KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF HEALTH SCIENCE

DEPARTMENT OF CLINICAL MICROBIOLOGY

SCHOOL OF MEDICAL SCIENCES

TOPIC: ASSESSMENT OF THE IMPACT OF 20 YEARS OF MASS DRUG ADMINISTRATION WITH IVERMECTIN ON THE PREVALENCE OF *ONCHOCERCA VOLVULUS* AND OTHER SOIL TRANSMITTED HELMINTH INFECTIONS IN CHILDREN IN THE PRU AND ATEBUBU DISTRICTS IN GHANA.

MPHIL RESEARCH THESIS SUBMITTED BY: BADIWON CHARLES

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DECLARATION

The work described in this thesis was carried out at the Department of Clinical Microbiology of the School of Medical Sciences, KNUST.

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DEDICATION

This work is dedicated to the entire Nachinaab Konbameng family of Tongo Puhig; Mr John Badiwon (my father), Madam Hannah Sampana Tindanpoasablig Badiwon (my late mother), Mathew Badiwon, Roger Badiwon, Anthony Badiwon, Pepertual Badiwon, Helen Badiwon, Gerald Badiwon (my late brother) and Gaetan Badiwon (my late brother) for their immense contribution to my education and livelihood. Again I dedicate this work to my wife Emmanuella and all my children.

ACKNOWLEDGEMENT

To the one who strengthens me to do all things; to He who is able to bring to completion whatever He has begun in my life; the omniscient God for bringing me this far: I believe He would do exceedingly above what the eyes can see. Thank you God. My sincere gratitude goes to my Supervisor Dr. Alexander Yaw Debrah for the support, encouragement, advice and guidance he gave me. At a point the going became tough but he never turned his back on me. There were falls but he lifted me up. Sir, may the God who knows your heart richly bless you. I say a big thank you to all the staff of the district hospital laboratory, Atebubu for their immense support. My sincere appreciation goes to my lovely wife Emmanuella and all my children for their heartfelt support and care. I am greatly indebted to my parents Mr John Badiwon and Madam Hannah Sampana Tindanpoasablig Badiwon (my late mother) who in their relentless efforts gave me what they never had. They gave me education to the university level for which I am forever grateful. I am grateful to my parents for my entire life. I am also grateful to my brothers Mathew, Roger and Anthony and my sisters Helen and Perpetual for their immense contribution to my education and my entire life. To Dr. Linda Debrah of KCCR I say thank you for your support.

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ABSTRACT

Onchocerciasis continues to be of great public health concern and it affects more than 37 million people worldwide. It is one of the leading infectious blinding disease agents of the developing world, second only to trachoma. Mass drug administration (MDA) with ivermectin has been going on for 20 years now.

This study was conducted in the Pru and Atebubu Districts in the Brong Ahafo Region to assess the prevalence of *Onchocerca volvulus* and intestinal parasite infection after 20 years of MDA. In all, 659 pupils from primary one up to Junior high school were involved. Twenty children per class were selected randomly in every school for snipping. From the Atebubu district, out of the 239 pupils examined from the schools, 1 pupil representing 0.42% had *O. volvulus* infection

whiles 16 pupils representing 6.7% had intestinal helminths and 31 representing 13.0% had protozoan infection. For Pru district, out of the 420 pupils examined from the four schools, 6 representing 1.43% had *O. volvulus* infection whiles 25 pupils representing 6.0% had intestinal helminths and 76 representing 18.4% had protozoan infection. In general, prevalence of onchocerciasis was low while that of intestinal parasites was high in the study population. However, one village in the Pru district, Abua, had onchocerciasis prevalence of 3.4% which is higher than the accepted 2% level set by the WHO and this should be a matter for concern. In conclusion, the prevalence of intestinal protozoan and *Onchocerca volvulus* infections were higher in the Pru district but lower in the Atebubu district whiles intestinal helmnths infection

was higher in the Atebubu district but lower in the Pru district. It is recommended that special attention should be paid to Abua in order to prevent the spread of onchocerciasis to other areas.

