known as whipworm infection is an infection by the parasitic worm *Trichuris trichiura* (whipworm). If infection is only with a few worms, there are often no symptoms.

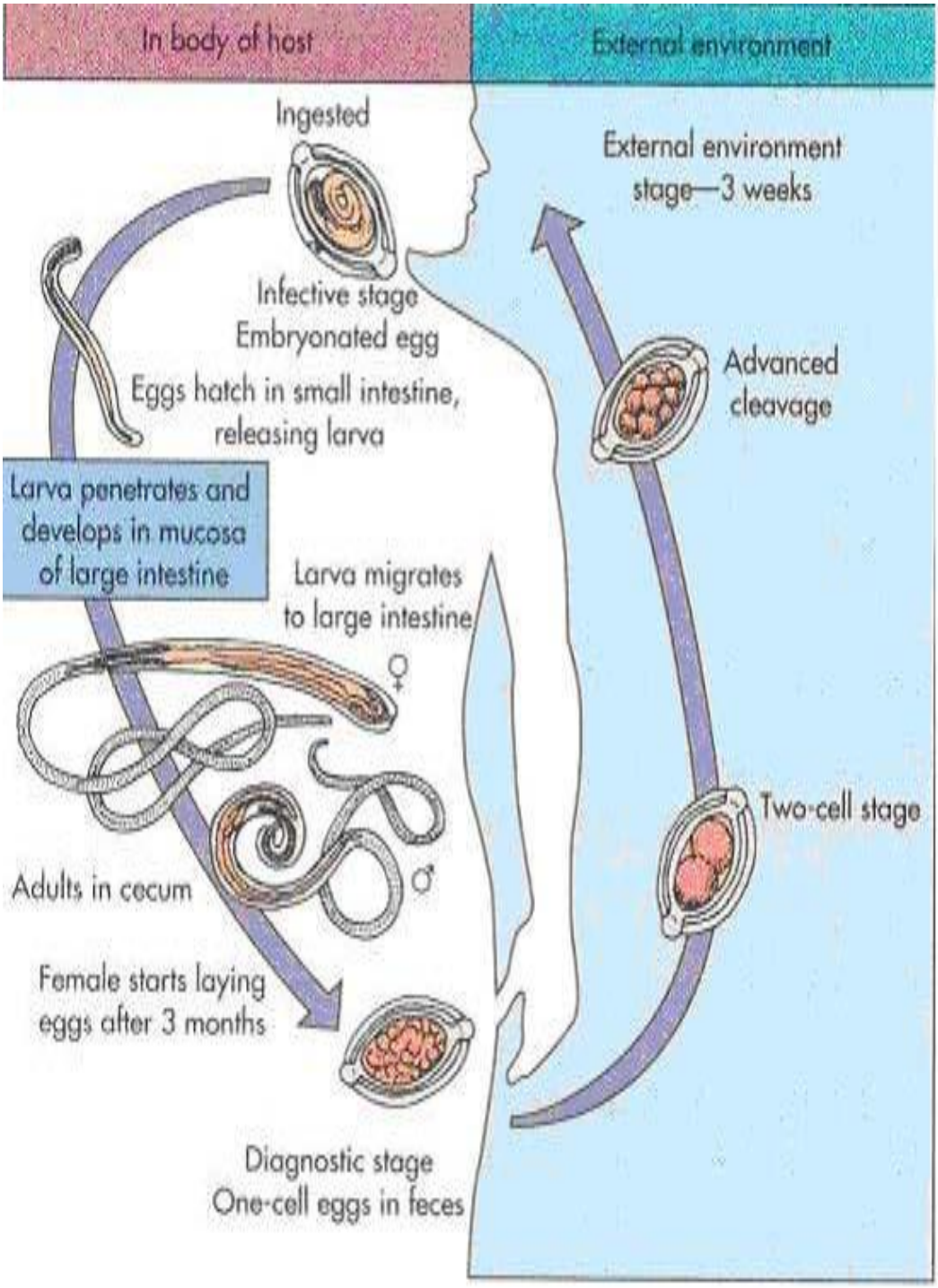


Figure 5; Life cycle of (Whipworm) *Trichuris trichiura*

Source: WHO 2012

In those who are infected with many worms, there may be abdominal pain, tiredness and diarrhea. The diarrhea sometimes contains blood (Bethony *et al*., 2006). Infections in children may cause poor intellectual and physical development. Low red blood cell levels may occur due to loss of blood (De Silver *et al*., 2012). The disease is spread by people eating food or water that contains the eggs of these worms. The eggs are in the faeces of people infected with the worms and the disease is most common in areas of the world where human faeces are used as fertilizer. The worms live in the large bowel and are about four centimeters in length. Whipworm is diagnosed by seeing the eggs when examining the stool with a microscope. Eggs are barrel-shaped (WHO, 2014).

Prevention is by properly cooking food and hand washing before cooking. Other measures include improving access to toilets and clean water. In areas of the world were the infections are common, often entire groups of people will be treated all at once and on a regular basis. Treatment is with three days of the medication albendazole, mebendazole or ivermectin. People often become infected again after treatment (Ziegelbauer *et al*., 2012).

Whipworm infection affects about 600 to 800 million people. It is most common in tropical countries. In the developing world those infected with whipworm often also have hookworms and ascariasis infections. They have a large effect on the economy of many countries. Work is ongoing to develop a vaccine against the disease (Ziegelbauer *et al*., 2012).

Light infestations (<100 worms) frequently have no symptoms. Heavier infestations, especially in small children, can present gastrointestinal problems including abdominal

pain and distension, bloody or mucus-filled diarrhea, and tenesmus (feeling of incomplete defecation, generally accompanied by involuntary straining). While damage may be done to the GI tissue and appendicitis may be brought on (by damage and edema of the adjacent lumen) if there are large numbers of worms or larvae present, it has been suggested that the embedding of the worms into the ileo-cecal region may also make the host susceptible to bacterial infection. Severe infection may also present with rectal prolapse, although this is typically seen only in heavy infections of small children. High numbers of embedded worms in the rectum cause edema, which causes the rectal prolapse. The prolapsed, inflamed and edematous rectal tissue may even show visible worms (Jia *et al*., 2012).

Growth retardation, weight loss, nutritional deficiencies, and anemia (due to long-standing blood loss) are also characteristic of infection, and these symptoms are more prevalent and severe in children. It does not commonly cause eosinophilia.

Coinfection of Trichuris trichiura with other parasites is common and with larger worm burdens can cause both exacerbation of dangerous trichuriasis symptoms such as massive gastrointestinal bleeding (shown to be especially dramatic with co infection with Salmonella typhi) and exacerbation of symptoms and pathogenesis of the other parasitic infection (as is typical with coinfection with Schistosoma mansoni, in which higher worm burden and liver egg burden is common) (Jia *et al*., 2012). Parasitic coinfection with HIV/AIDS, tuberculosis, and malaria is also common, especially in Sub-saharan Africa, and helminth coinfection adversely affects the natural history and progression of HIV/AIDS, tuberculosis, and malaria and can increase clinical malaria severity. In a

study performed in Senegal, infections of soil-transmitted helminths like Trichuris trichiura (as well as Schistosome infections independently) showed enhanced risk and increased incidence of malaria (Fenwick, 2012).

1. Heavy infestations may have bloody diarrhea.
2. Long-standing blood loss may lead to iron-deficiency anemia.
3. Rectal prolapse is possible in severe cases.
4. Vitamin A deficiency may also result due to infection.

Mechanical damage to the mucosa may occur as well as toxic or inflammatory damage to the intestines of the host (Jamison, 2006).