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CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND

Onchocerciasis also known as river blindness is a parasitic disease caused by infection with the nematode *Onchocerca volvulus* (WHO, 1995). The parasite is transmitted to humans through the bite of a black fly of the genus *Simulium*. Onchocerciasis affects more than 37 million people worldwide, and it remains a significant public health burden in developing countries, especially in the sub-Saharan Africa (WHO, 1995). It is one of the leading infectious blinding disease agents of the developing world, second only to trachoma (WHO, 1995). Onchocerciasis is the fourth most common cause of blindness in the world and ocular damage is the most serious complication of the disease. River blindness is essentially a rural disease, affecting the poorest and most remote communities, populations with the fewest resources and the least access to health services. It is now recognized by the World Health Organization (WHO) as one of the world´s major public health problems and it has been included as a target disease within WHO´s Special Program for Research and Training in Tropical Diseases (TDR) (WHO, 1995). Blindness tends to predominate in the African savannah and skin disease in the rain forest (WHO, 1995). In African communities with severe hyperendemic onchocerciasis of the savanna form, 15% of the population can be blind and up to 40% of the adults can be visually impaired (WHO, 1995). Visual impairment is a major occupational and social obstacle and reduces the life span of affected persons by an average of 10 years (WHO, 1995). It also causes a decrease in agricultural production, and young children are forced to care for their blind parents. For fear of becoming blind, adolescents are forced to emigrate or abandon the most

fertile riverside land, which leads to the disintegration of the family fabric in the villages of such regions (Opoku, 2000; WHO, 1995). Onchocerciasis is a major health and socio-economic problem, essentially in endemic areas in Africa (WHO, 1999). Treatment may involve the use of the drug ivermectin. For best effect, entire communities are treated at the same time (Opoku, 2000). A single dose may kill first-stage larvae (microfilariae) in infected people and prevents transmission for many months in the remaining population. However, the drug has no effect on the adult worm and the people have to take it for several years for the worm to die on its own after about ten (10) years (Opoku, 2000). Mass drug administration (MDA) with ivermectin has been going on in the Pru and Atebubu districts for the past 20 years. However, a suboptimal response to annual ivermectin treatment, defined as "a higher than normal rate of skin repopulation by *0. volvulus* microfilariae" was reported on several occasions in northern Ghana (Opoku, 2000; Osei-Atweneboana *et al*., 2007). Nonetheless, it is not yet clear as to whether this is true or not. If it is true, many reasons have been proposed to this suboptimal response. The contribution of the immune response to microfilarial killing and its variation in the human population is a likely contributor to this suboptimal response (Osei-Atweneboana *et al*., 2007). However, this was dismissed earlier on the basis that microfilariae from all but two suboptimal responders remained ivermectin-sensitive. It is believed that the immune response is a major contributor to the persisting effect of ivermectin, because this effect extends long after the drug has left the system. Although live nematodes appear to cause minimal inflammation, dying and degenerating parasites are known to activate such host reactions (Boussinesq *et al.,* 1998). This phenomenon was believed to be an explanation for a similar microfilarial repopulation phenomenon reported earlier from the Sudan where a small proportion of an ivermectin-treated population exhibited a more rapid skin repopulation than

expected (Boussinesq *et al.*, 1998). In the Sudan case, a small group of previously treated persons, about 10% of total respondents reported recurrent pruritus, with significantly higher associated loads of dermal microfilariae 4-6 months post treatment (Boussinesq *et al.*, 1998). It was proposed that while microfilarial increase could be attributed to weakening of the paralytic effect of the drug on adult females, it could also reflect an inability of the host's immune system to contribute to drug-initiated microfilarial destruction (Boussinesq *et al.*, 1998). In persons lacking the ability to kill microfilariae via an immune response, one could easily overlook this as a possible explanation when there was more rapid skin repopulation, and hypothesize instead that female worms were resistant and better able to release microfilariae (Boussinesq *et al.,* 1998). Thus, suboptimal response could be associated with lack of adequate drug coverage or an inability of a few persons to mount a proper immune response (Boussinesq *et al.*, 1998).

Worldwide infestation by intestinal worms is well documented (Anteson *et al.,* 1981). Intestinal worms remain one of the constant public health problems in almost all developing countries (Anteson *et al.,* 1981). It is widely recognized as a mirror of socioeconomic conditions and an indicator of poor sanitation. It has been estimated that more than a quarter of the world population is suffering from one or the other type of intestinal parasites (Anteson *et al.*, 1981). Despite its frequency, it ranks high as a neglected tropical disease (Anteson *et al.*, 1981). Many parasitic infections are of medical importance to man. These parasites cause pathological and physiological conditions, which may be symptomatic or asymptomatic as a result of the parasitic existence. A high concentration of intestinal parasites inevitably leads to anaemia, malnutrition, and different types of morbidity, particularly growth and cognitive development in children (Anteson *et al.,* 1981). In a study of primary school children in the