2.2.4 Pinworm or Threadworm (*Strongyloides stercoralis*)

Strongyloides stercoralis is the scientific name of a human parasitic roundworm causing the disease of strongyloidiasis. Its common name is threadworm. In the UK and Australia, however, the term *threadworm* can also refer to nematodes of the genus *Enterobius*, otherwise known as pinworms (Vanderkooi, 2000). The *Strongyloides stercoralis* nematode can parasitize humans. The adult parasitic stage lives in tunnels in the mucosa of the small intestine. The genus *Strongyloides* contains 53 species (Speare, 1989) and *S. stercoralis* is the type species. *S. stercoralis* has been reported in other mammals, including cats and dogs (Skerratt, 1995). However, it seems that the species in dogs is typically not *S. stercoralis*, but the related species *S. canis*. Non-human primates are more commonly infected with *S. fuelleborni* and *S. cebus*, although *S. stercoralis* has been reported in captive primates. Other species of *Strongyloides*,

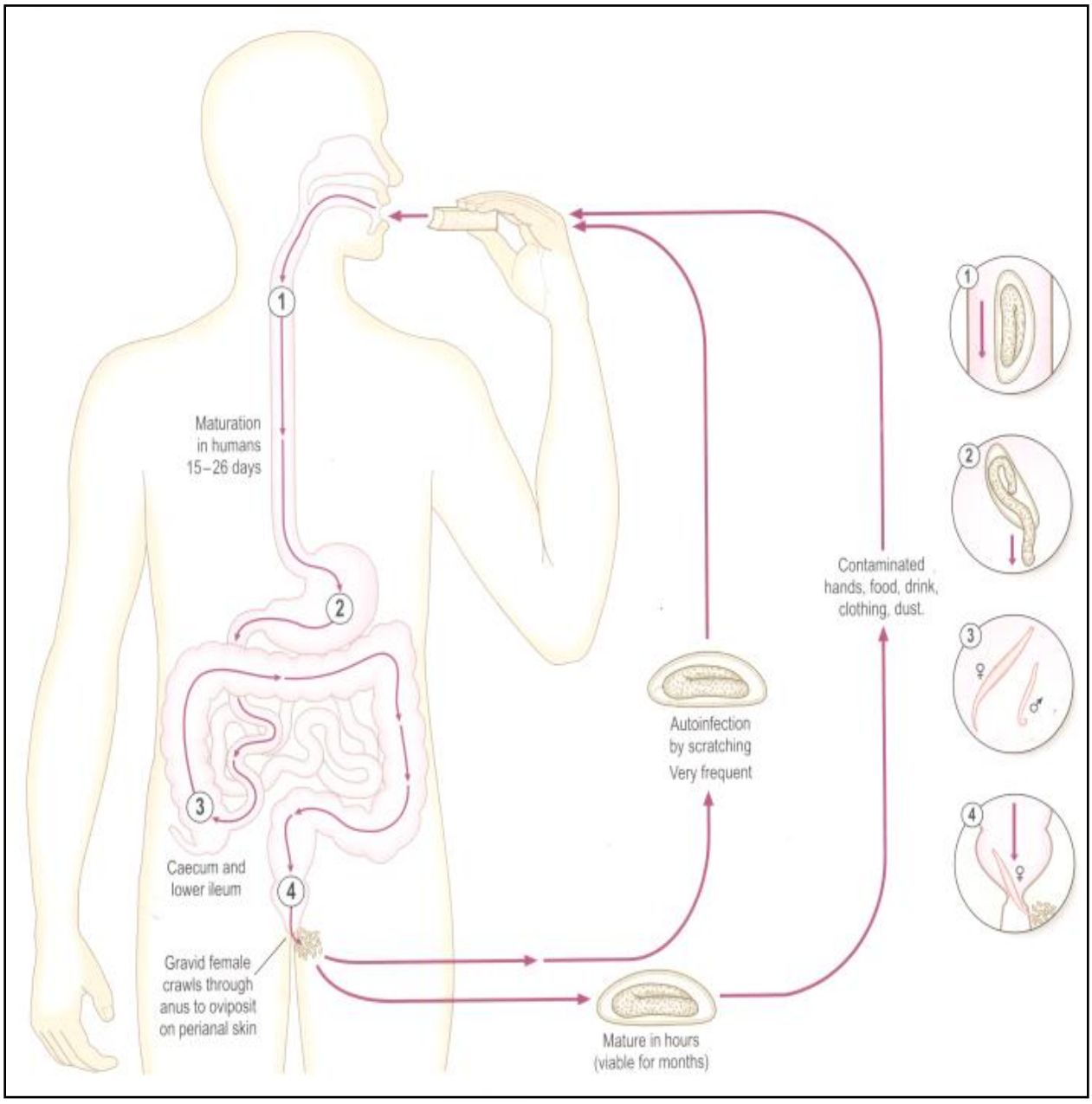


Figure 6; Life cycle of Pinworm or Threadworm (*Strongyloides stercoralis*)
Source: WHO, 2013

naturally parasitic in humans, but with restricted distributions, are *S. fuelleborni* in central Africa and *S. kellyi* in Papua New Guinea (Speare, 1989).

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

Strongyloidiasis was first described in the 19th century in French soldiers returning home from expeditions in Indochina. Today, the countries of the old Indochina (Vietnam, Cambodia, and Laos) still have endemic strongyloidiasis, with the typical prevalences being 10% or less. Regions of Japan used to have endemic strongyloidiasis, but control programs have eliminated the disease. Strongyloidiasis appears to have a high prevalence in some areas of Brazil and Central America. It is endemic in Africa, but the prevalence is typically low (1% or less). Pockets have been reported from rural Italy, but current status is unknown. In the Pacific islands, strongyloidiasis is rare, although some cases have been reported from Fiji. In tropical Australia, some rural and remote Australian Aboriginal communities have very high prevalences of strongyloidiasis (Johnson *et al*., 2005).

In some African countries (e.g., Zaire), *S. fuelleborni* was more common than *S. stercoralis* in parasite surveys from the 1970s, but current status is unknown. In Papua New Guinea, *S. stercoralis* is endemic, but prevalence is low. However, in some areas, another species, *S. kellyi* (Dorris *et al*., 2002), is a very common parasite of children in

the New Guinea Highlands and Western Province. Knowledge of the geographic distribution of strongyloidiasis is of significance to travelers who may acquire the parasite during their stays in endemic areas (Dorris *et al*., 2002). Because strongyloidiasis is transmittable by textiles, such as bedclothes and clothing, care must be taken never to use hotel bed sheets in endemic areas. Personal sleeping bags and using plastic slippers when showering are very important when travelling in tropical regions (Skerratt, 1995). An unusual feature of *S. stercoralis* is autoinfection. Only one other species in the *Strongyloides* genus, *S. felis*, has this trait. Autoinfection is the development of L1 into small infective larvae in the gut of the host. These autoinfective larvae penetrate the wall of the lower ileum or colon or the skin of the perianal region, enter the circulation again, travel to the lungs, and then to the small intestine, thus repeating the cycle. Autoinfection makes strongyloidiasis due to *S. stercoralis* an infection with several unusual features (Speare, 1989). Persistence of infection is the first of these important features. Because of autoinfection, humans have been known to still be infected up to 65 years after they were first exposed to the parasite (e.g., World War II or Vietnam War veterans). Once a host is infected with *S. stercoralis*, infection is a lifelong unless effective treatment eliminates all adult parasites and migrating autoinfective larvae (Johnson *et al*., 2005).

2.3 Epidemiology and burden of disease

A heartbreaking fact of STH is that children are most affected. The World Bank 2013 says STHs cause more ill health in school-age children (age 5–15 years) than any other infection in deprived communities. Nigeria as the most populous country in Africa its huge population, coupled with the absence of basic social amenities, auspicious climatic environment, and weak public health infrastructure favour the transmission of soil

transmitted helminths (Hotez *et al*., 2009a; Hotez *et al*., 2009b; UNICEF, 2011). Malnutrition caused by STHs has a significant impact on growth and physical development in addition to their nutritional effects, soil transmitted helminth infections impair cognitive development, limit educational advancement and hinder economic development (Chigozie *et al*., 2007). The World Health Organization 2012 estimates that nearly 890 million children of all ages are living in areas where these parasites are transmitted easily and believe that all of them deserve treatment and prevention. Some cultural practices favour spread of infection, the use of water for cleaning after defecation, and communal feeding from a common bowl in open street yard, a usual practice also account for a high prevalence of soil transmitted helminthes (Iyor, 2006; Akogun, 2012). Meals are often exposed to the wind, insects and domestic animals which may contaminate food with helminth ova while participants in the communal dinner are awaited and however, majority of the country is warm and moist for most of the year creating a good environment for the parasites to develop all year round (Obiamiwe, 1991; Ayanwale *et al*., 2011; Anthony *et al*., 2013).

Soil-transmitted helminthes infections are widely distributed throughout the tropics and subtropics. Climate is an important determinant of transmission of these infections as proposed by Crompton, Pierce and Miller (2010), with adequate moisture and warm temperature essential for larval development in the soil. Equally important determinants are poverty and inadequate water supplies and sanitation. In such conditions, soil transmitted helminth species are commonly co endemic (Cooper, 2012). There is evidence that individuals with many helminth infections have even heavier infections

with soil transmitted helminths. Because morbidity from these infections and the rate of transmission are directly related to the number of worms harboured in the host, intensity of infection is the main epidemiological index used to describe soil-transmitted helminth infection (Wani *et al*., 2007). Marsh 2002 explained the intensity of infection is measured by the number of eggs per gram of faeces, generally by the Kato-Katz faecal thick-smear technique. For *A lumbricoides* and *T trichiura*, the most intense infections are in children aged 5–15 years, with a decline in intensity and frequency in adulthood. Although heavy hookworm infections also occur in childhood, frequency and intensity commonly remain high in adulthood, even in elderly people (World Bank, 2013).

Intestinal infections are often referred to as being "over dispersed" in endemic communities, such that most worms are harboured by a few individuals in an endemic area. There is also evidence of familial and household aggregation of infection with the relative contribution of genetics and common household environment debated in 1998 by Patney and Andrews, thus, estimates of annual deaths from soil-transmitted helminth infection vary widely, from 1 200 025 to as many as 13 500 026. Because these infections cause more disability than death, the worldwide burden, as for many neglected tropical diseases, is typically assessed by disability-adjusted life years (DALY). Since the first DALY estimates were provided, there has been much variability in quoted estimates partly because of different emphases on the cognitive and health effects. The lower estimates assume that most hookworm cases do not result in severe anemia or pronounced protein loss by the host, whereas the higher estimates show the long-term results of infection such as malnutrition and delayed cognitive development, especially in

children (Nacher *et al.*, 2001). For these reasons, school-aged children have been the major targets for anthelminthic treatment, and the scale of disease in this age group was pivotal in leveraging support for school-based control.

One of the principal factors contributing to children morbidity and mortality in the tropical countries is the high prevalence of intestinal infections. These infections have been associated with low standard of sanitation as well as poverty, and approximately 480-500 million children are infected and mortality ranges from 40,000 to 130,000 persons per year (Steven *et al*., 2003). School age children are one of the groups at high-risk for intestinal infections. The adverse effects of intestinal parasitic infections among children are diverse and alarming. Intestinal parasitic infections have detrimental effects on survival, appetite, growth, school attendance and cognitive performance of school age children (Girum, 2005). Estimation of over one billion of the world population including 400 million school children are chronically infected with *Ascaris lumbricoides, Trichuris trichiura* and the Hookworms (WHO, 2012).

2.4 Transmission of Intestinal infections

Intestinal infections are transmitted by eggs that are passed in the faeces of infected people. Adult worms live in the intestine where they produce thousands of eggs each day. In areas that lack adequate sanitation, these eggs contaminate the soil. This can happen in several ways:

- Eggs that are attached to vegetables are ingested when the vegetables are not carefully cooked, washed or peeled;
- Eggs are ingested from contaminated water sources;
- Eggs are ingested by children who play in soil and then put their hands in their mouths without washing them (WHO, 2013).

In addition, hookworm eggs hatch in the soil, releasing larvae that mature into a form that can actively penetrate the skin. People become infected with hookworm primarily by walking barefoot on the contaminated soil (Dorris *et al*., 2002). There is no direct person-to-person transmission, or infection from fresh faeces, because eggs passed in faeces need about three weeks to mature in the soil before they become infective. Since these worms do not multiply in the human host, reinfection occurs only as a result of contact with infective stages in the environment (WHO, 2013).

2.5 Prevalences of Intestinal infections in Nigeria.

In Nigeria, a lot of work has been carried out over the years in different parts of the country on the prevalence of intestinal helminthes and its associated diseases among many groups of people. Ahmed, *et al*., (2003) reported that 30.8% of students in Katsina were infected with at least one intestinal helminthes. Also, prevalence of intestinal helminthes in some patients in Zaria has been reported to be 1.67% for *Strongyloids stercoralis* only and 62.7% of other helminthes (Abdullahi and Abdulazeez, 2000). The high percentage of children with severe infection with STH is clinically important because problems associated with this infection are proportional to the worm burden. Other complications of soil-transmitted helminthiasis, such as intestinal obstruction in

severe ascariasis, or dysentery and rectal prolapsed in severe *trichuriasis*, have been reported in Southern Nigeria by Nwosu (2010), in Ibadan by Ayanwale (2011) and Bauchi in 2012 by Akogun.

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

In Nigeria, however, various baseline surveys have been carried out to estimate the status of soil transmitted infections (De Silva, 2003; Wani, 2007; UNICEF, 2007). This study was undertaken to add to the growing pool of essential baseline data on the prevalence and intensity of soil transmitted helminth infection in Nigeria. These infections have been

associated with low standard of sanitation as well as poverty, and approximately 480-500 million children are infected and mortality ranges from 40,000 to 130,000 persons per year (UNICEF, 2007). In 2006, the World Health Organization (WHO) launched a new strategy against helminth infections, based on the concept of preventive chemotherapy. According to this recommendation, anthelminthic drugs should be distributed to all individuals at risk of infection, with the aim of reducing the intensity of infection and, as such, to prevent or reduce morbidity associated with the infection. In large-scale preventive chemotherapy interventions, drugs are administered to the entire population in a given endemic administrative setting (state, region, province, district, etc.), or to groups at highest risk, at regular intervals. Anthelminthic drugs can be administered alone or in combination according to the disease or the diseases targeted. To treat the three types of helminth infections discussed here the following drugs are used: praziquantel against schistosomiasis, albendazole (or mebendazole) against STH and a combination of ivermectin and albendazole or ivermectin and di-ethyl-carbamazine citrate (DEC) against LF. Considering that the three diseases are frequently co-endemic, praziquantel, albendazole and ivermectin can also be co-administered to the same individual at the same time (Hotez *et al*., 2009a). Anthelminthic drugs have beneficial effects beyond the diseases targeted: ivermectin for example can also treat ectoparasite infections such as lice and scabies, thus expanding the beneficial effect and compliance linked to its large-scale distribution (Roberts *et al*., 2009) It is well established that severe hookworm infection can lead to iron deficiency anemia (Hopkins *et al.,* 1997; Schad and Warren, 2000; Engels *et al.,* 2002; Genta and Woods, 2009; Andrade, 2012; Anthony *et al.,* 2013). Trichuriasis, with or without concomitant ascariasis, has been associated with

malnutrition, iron deficiency anemia and growth stunting (Layrisse *et al.*, 2006; Dold and Holland, 2011; Cooper *et al.,* 2012). Severe ascariasis has been associated with malnutrition (Thein-Hlaing *et al.,* 1991; Sakti *et al.,* 1999; Roberts *et al.,* 2009). It has also been reported that ascariasis was responsible for 42.0% and 41.0% of all acute abdominal emergencies and intestinal obstruction, respectively, in children aged 7 years and below admitted to Hospitals in Nigeria (WSP, 2012).