Derma District of Libya (Sadaga *et al.*, 2007) there was a 31% infection rate of intestinal parasites. These parasites were *G. lamblia* (12.7%), *B. hominis* (6.7%), *E. histolytica/dispar* (6.6%), *Entamoeba coli* (3.2%), and *E. Hartmanni* (1.0%). Such high prevalence might be associated with poor sanitation, lack of good water supply and improper hygiene. *G. lamblia* causes giardiasis and has been recognized as the most common intestinal pathogen worldwide (Farthing, 2006). Although its pathogenicity has long been a source of debate, it is now generally accepted that *G. lamblia* does cause diarrhoea in humans (Farthing, 2006). *G. lamblia* has also been associated with diarrhoeal illness among campers, swimmers and those travelling abroad, usually to less developed countries (Gray *et al*., 1994). *G. lamblia* infection is a leading cause of waterborne outbreaks in the developed world (Levy *et al*., 1998), and evidence exists that those individuals in households with a shallow well or surface water source are at a high risk for giardiasis than those with a drilled well or municipal water supply (Levy *et al*., 1998). In the developing world, *G. lamblia* has been frequently identified in both cross-sectional and cohort studies of children as a very common intestinal pathogen (Guerrant, 1997). In immunocompromised people such as Human Immunodeficiency virus (HIV) patients, infections often cause fatal diarrhoeal diseases and respiratory problems (Cheesbrough, 2005). Clinically, *G. lamblia* has been associated with diarrhoea in the study population (Mahmud *et al*., 1995) and day care settings (Sempertegui *et al*., 1995). However, other studies have identified *G. lamblia* just as commonly or even more commonly in asymptomatic as in symptomatic children (Hoge *et al.*, 1997). Helminthic parasites can live in the intestine, tissue or blood of humans (Cheesbrough. 2005). Intestinal helminth parasites are a group of worms that use the body lumens of the gut as the normal locations for their adult forms (Ijagbone and Olagunji, 2006). More than 12 different species of intestinal helminths

infect humans especially those in the tropical and subtropical parts of the developing world (Ijagbone and Olagunji, 2006). The large roundworm, *Ascaris lumbricoides*, the whipworm, *Trichuris trichiura*, and the two species of hookworm *Nector americanus* and *Ancylostoma duodenale*, however, stand out due to their widespread prevalence and distribution (Hotez *et al*., 2003). Intestinal helminth infections like most other parasitic infections, represent a major public health problem in poor and developing countries and constitute a universal burden which does not only depend on regional ecological condition but also on local standard of socio-economic development of the people (Chigosie *et al*., 2007). It is estimated that approximately 2 billion people worldwide are infected with one or more of these intestinal helminths (Glirkman *et al.,* 1999) accounting for an estimated 300 million clinical episodes (WHO, 2003) and 9400 deaths annually (WHO, 2005). According to Ezeamama *et al*. (2005), there are 1,471 million estimated cases of infection with *T. trichiura*. The major soil transmitted helminths in Ghana are *A. lumbricoides*, *T. trichiura*, hookworm, and *S. stercoralis*. These species of helminths are known to be endemic in all the ten regions of the country, although no definitive prevalence assessments have been done (Ghana Health Service, 2007).

1.1 Problem Statement

Till date the dream of eliminating some parasitic diseases such as onchocerciasis has not been fully realized. Instead, there appears to be a recrudescence of these old, endemic, debilitating parasitic diseases in some parts of developing countries.

1.2 Rationale/Justification of the study

Efforts to eliminate onchocerciasis as a public health problem have evolved over decades now. Data from Pru and Lower Black Volta river basins also in Ghana where even though vector

control had been applied for 20 years and ivermectin mass treatment had been administered since 1987, showed cases of recrudescence of the infections in some repeatedly treated individuals, suggestive of ivermectin resistance to *O. volvulus* (Osei-Atweneboana *et al*, 2007). These reports have caused fear and panic among scientists in the filariasis community, because there is no other safe drug approved for MDA for the treatment of onchocerciasis.

1.3 Hypothesis

In recent data from Pru and Lower Black Volta basins in Ghana where even though vector control has been applied for 20 years and ivermectin mass treatment has been administered since 1987, there were cases of recrudescence of the infections in some repeatedly treated individuals, suggestive of ivermectin- resistance to *O. volvulus.* Resistance or not will be determined by the presence of the infection in children who were born after the initiation of the program. According to WHO, if more than 2% of the children born after the initiation of the program has the infection, then that could be a sign of the failure of the program which can be attributed to resistance of the drug (ivermectin) (Osei-Atweneboana *et al*., 2007).

1.4 Aim of the study

- To assess the impact of the Mass Drug Administration (MDA) on the prevalence of onchocercal infection in children in "ivermectin resistance" areas in the Pru and Atebubu districts.

1.5 Specific objectives

Specific objectives are

- To assess the prevalence of microfilaria in the skin of school children in the Pru and Atebubu Districts after 20 years of MDA.