2.6 Age and Sex related prevalence

Studies in Nigeria shows that the age-related prevalence of *A. lumbricoides* and *T. trichiura* is not significantly dependent on age and therefore these infections do not show age prevalence convexity (Chigozie *et al*., 2007; Nmorsi *et al*., 2009). This finding is in contrast to the results of previous studies carried out in Malaysia, (Bundy *et al,* 1988; Chan *et al,* 2010). The high prevalence and mean epg counts for ascariasis and trichuriasis in the younger age group was the reason why age-prevalence convexity and age-mean epg convexity were not seen in this study. Thus, in endemic areas where infection occurs at a very early age and re-infection is continuous throughout life, the prevalence and mean epg counts tend to be very high (Engels *et al*., 2002). In contrast, the prevalence and mean epg counts for hookworm showed a significant increase with age and convexity with age. The differences in mode of infection and infectious stages with *A. lumbricoides* and *T. trichiura* may explain why hookworm infection tends to occur in older age groups and shows convexity with age (Hotez and Molyneux, 2009) .. However, a weak positive correlation was also seen between hookworm and *T. trichiura* despite the different mode of transmission. This suggests that both the prevalence and

mean epg counts in an infection are important factors in this correlation (Anthony *et al*., 2013). A similar trend in correlation has been reported before in Malaysia as well as in studies conducted in other countries (Gilles, 2005; Fenwick, 2012). Intestinal parasitic infections affect childhood development and morbidity in many developing countries. Reducing the prevalence of parasitic infections in school children, may be of tremendous benefit on child growth, development and educational outcome. Helminthes are complex eukaryotic organisms with large genomes, endowing some species with the ability to live for decades in human host (Murray *et al*., 2009). There are about 20 major helminth infections of humans, affecting more than one third of the world's population (Chigozie *et al*.,, 2007) and the most common ones that account for most of the global helminth disease burden in many sub-Saharan African countries including Nigeria are ascariasis, trichuriasis, strongyloidiasis, taeniasis, schistosomiasis and hookworm infections (Bethony *et al*., 2006; Fenwick *et al*., 2012). It is common for the host-parasite interplay to seem harmonious, and clinically asymptomatic helminth carriers act as long term reservoirs for transmission. About 7 % of the helminth-infected patients suffer severe and permanent impairments of immunopathological complications such as granulomatous disease and organ failure (Crompton *et al*., 2010; Dold *et al*., 2011). Helminth infections have also been shown to play a significant role in anaemia and childhood malnutrition, which often leads to growth retardation, poor intellectual development and impaired cognitive function, resulting in a poorer quality of life and less ability to contribute to society (Crompton *et al*., 2010 and Auta *et al*., 2013).

2.7 Diagnosis of Intestinal Infections

For basic diagnosis, specific helminths can be generally identified from the faeces, and their eggs microscopically examined and enumerated using faecal egg count method. However, there are certain limitations such as the inability to identify mixed infections, and on clinical practice, the technique is inaccurate and unreliable (Hotez *et al*., 2010). A novel effective method for egg analysis is the Kato-Katz technique. It is a highly accurate and rapid method for *A. lumbricoides* and *T. trichiura*; however not so much for hookworm, which could be due to fast degeneration of the rather delicate hookworm eggs (WHO, 2014).

2.8 Prevention

For basic diagnosis, specific helminths can be generally identified from the faeces, and their eggs microscopically examined and enumerated using faecal egg count method. However, there are certain limitations such as the inability to identify mixed infections, and on clinical practice, the technique is inaccurate and unreliable (Hotez *et al*., 2010). A novel effective method for egg analysis is the Kato-Katz technique. It is a highly accurate and rapid method for A. lumbricoides and T. trichiura; however not so much for hookworm, which could be due to fast degeneration of the rather delicate hookworm eggs (WHO, 2014).

Several countries have launched their helminthiasis control programs and made progress towards achieving de-worming coverage rates of 75% of school-age children (Uneke, 2001). An assessment of the prevalence of infection is instrumental in determining who has to be treated (high-risk groups or entire communities); and information about the

number of people at-risk to be treated is needed to appropriately implement preventive chemotherapy interventions. For many countries, however, no systematic source of data exists information is frequently scattered across literature, and often only estimates of prevalence are available the situation is, however, different between one disease and another (Engels *et al.*, 2002). There is also an apparent lack of current, up-to-date data for helminth infections in the African Region (WHO, 2010b). The availability of data is in clear imbalance with the magnitude of the problem in Sub-Saharan Africa, 50.8% of the districts in the African Region for which data were found on STH prevalence had data from year 2000 onwards in contrast to South East Asia and Western Pacific Regions, in which 81.5% and 67.1% of the districts had data from year 2000 onwards. This reflects the fact that most territories in South East Asia and Western Pacific have ongoing STH anthelminthic drug distribution programs and report data on prevalence regularly (Keiser *et al*., 2008). Attempts on retrieving epidemiological data on soil transmitted helminthiasis should therefore focus strictly on Sub-Saharan Africa (WHO, 2010). The burden of these helminth infections has been consistently underestimated in the past, but there is now a general consensus that STH infections and schistosomiasis represent an important public health problem especially for children (Keiser *et al*., 2008; WHO, 2010; Jia *et al*., 2012; WSP, 2012).

In 2001, the World Health Assembly (WHA) passed a resolution urging member states to control the morbidity of soil-transmitted helminth infections through large-scale use of anthelminthic drugs for school-aged children in less developed countries. A response to this resolution could establish one of the largest worldwide health initiatives ever undertaken. However, such widespread and frequent use of anthelminthic could lead to

drug resistance or at least a decline in effectiveness of these front-line drugs in the long-term battle with soil-transmitted helminths (Bundy 1995; Brooker *et al*., 2009). The WHO (2012) recommendation aims at reaching all individuals at risk of helminth infection in an endemic area without carrying out individual diagnosis and identification of target areas is based on population-based assessment of the endemic status of such area. Information about prevalence of a given infection in a given district is the key indicator in making the decision whether large-scale preventive chemotherapy should be carried out against that disease or not. While a standard interval of re-treatment is recommended for preventive chemotherapy interventions against STH, prevalence is also used to determine the appropriate frequency of drug administration. This is based on the fact that re-infection rates will be higher where the prevalence of infection is higher. Therefore a less-frequent treatment is warranted in order to keep the worm burden in infected individuals low (Nacher, 2001). However, monitoring changes in prevalence are an important tool for evaluation of mass-drug administration programs, and are used as an indicator to measure the impact of preventive chemotherapy interventions on morbidity and transmission (Hotez and Kamath, 2009a).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1. Study area

The study was carried out in Tamburawa, Dawakin Kudu Local Government Area of Kano State which was named after the Gadar-Tamburawa River. Dawakin Kudu is located in the south-eastern part of Kano state. This local government lies between latitude 11°00′N to 12°00′N and longitude 8°00′E to 8°44′E and mean altitude of 486.5′M above sea level. Dawakin Kudu shares boundary with Kumbotso local government to the North West, Gezawa local government to the north east, Warawa Local Government to the east, Wudil Local Government Area to the south east, Bunkure local government area to south and Kura Local Government Area to the south west. Dawakin Kudu local government area falls within Kano central as well as Sudan savanna agro-ecological zone of Nigeria (Katama *et al*., 2010). The climate of the area is described as tropical climate, which is characterized by two distinct seasons, the dry season and rainy season with temperature that is hot during the dry season and cool during the rainy season, from November to February the cold dry hamarttan wind blows across the district. Generally the rains start in April and end in October. The area has tropical grassland (savannah). The people of this area are Hausa and Fulani and most of them are farmers, mostly cultivating crops like; Sorghum, Millet, Groundnuts, Cowpea and Maize. Seven Primary Schools were visited namely; Tamburawa central Primary School, Gurjiya Primary School, Tudun Bayero Primary School, Fagi Primary School, Daginawa Primary School, Dantube Primary School and Unguwar Na'ibi Primary School.

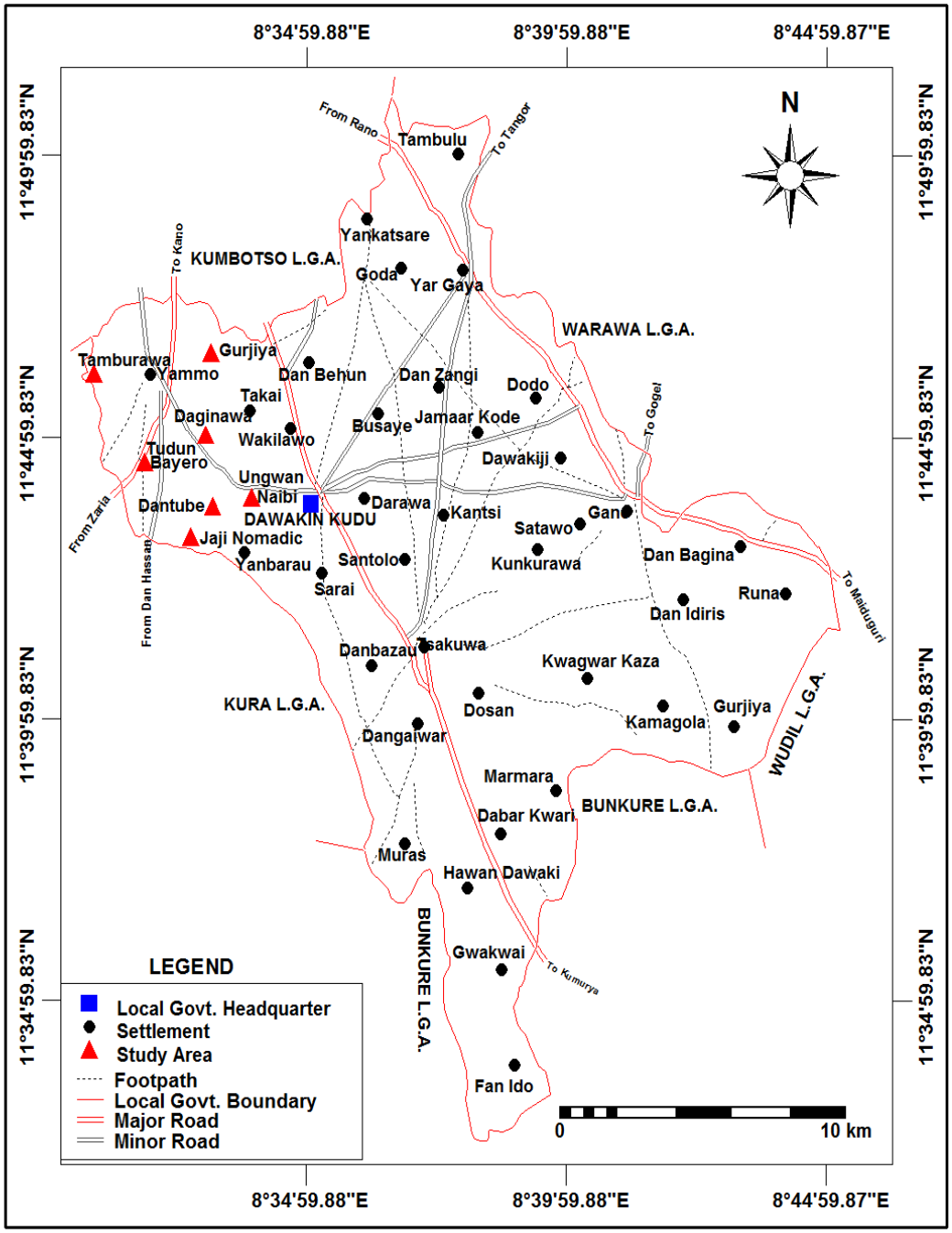


Figure 7: Dawakin Kudu Local Government Area Showing the Study Areas

Source: Adopted and Modified from Dawakin Kudu Local Government Area Map 2013

3.2 Study population

The study population consisted of seven registered primary school children of ages between 6 to 15 years because they form most accessible age group and most vulnerable to STH infection community. A questionnaire were administered to survey the pupils data such as age, type of toilet available, sex, hand washing habit, water sources, and occupation of parents or guardians. Ethical approval for the study was granted by the Educational Secretary of Dawakin-Kudu educational district in addition head and school teachers. Those who refused to give consent were excluded from the study.

3.3 Sample Size Determination

Information is very scarce on the prevalence on soil-transmitted helminths infection among primary school pupils in Kano State. A projected prevalence rate of 40% based on the previous study of Michael *et al*. (2012) was used to determine the sample size. The sample size was determined according to Daniel (1999). The advantage of this formula over other formulae is to get an optimum or adequate sample size because unnecessarily large sample is not cost-effective. In some circumstances it is unethical (Daniel, 1999).

$$N = \frac{Z^2 pq}{L^2}$$

Where;

N = sample size

Z = standard normal distribution at 95% Confidence Interval = 1.96

P = prevalence of 40% (0.4 from Michael *et al*. (2012)

q = 1 – p = (1- 0.4) = 0.6

L = the allowable error, which is taken as 5% = 0.05

Substituting the values in the formula;

$$N = \frac{(1.96)^2 \times 0.4 \times 0.6}{(0.05)^2}$$

$$\frac{3.8416 \times 0.4 \times 0.6}{0.0025}$$

N= 368.79 approximately 369

Therefore, 369 is the minimum number of samples that was to be collected however a total of five hundred and sixty (560) samples were randomly collected from seven primary schools based on the availability of samples.

3.4 Selection of schools and children

A random sampling method was used to select the primary schools. Schools selected are those located close to each other and to the ponds and/or river of Tamburawa, where transmission of Helminth may be high. Communities surrounding the selected schools are mainly involved in subsistence farming of corn, maize, cotton, millet, sweat potatoes, rice cassava and vegetables. They also practice small scale animal husbandry (cattle, goat, sheep and chicken). Few people have small scale businesses. Because of close proximity to the river, communities also practice fishing and also obtain water for most of their domestic needs from the river. Seven primary schools were selected namely Tamburawa, Gurjiya, Tudun Bayero, Fagi nomadic, Daginawa, Dantube and Unguwan- Na'ibi. The schools selected were located within a distance of 1 to 3 kilometer from Gadar Tamburawa River under Dawakin kudu Local Education Authority (DKLEA). In each primary school, all children in primary one and Early Child Center (ECC) classes were randomly selected.

3.5 Ethical considerations

Before commencement of the project, the researcher conducted meetings with Education Secretary (ES), leaders and head teachers of all selected villages during which the objectives of the study was explained. The village leaders convened village meetings

during which sensitization of the communities was carried out. During these meetings, the objectives of the study including the study procedures to be followed, samples to be taken, study benefits and potential risks and discomforts were explained. Informed consent for children to participate in the study was sought from parents and legal guardians after they have been clearly informed about the study. This investigation commenced by first reaching out to the heads of the seven schools explaining the objectives, possible outcome and benefits of the research. Consents were obtained from the heads of the schools, parents and their class teachers. Children were informed of their right to refuse to participate in the study and to withdraw at any time during the study without jeopardizing their right.

3.6 Collection of Samples

All pupils that consented to the study were enrolled by collection of their survey bio-data within the months of January to May, 2013. Children that have received anti-helminthic drugs (randomly and infrequently distributed by State and Local Government Authority) within the past three months in all the schools were excluded from the study. A labelled sterile universal plastic bottle with pupil's serial number and bio-data was given to each pupil. They were then given sample collection instruction that was done in the local language of the pupils for understanding. These samples were preserved using 10% formalin and taken to the Parasitology laboratory of Biological Sciences Department, Ahmadu Bello University, Zaria as soon as received in a carton.

3.6.1 Questionnaire

A questionnaire was administered to each of the selected pupils to obtain information from them on the following: Class, age, sex, whether hands were washed after using toilet, whether fruits and vegetables were washed before eating, source of drinking water, water contact activities parent's occupation and possession of pets at home as well as method of waste disposal.

3.6.2 Inclusion criteria

1. Primary schools in Tamburawa village close to each other and close to the ponds or river.
2. In each selected school, pupils in primary one and Early Child Center (ECC) classes were included in the study.

3.6.3 Exclusion criteria

1. Children whose parents or legal guardians did not provide informed consent.
2. Children who received treatment or dewormed before the period of study

3.7 Laboratory Analysis of Samples

Microscopic examination was done on each sample as soon as they reached the laboratory using Formol-Ether concentrations Technique. This method has the advantage of removing lipid and colloidal materials to yield clear sediment (Murray *et al*., 2009). In addition, the presence of formalin preserves eggs, larvae and cysts so that the material can be examined hours or even days later. This was used to assess the diarrhoeic

condition of the sample. Particular attention was paid to watery, loose or formed stools including presence of mucus and blood in stool. Wet preparation of each sample was done using normal saline and examined immediately. Ridley modified Formol ether concentration technique (Cheesbrough, 1987) was used to improve on the recovery of the ova and larvae of helminth parasites from the samples that were missed in wet preparation. The sediments were examined by placing one drop each on the centre of the slide covered with cover-slip and parasites were identified as previously described (NCCLS, 2009). The eggs and larvae count was done in Formol ether concentration technique by weighing 1g faeces. The entire preparation was examined and eggs found were counted, which gave the number of eggs per gram of faeces.