- To assess the prevalence of other soil- transmitted helminths among the school children in the Pru and Atebubu districts.
- To assess the prevalence of protozoan infection among the school children in the Pru and Atebubu districts.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 OVERVIEW OF ONCHOCERCIASIS

Onchocerciasis, commonly known as 'River Blindness' affects more than 37 million people worldwide, and it remains a significant public health burden in developing countries, especially in sub-Saharan Africa (WHO, 1995). Human onchocerciasis is caused by the filarial nematode parasite, *Onchocerca volvulus,* and it is one of the leading infectious blinding disease agents of the developing world, second only to Trachoma. The infective larvae of the parasite are transmitted by *Simulium* black flies that breed in fast flowing rivers and streams (Opoku, 2000; WHO, 1995). The world Health Organisation Expert Committee on Onchocerciasis estimated that 123 million persons were at risk of contracting the infection, and about 37 million were infected, of whom 270000 were blind and 500,000 severely visually impaired (WHO, 1995). About 95% of these infected persons reside in tropical Africa, where the disease is most severe along the major rivers in 30 countries (WHO, 1999). Onchocerciasis is the fourth most common cause of blindness in the world (Soboslay *et al.,* 1994) and second most frequent cause of preventable blindness in Africa. Visual impairment is a major occupational and social obstacle and reduces the life span of affected persons by an average of 10 years (Kirkwood *et al,* 1983; WHO, 1999). It also causes a decrease in agricultural production, and young children are forced to take care of their blind parents. For fear of becoming blind, adolescents are forced to emigrate or abandon the most fertile riverside land, which leads to disintegration of the family fabric in the villages of such regions (WHO, 1999).

2.2 EPIDEMIOLOGY OF ONCHOCERCIASIS

It is estimated that there are more than 117 million people with onchocerciasis with most infections (99%) occurring in tropical Africa. *O. volvulus* occurs most widely along the courses of fast running rivers and streams in rain forests and savannah areas (WHO, 1999). It is found in 28 countries in Africa from Senegal in the west to Uganda and Ethiopia in the east and as far south as Zambia. Following the success of the Onchocerciasis Control Program (1974-2002), onchocerciasis has been eliminated as a public health problem in 11 countries in West Africa. Smaller onchocerciasis endemic areas occur in the Yemen Arab Republic, in Central America (Mexico and Guatemala), and in South America (Brazil, Ecuador, Venezuela, Columbia). In Central America, the vectors of *0. volvulus* breed in slow running streams. Onchocerciasis is endemic in tropical Africa, where the vast majority (over 96%) of the global disease burden is found. Small foci also exist in the Arabian Peninsula (Yemen and Saudi Arabia) and in parts of Central and Southern America such as Mexico, Guatemala, Ecuador, Colombia, Venezuela, and Brazil (WHO, 1999).

Previous estimates have placed the total number of people infected at 18 million, of whom 99% live in Africa. Since then, the true extent of the disease has been estimated by Rapid Epidemiological Mapping of Onchocerciasis (REMO). By 2005, more than 22,000 villages in Africa (outside the Onchocerciasis Control Program area) had been surveyed, allowing the identification of many new foci. It is estimated that 37 million people are carrying *O.volvulus*, with 90 million at risk in Africa (WHO, 1995). Onchocerciasis is the second most common cause of preventable blindness in sub-Saharan Africa.

Globally, approximately 270,000 people are blind and 500,000 have significant visual loss directly as a consequence of onchocerciasis. To these figures is added each year an estimated number of 40,000 new blind cases (WHO, 1999).

There are marked geographical variations in the prevalence and clinical manifestations of onchocerciasis and these have a direct bearing on estimates of the burden of the disease in different parts of the world. There are two fairly broad but distinct clinico-pathological patterns of onchocerciasis, particularly in West Africa, based on the disease´s two predominant and major clinical complications: blindness and skin disease. In West Africa, blindness rates are significantly higher in hyperendemic communities in the savannah than in communities with similar levels of infection in the rain forest. DNA probes have confirmed that these different patterns are the result of different parasite strains.

2.3 TRANSMISSION AND LIFE CYCLE OF *ONCHOCERCA VOLVULUS*

O. volvulus is transmitted by *Simulium* black flies. The commonest vectors belong to the *Simulium damnosum* complex. The infective larvae enter through the bite wound after an infected black fly takes a blood meal. The larvae take several months to develop into mature worms (Cheesbrough, 2005).