3.7.1 Direct Wet Smear Method

Steps:

1. A clean grease-free microscope slide was used and a drop of normal saline was placed in the middle of the left half and a drop of lugol iodine solution was added in the middle of the right half of the slide.
2. An applicator or wire loop was used to take a small portion of the stool from inside and also the surface of semi solid stool and also from blood stained mucus portion of liquid stool.
3. The sample was mixed with the drop of saline and immediately covered with a cover slip
4. Same was done for the iodine solution

5. The preparation was examined under the microscope using x10 and x40 objectives.

Formalin-Ether Concentration according to NCCLS (2009)

Steps:

1. The faecal specimen was comminuting with sufficient water so that at least 10 to 12ml of strained suspension can be recovered, which will yield 0.5 to 1.0ml of centrifuged sediment.
2. The suspension was strain through two layers of gause or a stainless-steel-wire screen to remove particulate material.
3. The suspension was washed twice by centrifugation in a 15ml conical centrifuge tube (2minutes at 2000 rpm), with the supernatant being poured off.
4. After the second centrifugation, the faecal sediment was thoroughly mixed with 10ml of 10% formalin.
5. About 3ml ether was added to 10ml formalinized suspension and stopper with a cork shaken vigorously. The pent-up aerosol of ether was released carefully after shaking by loosening the stopper before the final centrifugation for 2 minutes.
6. An applicator stick was used to rim off the plug of debris and ether that was formed at the top of the tube. It was poured off as well as the supernatant leaving only the sediment in a small volume of formalin that drains back from the sides of the tube; the debris on the side of the tube was cleaned off with cotton swab.
7. Some of the sediments were removed with a pipette for examination under the microscope.

3.8 Data Analysis

Prevalence was calculated and expressed as percentage of positive cases over the number examined. Data from questionnaire were coded and ranked and analysed using SPSS version 13.0. Chi-square was used to compare significant differences in prevalence between the primary schools visited, male and female infection of the parasites, ages and risk factors. The odds ratio was used to determine association between infection and both gender and association between infection with risk factors. Significance was determined at $P \leq 0.05$ (95% confidence interval).

CHAPTER FOUR

4.0 RESULTS

4.1 Prevalence of Intestinal Infection among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government.

The prevalence of Intestinal Infections among pupils in seven primary schools of Tamburawa was presented in Table 1. Out of the five hundred and sixty (560) samples examined for the geohelminths infection, a total of four hundred and twenty six (426) indicating 76.1% infection was recorded with the highest prevalence rate recorded from Fagi Nomadic Primary School with 93.8% prevalence, while the lowest prevalence was recorded from Tamburawa Central Primary School with the prevalence of 60.0%. Statistically, there was highly significant difference at ($P \leq 0.05$) in the prevalence of geohelminths in Dawakin Kudu Local Government Area.

4.2 Prevalence by Species of Intestinal Infection among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government.

Table 2 showed prevalence of various types of parasites isolated and observed were Hookworm 142 (25.4%), *Schistosoma mansoni,* 89 (15.9%), *Ascaris lumbricoides* (8.6%), *Taenia sp* 36 (6.4%), *Trichuris trichiura* 17 (3.0), *Enterobius vermicularis* 11(2.0%), *Entamoeba histolytica* 6 (1.1%). Hookworm had the highest prevalence (25.4%) while *Entamoeba histolytica* had the least (1.1%). The prevalence of Intestinal

infections by species in the area was statistically different ($p \leq 0.05$) therefore, significant. Double and multiple infections were observed among the pupils.

Table 1: Prevalence of Intestinal Infections among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government.

School Name	Number Examined	Infected	
		No	%
Tamburawa Central Primary School	80	48	60.0
Gurjiya Primary School	80	62	77.5
Tudun Bayero Primary School	80	67	83.8
Fagi Nomadic Primary School	80	75	93.8
Daginawa Primary School	80	56	70.0
Dantube Primary School	80	66	82.5
Unguwar Na'ibi Primary School	80	52	65.0
Total	**560**	**426**	**76.1**

Chi-square	**36.592**
Df	**6**
P value	**0.000**

Table 2: Prevalence by Species of Intestinal Infections among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government.

School	**Hookworm (%)**	***Schistosoma mansoni (%)***	***Entamoeba coli (%)***	***Ascaris lumbricoides (%)***	***Taenia* species (%)**	***Trichuris trichiura (%)***	***Enterobius vermicularis (%)***	***Entamoeba histolytica (%)***	**Total (%)**
Tamburawa Central Primary School	33 (41.3)	9 (11.3)	10 (12.5)	7 (8.8)	4 (5.0)	0 (0.0)	3 (3.8)	2 (2.5)	**68 (16.0)**
Gurjiya Primary School	22 (27.5)	11 (13.8)	9 (11.3)	5 (6.3)	7 (8.8)	0 (0.0)	0 (0.0)	2 (2.5)	**56 (13.1)**
Tudun Bayero Primary School	9 (11.3)	13 (16.3)	17 (21.3)	8 (10.0)	3 (3.8)	4 (5.0)	0 (0.0)	1 (1.3)	**55 (12.9)**
Fagi Nomadic Primary School	35 (43.8)	19 (23.8)	16 (20.0)	9 (11.3)	4 (5.0)	0 (0.0)	3 (3.8)	0 (0.0)	**86 (20.2)**
Daginawa Primary School	10 (12.5)	11 (13.8)	15 (18.8)	11 (13.8)	8 (10.0)	6 (7.5)	4 (5.0)	1 (1.3)	**66 (15.5)**
Dantube Primary School	14 (17.5)	16 (20.0)	5 (6.3)	3 (3.8)	6 (7.5)	5 (6.3)	0 (0.0)	0 (0.0)	**49 (11.5)**
Unguwar Na'ibi Primary School	19 (23.8)	10 (12.5)	5 (6.3)	5 (6.3)	4 (5.0)	2 (2.5)	1 (1.3)	0 (0.0)	**46 (10.8)**

Total	**142 (25.4)**	**89 (15.9)**	**77 (13.8)**	**48 (8.6))**	**36 (6.4)**	**17 (3.0)**	**11 (2.0)**	**6 (1.1)**	**426 (100.0)**
Chi-square	**43.286**	**7.241**	**16.232**	**7.155**	**4.334**	**16.865**	**11.499**	**5.728**	
Df	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	
p value	**0.000**	**0.299**	**0.013**	**0.307**	**0.632**	**0.01**	**0.074**	**0.454**	

4.3 Prevalence in Relation to Age of Intestinal Infections among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government.

The prevalence of geohelminths according to age group of the pupils was presented in Table 3. Infection was detected in all age groups. The 12-14 years group had the highest prevalence of 10.9%. The prevalence of the geohelminths infection was statistically significant when compared with the age of the pupils ($P \leq 0.05$).

4.4 Prevalence in Relation to Sex of Intestinal Infections among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government.

The prevalence of geohelminths in relation to gender was presented in Table 4. Out of the 560 samples examined, 267 pupils were males, while 159 were females. The highest prevalence of 9.8% was recorded among the females compared to a prevalence of 9.3% in the males. Statistically, the prevalence of geohelminths among males and females was significantly different ($P \leq 0.05$).

4.5 Prevalence of Intestinal Infections among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government in Relation to Risk Factors

Table 5 showed the prevalence of geohelminths in relation to some predisposing factors. High prevalence (69.2%) was recorded among pupils who use well water to 25% prevalence among those who use borehole. 73.2% prevalence was found among pupils that swim compared to the

14% prevalence of those that do not swim. 41.5% prevalence occasionally trim their nails compared to 43.6% prevalence recorded among those who **Table 3: Prevalence in Relation to Age of Intestinal Infections among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government.**

Parasite Identified	**Number of Children Infected**			
	6-8 Years (n=96)	**9-11 Years (n=168)**	**12-14 Years (n=186)**	**15 Years and Above (n=110)**
	Number (%)	**Number (%)**	**Number (%)**	**Number (%)**
Hookworm	27 (28.1)	43 (25.6)	51 (27.4)	21 (10.1)
Schistosoma mansoni	15 (15.6)	19 (11.3)	33 (17.7)	22 (20.0)
Entamoeba coli	12 (12.5)	24 (14.3)	27 (14.5)	14 (12.7)
Ascaris lumbricoides	9 (9.4)	15 (8.9)	21 (11.3)	3 (2.7)
Taenia species	4 (4.2)	8 (4.8)	16 (8.6)	8 (7.3)
Trichuris trichiura	0 (0.0)	2 (1.2)	7 (3.8)	8 (7.3)
Enterobius vermicularis	0 (0.0)	0 (0.0)	6 (3.2)	5 (4.5)
Entamoeba histolytica	0 (0.0)	5 (3.0)	1 (0.5)	0 (0.0)
Total	**67 (8.7)**	**116 (8.6)**	**162 (10.9)**	**81 (9.2)**
Chi-square	**82.921**	**107.333**	**106.842**	**50.351**
Df	**7**	**7**	**7**	**7**

p value	**0.000**	**0.000**	**0.000**	**0.000**

Table 4: Prevalence in Relation to Sex of Intestinal Infections among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government