The life cycle of *O. volvulus* is summarized in Figure 2.1. The adult worms live in subcutaneous tissue and in lymph spaces, occurring singly or in tangled masses. In the later stages of infection a proportion of the worms become encapsulated in fibrous nodules. The worms can live up to 10 years or more in their host. The females produce many unsheathed microfilariae which can be found just below the surface of the skin in the lymph spaces and in connective tissues. They can also be found in the fluid of nodules. Microfilariae are thought to

be present in the skin from about 7 months onwards after infection. The microfilariae also migrate to the eye and other organs of the body. The microfilariae are ingested by a black fly as it feeds. After passing through the stomach wall of the fly, the microfilariae migrate to the thoracic muscles where they develop into infective larvae. Development in the black fly vector takes about 10 days. The mature infective larvae pass to the mouth parts of the black fly ready to be transmitted when the fly next takes a blood meal (Cheesbrough, 2005).

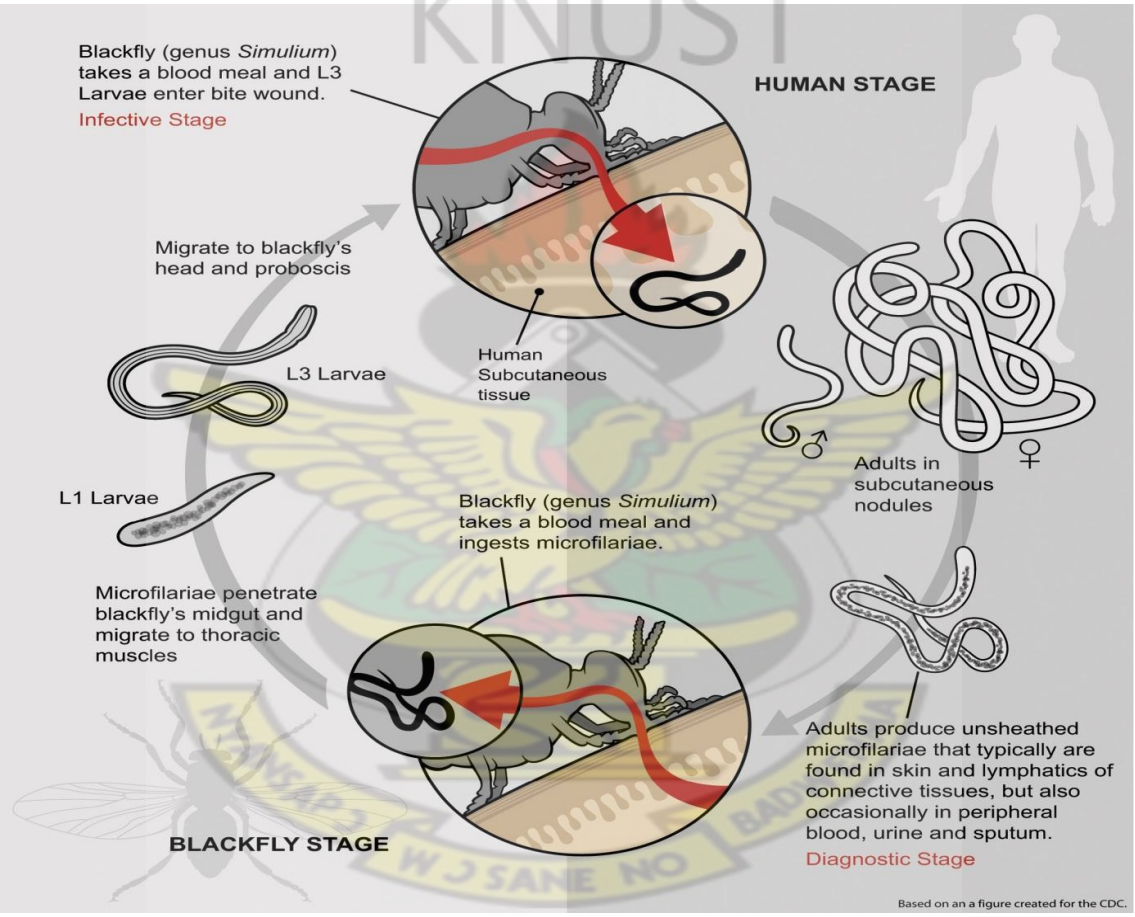


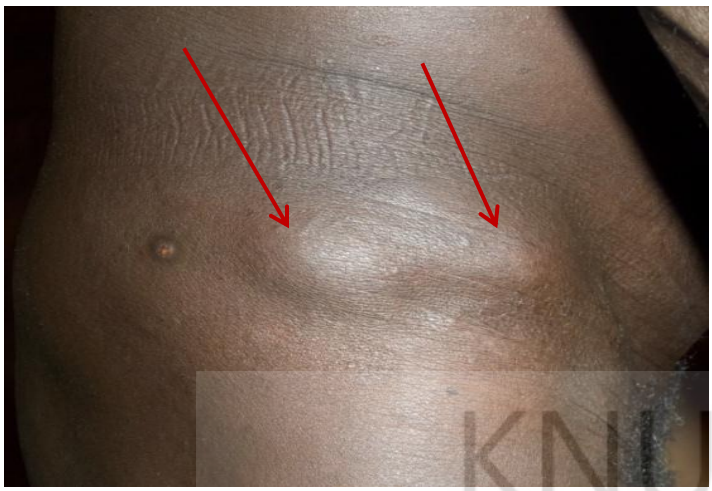
Figure 2.1 Transmission and life cycle of *Onchocerca volvulus*.