Parasites Identified	**Male (n=357) No (%)**	**Female (n=203) No (%)**	**Number of Children Infected (n=560)**
Hookworm	88 (24.6)	54 (26.6)	142 (25.4)
Schistosoma mansoni	56 (15.7)	33 (16.3)	89 (15.9)
Entamoeba coli	48 (13.4)	29 (14.3)	77 (13.8)

Ascaris lumbricoides	32 (9.0)	16 (7.9)	48 (8.6)
Taenia species	18 (5.0)	18 (8.9)	36 (6.4)
Trichuris trichiura	13 (3.6)	4 (2.0)	17 (3.0)
Enterobius vermicularis	8 (2.2)	3 (1.5)	11 (2.0)
Entamoeba histolytica	4 (1.1)	2 (1.0)	6 (1.1)
Total	**267 (9.3)**	**159 (9.8)**	**426 (9.5)**
Chi-square	**194.014**	**127.997**	**319.083**
Df	**1**	**1**	**1**
p value	**0.000**	**0.000**	**0.000**

Table 5: Prevalence In Relation to Risk Factors of Intestinal Infections among Pupils in Seven Primary Schools of Tamburawa, Dawakin-Kudu Local Government

Factor	Number Infected	Number Uninfected	Chi-square	Df	P value	Odds Ratio Value	95%	C. I.

Source of Water							
Stream [R]	21 (65.8)	11 (34.4)					
Well	204 (69.2)	91 (30.8)	0.167	1	0.682	0.852	0.394 - 1.840
Bore-hole	36 (25.5)	105 (74.5)	18.977	1	0.000	5.568	2.448 - 12.666
Water contact activities							
i Swimming							
Yes [R]	142 (73.2)	52 (26.8)	129.104	1	0.000	16.84	9.856 - 28.772
No	24 (14.0)	148 (86.0)					
ii Fishing							
Yes [R]	86 (41.5)	121 (58.5)	60.701	1	0.000	6.486	3.918 - 10.736
No	24 (9.9)	219 (90.1)					
Hand washing							
Yes [R]	134 (57.0)	101 (43.0)	10.187	1	0.001	2.116	1.330 - 3.367
No	42 (38.5)	67 (61.5)					
Walk with barefoot							
Always [R]	143 (60.3)	94 (39.7)					
Occasionally	73 (56.6)	56 (43.4)	0.435	1	0.486	1.167	0.756 - 1.802
Not at all	8 (42.1)	11 (57.9)	2.417	1	0.120	2.092	0.811 - 5.393
Finger nail trimming							
Always [R]	96 (43.6)	124 (56.4)	1.1	1	0.294	0.829	0.583 - 1.177
Occasionally	142 (48.3)	152 (51.7)					
Type of Latrine							
Stream [R]	64 (46.7)	73 (53.3)					

Pit	126 (63.6)	72 (36.4)	9.444	1	0.002	0.501	0.322 - 0.780
Modern	3 (33.3)	6 (66.7)	0.609	1	0.435	1.753	0.421 - 7.298
Bush	143 (63.8)	81 (36.2)	10.19	1	0.001	0.497	0.322 - 0.765
Occupation of Parent							
Farmer [R]	210 (67.5)	101 (32.5)					
Civil servant	63 (42.3)	86 (57.7)	26.605	1	0.000	2.838	1.898 - 4.245
Business	16 (33.3)	32 (66.7)	20.843	1	0.000	4.158	2.181 - 7.929

do not trim their nails. 63.8% prevalence was recorded from pupils who use bush to defecate compared to the 33.3% prevalence seen among those who use modern toilet. 67.5% prevalence was recorded among pupils whose parents were farmers compared with the 33.3% whose parents were into business. Statistically there was significant association between the predisposing factors and Intestinal infection ($p \leq 0.05$) was recorded among pupils engaged in fishing compared to 9.9% prevalence of those who do not fish. 57% was recorded among pupils who wash their hands. 60.3% prevalence was found among pupils who indicated always walking bare footed compared to 42.1% of those who do not walk bare footed.

CHAPTER FIVE

5.0 DISCUSSION

In this study, the overall prevalence for Intestinal infections among the seven primary school pupils in Tamburawa, Dawakin-Kudu Local Government was 76.1% this is high. This implies geohelminths infection is highly endemic among the primary schools pupils in Tamburawa which could leads to high mortality among the pupils if not treated. Out of the five hundred and

sixty (560) pupils examined, a total of four hundred and twenty six (426) individuals were reactive. This could be due to lack of good hygiene, poverty and lack of awareness on the soil-transmitted helminths and its route of transmission as most of the primary schools visited were situated in rural areas. Out of the seven primary schools visited, the highest prevalence recorded was 98.8% from Fagi Nomadic Primary School. This could be due to the fact that there was no toilet facility in the school premises and the pupils defecate indiscriminately in the nearby bushes and around the school compound. Statistically, there was significant difference between the prevalence of intestinal infection among the schools visited ($P \leq 0.05$), this indicated that lack of good personal hygiene triggers the rate of infection of soil transmitted helminths. This was similar to the studies of (Obiamiwe and Nmorsi, 1991; Ukpai and Ugwu, 2003) whose high prevalence was attributed to poor environment, low sanitary standard, personal hygiene, shortage of portable water and indiscriminate defecation. Similarly, Oyerinde *et al*., (1981) recorded a prevalence rate of 89.5% in Lagos state, Nigeria while Awogun (1984) observed a prevalence rate of 70.8% in Ilorin, Nigeria. The high infection rate recorded in this study contradicts that of 16.9% observed by Chigozie *et al.,* (2007) in South Eastern Nigeria.

Based on species of parasites, eight Intestinal parasites; Hookworm (25.4%), *Schistosoma mansoni* (15.9), *Entamoeba coli* (13.8%), *Ascaris lumbricoides* (8.6%), *Taenia sp*. (6.4), *Trichuris trichiura* (3.0%), *Enterobius vermicularis* (2.0%), and *Entamoeba histolytica* (1.1%) were identified in this study. This was in conformity with a number of previous studies (Ukpai *et al*., 2003; Bethony *et al*., 2006). There is a high level of contamination of objects with this is as a result of poor local level of environmental sanitation and personal hygiene (Hotez *et al*., 2010). Bundy (1995) reported that it is usually common of most tropical and subtropical

regions of the world where up to 15% of host population harbor approximately 70% of the worm population and serve as major source of environmental contamination. Hookworm infection occurred with the highest frequency, this could be attributed with the fact that Hookworm were much higher in their water or food (raw vegetables) which the pupils consumed or ingested not considering the hygienic level of the food material which are been eaten at school and homes. Statistically, there was significant difference in the prevalence of geohelminths infection by species among the primary school pupils examined ($P \leq 0.05$). The possible reason for this is not farfetched. It is well established that the infective stages of *A. duodenale* can penetrate into blood circulation; the embryonated eggs have enormous capacity for withstanding the environmental extremes of urban environments (Hotez, 2009a). Furthermore, the eggs are laid in large number of up to 25,000 an can be found in wide variety of environmental surfaces; this feature accounts for their adhesiveness to everything from door handles, dust, fruits and vegetables, paper money and coins (Crompton, 1989).

In this study, the age group 12 to 14 years was the most affected (10.9%) while the age group 9 to 11 years was the least affected (9.2%), this could be because of high level of soil contact activity and low personal hygiene in this age group. This finding is supported by a previous report from Zaria (Nock *et al*., 2007). The difference in infection rate between the age group was statistically significant ($P \leq 0.05$). This is in agreement with earlier report that infection disease was much with age of the pupils (Asaolu *et al*., 1992; Sakti *et al*., 1999; Budy, 1990). The result revealed a decrease in infection rate among the older children. This could be attributed to the increased public health awareness of the danger of intestinal helminthiasis as the children grow older.