2.4 CLINICAL FEATURES OF ONCHOCERCIASIS

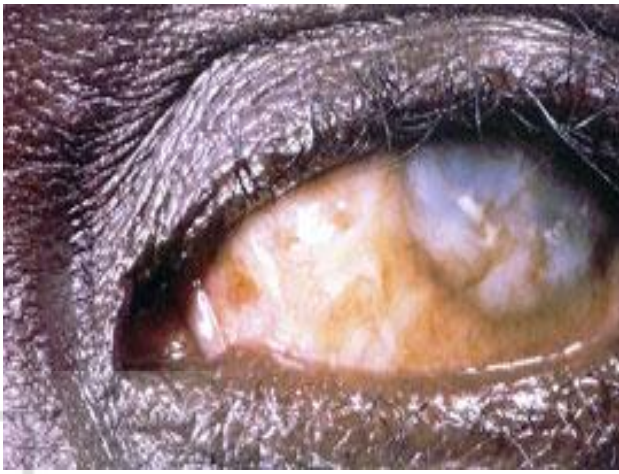
The clinical features and pathology of onchocerciasis are caused mainly by the inflammatory reactions around damaged and dead microfilariae. The disease varies from one area of

infection to another and within a particular population. Variations are due to differences in parasitic strains, degree and frequency of infection, and host differences which include nutritional state and immune responses to parasite antigens. The main clinical features are the formation of nodules, dermatitis, and inflammatory reactions in the eye leading to blindness (Cheesbrough, 2005).

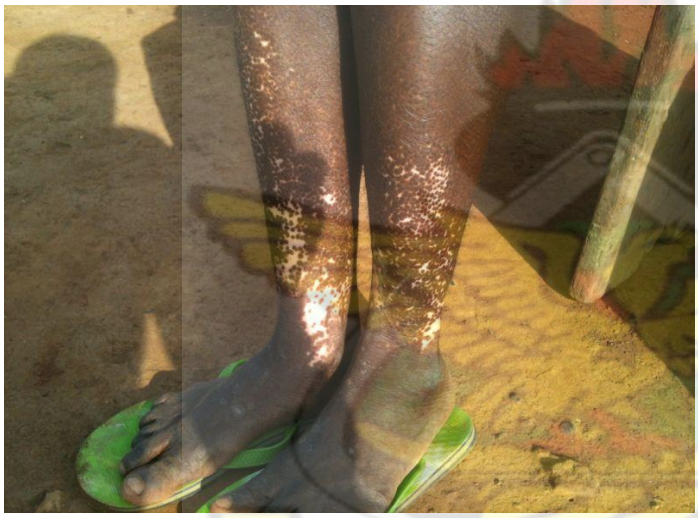
Onchocerciasis has a broad clinical spectrum, which is thought to reflect different host immune responses to the microfilarial stage of *O. volvulus*. The main manifestations of the disease are predominantly seen in the eyes and in the skin.



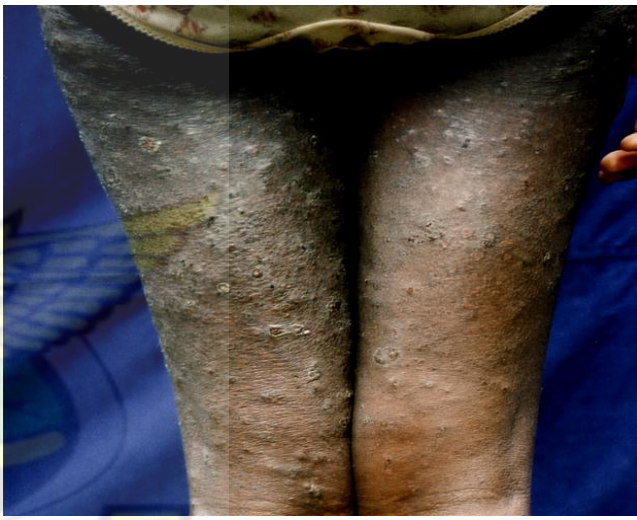
Onchocercoma



Ocular onchocerciasis



Skin depigmentation



Onchodermatitis

Figure 2.2 Clinical features of onchocerciasis

Pruritus is commonly the first clinical symptom of the disease, and may occur on its own or in association with onchocercal skin disease.

Eye disease

Microfilariae can be seen in all ocular tissues. Dead microfilariae in the cornea cause opacities known as punctate keratitis, which may resolve spontaneously (Cheesbrough, 2005). The more serious and potentially blinding ocular lesions of onchocerciasis are sclerosing keratitis,

iridicyclitis, choroido-retinitis, choroido-retinal atrophy, optic neuritis, and opticatrophy (Cheesbrough, 2005).

Nodule formation

Nodules form under the skin when the adult worms become encapsulated in subcutaneous tissue. The nodules are called onchocercomas. They are firm, smooth and rubbery, round or elongated and measure from 5 mm across up to 50 mm when found in clusters. They may contain large numbers of microfilariae. In many endemic areas of Africa, nodules are commonly found on the lower part of the body around the pelvis. In Central America and the savannah areas of Africa, nodules are often found on the upper part of the body. In young children below 9 years, the nodules are found mainly on the head. In Yemen the lower limbs are mainly affected (Cheesbrough, 2005).

Skin disease

There is an inflammatory dermatitis which is usually accompanied by intense irritation, raised papules on the skin, and subsequently alteration in the pigmentation of the skin. The term 'sowda' (black disease) is used to describe a severe allergic response usually affecting only one limb with darkening of the skin. The lymph nodes draining the limb become swollen and painful (Cheesbrough, 2005).

In chronic onchocerciasis, the skin loses its elasticity and becomes wrinkled which makes people look more aged than they are (Cheesbrough, 2005).

When the skin around the groin becomes affected 'hanging groin' develops. The term 'leopard skin' refers to a spotted depigmentation of the skin which is associated with chronic onchocerciasis.

Blindness

The most serious complication of onchocerciasis occurs when microfilariae in the skin of the face migrate into the eye. In early eye infections the microfilariae can be found in the cornea and in the anterior chamber. There is redness and irritation of the eye. Progressive changes caused by inflammatory reactions around damaged and dead microfilariae can cause sclerosing keratitis which can lead to blindness (Cheesbrough, 2005).

Often the iris is also affected. Inflammation of the choroid and retina can also lead to blindness (Cheesbrough, 2005).

2.5 CONTROL PROGRAMS FOR ONCHOCERCIASIS

The effort to eliminate onchocerciasis as a public health problem has evolved over decades now. For instance, the Onchocerciasis Control Program (OCP) which was launched in 1974 and officially ended in 2002, aimed at controlling the breeding of black flies, and hence the disease in 11 West African countries including Ghana, through larvicide spraying of fast flowing rivers and streams (WHO, 2010; Thylefors *et al*., 1995; WHO, 1995). In 1987, ivermectin (Mectizan®), produced by Merck and Co was introduced and free distribution by mobile teams for the treatment of onchocerciasis commenced immediately. Because of its safety profile and effectiveness against microfilaria, current onchocerciasis control programs including the African Program for Onchocerciasis Control (APOC) rely on mass administration of this microfilaricidal drug; which is known to lower the microfilarial load in affected individuals and temporarily sterilize adult female filarial worms, thereby reducing transmission and mitigating the clinical manifestations of the infection (Awadzi *et al*., 1999; Goa *et al*., 1991). Merck and Co Inc. has donated ivermectin for the past 22 years to countries affected by

onchocerciasis. As a result of this Mass Drug Administration (MDA), the disease has been reduced in many countries and transmission has been interrupted in a few foci in other endemic countries (Cupp *et al*., 2011). More disturbing however is recent data from the Pru and Lower Black Volta river basins also in Ghana where even though vector control had been applied for 20 years and ivermectin mass treatment had been administered since 1987, there were cases of recrudescence of the infections in some repeatedly treated individuals, suggestive of ivermectin- resistance to *O. volvulus* (Osei-Atweneboana *et al*., 2007).

2.6 INTESTINAL PARASITES OF MEDICAL IMPORTANCE

Intestinal parasites of medical importance can be classified into various categories. These include: Protozoa, which are single-celled parasites and are found worldwide. Examples of protozoa include amoebae (*Entamoeba histolytica*) and ciliates (*Balantidium coli*), (Cheesbrough, 2005).