High prevalence of 9.8% was observed among the females compared to the 9.3% in males. This could be as a result of the facts that children whose parents are poor often go to stream with their female children which were found frequently with barefoot. This might have led to more accumulation of infections in the females than in males. Statistically, there was significant difference in the prevalence of geohelminths infection among both genders ($P \leq 0.05$), which suggested that females were more exposed to the environmental conditions, occupational settings, that could predispose them to infections. This agreed with the work by Ukpai and Ugwu (2003) and Odikamnoro and Ikeh (2004), which stated that intestinal nematodes are nematode diseases that affect especially local farmers and poor people as there were traced with unhygienic environments and contaminated soil. This observation was in consonance with some previous works (Odikamnoro and Ikeh, 2004; Flores *et al*., 2001) but contrary to others (Ukpai and Ugwu, 2003; Albonico *et al*., 1999; Dakul *et al*., 2004). It is not apparently clear if the prevalence of STH infection among children is gender dependent. Therefore, more systematic research works are required to elucidate this.

The association between sources of drinking water and infection with soil transmitted helminths was not significant ($p \leq 0.05$) among the schools visited. However pupils who use well water had higher prevalence (69.2%) than those who used borehole water (25%). The odds ratio 0.9 indicates that well water do not actually triggers the infection. This is in agreement with another report by Wani and Ahmad (2009) who observed that children drinking water from well were found to have a greater prevalence of infection than those who had access to tap water. Poor hygiene practices associated with access to faecally contaminated water is a highly probable risk

factor for increased parasitic infection (Omar *et al*., 1995). This is however in contrast to the report of Agi (1997) in the Niger-Delta region. This was attributed to the fact that water supplied in taps were not properly treated or contaminated before usage.

The association between water contact activities and infection with soil transmitted helminths was significant ($p \leq 0.05$) among the schools visited. Pupils who swim recorded higher prevalence (73.2%) than those who do not (14.0%) and also those who go fishing recorded the highest prevalence (41.0%) compared to those who do not go fishing (9.9%). This could be because wet environments and damp soil favours the eggs of helminths and water bodies enables them to thrive more than the dry places (Nock *et al*., 2007). The odds ratio values of 16.8 and 6.5 for swimming and fishing respectively showed that; fishing and swimming could be associated with the infection. This is in agreement with the report of; Dakul *et al*. (2004) who revealed that rainy season and damped environment favour the proliferation of STH infections. More so, it agreed with the report from Vietnam (Vander-Hoed *et al*., 2003), which indicated that environmental and human behavioural factors influence the transmission process of infection.

Pupils who wash their hands before eating recorded the highest prevalence (57.0%) compared to those that do not washed their hands (38.5%). Statistically there was significant difference ($p \leq 0.05$). The reason for this could be that the water which the pupils used in washing their hands is already contaminated before usage. This agrees with the findings of Agi (1997), who stated that tap water could be contaminated with viable eggs or cyst of helminths before usage.

In this study pupils who always walk barefooted recorded the highest prevalence (63.3%) compared between those that do not walk barefooted (42.1%). Statistically there was significant difference. This indicates that walking barefooted is a factor that triggers the infection of soil transmitted helminths because children who do not wear protective shoes as a cover while playing within and outside school premises come in contact with infective stages of the parasites in the soil. This agrees with previous report that major behavioral factors play a role in disease transmission (Harhay *et al*., 2010).

Pupils who do not always trim their nails recorded the highest prevalence (48.3%) compared to those that do always trim their nails (43.6%). Statistically there was significant difference ($p \leq 0.05$). This indicates that long nails habour the parasites' infective stages which are acquired as the pupils play and come in contact with contaminated soil. The odds ratio of 0.4 signifies that lack of trimming nails is not a factor that triggers the infection of soil transmitted helminths. This still agrees with previous report that major behavioral factors play a role in disease transmission (Harhay *et al*., 2010).

The prevalence based on the type of toilet system used by pupils states that those that used bush method type of toilet recorded highest rate (63.8%) infected than those that used pit toilet (63.6%) and water closet (33.3%) respectively. this could be that bush method type of toileting, encourages the development of eggs and larvae of these soil transmitted helminthes infection. this occurs with indiscriminate defecation of feacal materials which creates a conducive atmosphere for the survival of eggs and larvae of these parasites. This agrees with

Oyerinde (1999) which states that children constantly are infected hence they come in close contact with soil and use unwashed hands to eat, thus there is oral feacal contamination.

Furthermore, the prevalence based on occupation of parents indicated that pupils whose parents were farmers' recorded highest rate (67.5%) infection than those whose parents were civil servants (42.3%) and business people (33.3%) respectively.

5.1 Summary

This research was conducted to determine prevalence of geohelminth infections among primary school pupils in Tamburawa, Dawakin-kudu Local Government Area, Kano State, Nigeria. Seven primary schools were used these include: Tamburawa central Primary School, Gurjiya Primary School, Tudun Bayero Primary School, Fagi Primary School, Daginawa Primary School, Dantube Primary School and Unguwar Na'ibi Primary School. Of the 560 primary school pupils recruited for the study 426 (76.1%) were positive. prevalence amongst the species varied significantly from 25.4% to 1.1%. A significant variation was observed among the age groups with the 9-11 years group having the least (8.6%) while the highest prevalence (10.9%) was recorded in the 12-14 years group. Similarly infection varied significantly among males (17.2%) and females (12.7%). Most risk factors examined influenced the spread of the infection in the study area.

5.2 Conclusions

The 76.1% prevalence of the soil-transmitted helminths reported in this study indicated that geohelminths infection is highly endemic among primary school pupils in Tamburawa, Dawakin-kudu Local Government Area, Kano State. The infection was significantly influenced by location, species type, age, gender and risk factors.

5.3 Recommendations

Apart from confirming endemicity in the study area, the general prevalence of 76.1% is a cause for alarm, therefore, calls for regular survey in school children to determine the prevalence and intensity of infections so as to provide basis for effective treatment strategies and control programmes at national, regional and district levels (Andrade *et al*., 2012).

Based on these findings, free medical tests and periodic de-worming of pupils with benzimidazole antihelmintics, mebendazole, and albendazole should be carried and sustained to remove these infections in the primary schools. This is in line with WHO guidelines recommended periodic treatment rounds for groups with high intensity infections of 10% and above (WHO, 2013).

Efforts should be made to create better sanitary and toilet facilities in schools at all times to avoid indiscriminate defecation that could lead to the transmission of helminthic infections. The government, non-governmental agencies and private individuals should help in the provision of these social amenities to ensure total eradication of these diseases.

The teaching of health education in both public and private schools should be encouraged by the government. Also, children should be educated on the need to always observe good hygienic practices and behavioral activities both at school and homes.

Parents should teach their children about the dangers of playing in contaminated soil and walking barefooted. The prevalence of intestinal parasites in indiscriminately passed faeces in the area should be studied to establish the possible sources of the infection.

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APPENDIX

AHMADU BELLO UNIVERSITY, ZARIA

FACULTY OF SCIENCES

DEPARTMENT OF BIOLOGICAL SCIENCES

JUNE, 2013

RESEARCH QUESTIONNAIRE

TITLE: STUDIES OF GEOHELMINTH INFECTIONS AMONG PRIMARY SCHOOL PUPILS IN TAMBURAWA VILLAGE, DAWAKIN-KUDU LOCAL GOVERNMENT AREA, KANO STATE

SIR,

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

1. REF. №.: …… 2. GENDER ……

3. SCHOOL: …… 4. CLASS: ……..

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

8. OCCUPATION OF PARENT: ……

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

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

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

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

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

16. METHODS OF REFUSE DISPOSAL: ……

17. SOURCE OF DRINKING WATER: ……

18. SOURCE OF LAUNDRY WATER: ……

19. DO YOU SWIM IN TAMBURAWA RIVER? :……

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

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

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

FOR RESEARCHER USE ONLY

RESULT OF LAB EXAMINATION:

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

2. MICROSCOPIC FEACAL EXAMINATION (Eggs and/or Larvae seen)
   a. *Ascaris lumbricoides*: ……
   b. *Trichuris trichiura*: ……
   c. Hookworm: ……

d. *Schistosoma mansoni*: ……

e. Taenia species: ……

f. *Entamoeba coli*: ……

g. *Enterobius vermicularis*: ……

h. *Entamoeba histolytica*: ……

i. Others: ……