Metazoa which are multicellular parasites also found worldwide. They include nematodes, which are non-segmented cylindrical worms that are tapered at both ends. Examples include *Ascaris lumbricoides* and *Strongyloides stercoralis.* Metazoa also include trematodes, which are a class of parasitic flukes that are unsegmented and mostly flat-like worms. Examples include *Schistosoma mansoni* and *Paragonimus westermani* (Cheesbrough, 2005). Also included in the metazoa are cestodes which are a group of parasites that have a ribbon-like chain of segments known as proglottides, each bearing a complete male and female systems which make them capable of producing output. Examples of tapeworms are *T. solium, T. saginata* and *H. nana.*

2.6.1 The Morphology of the diagnostic stages of intestinal parasites

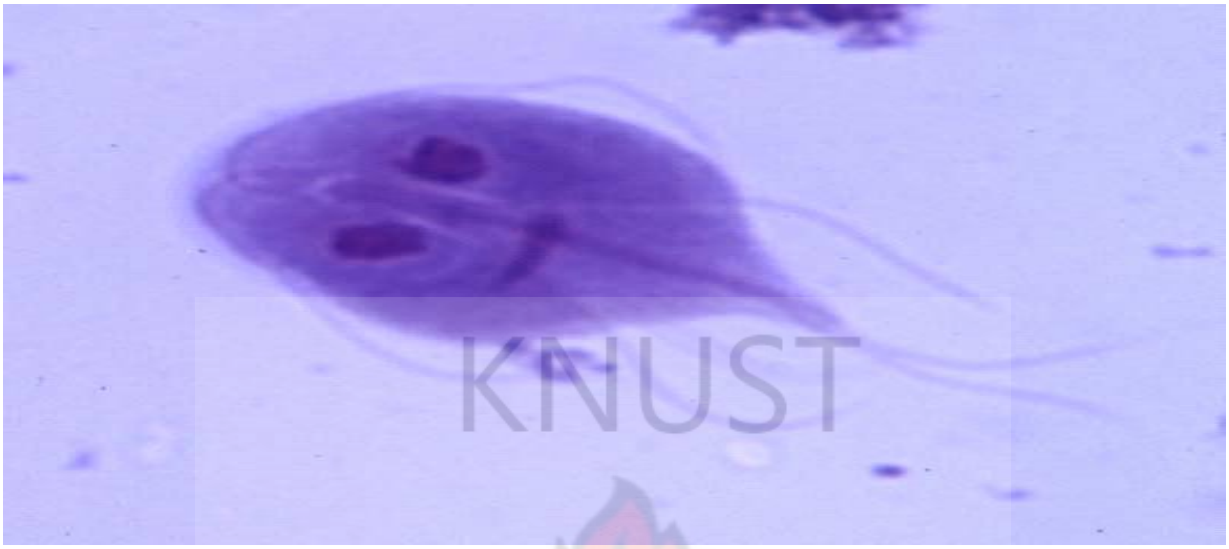


Figure 2.3 *Giardia lamblia* trophozoite

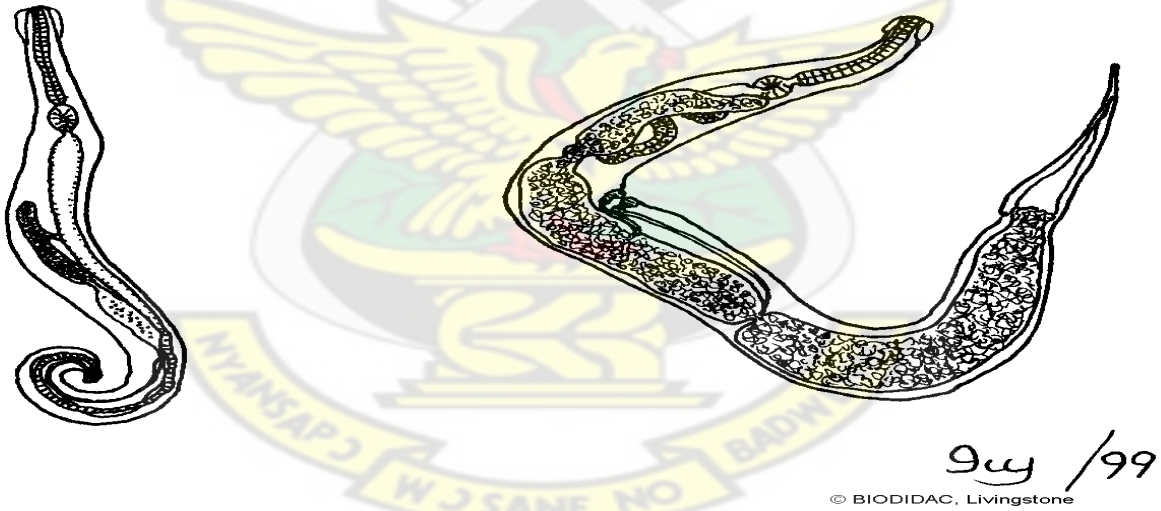


Figure 2.4 *Enterobius vermicularis* (male and female)

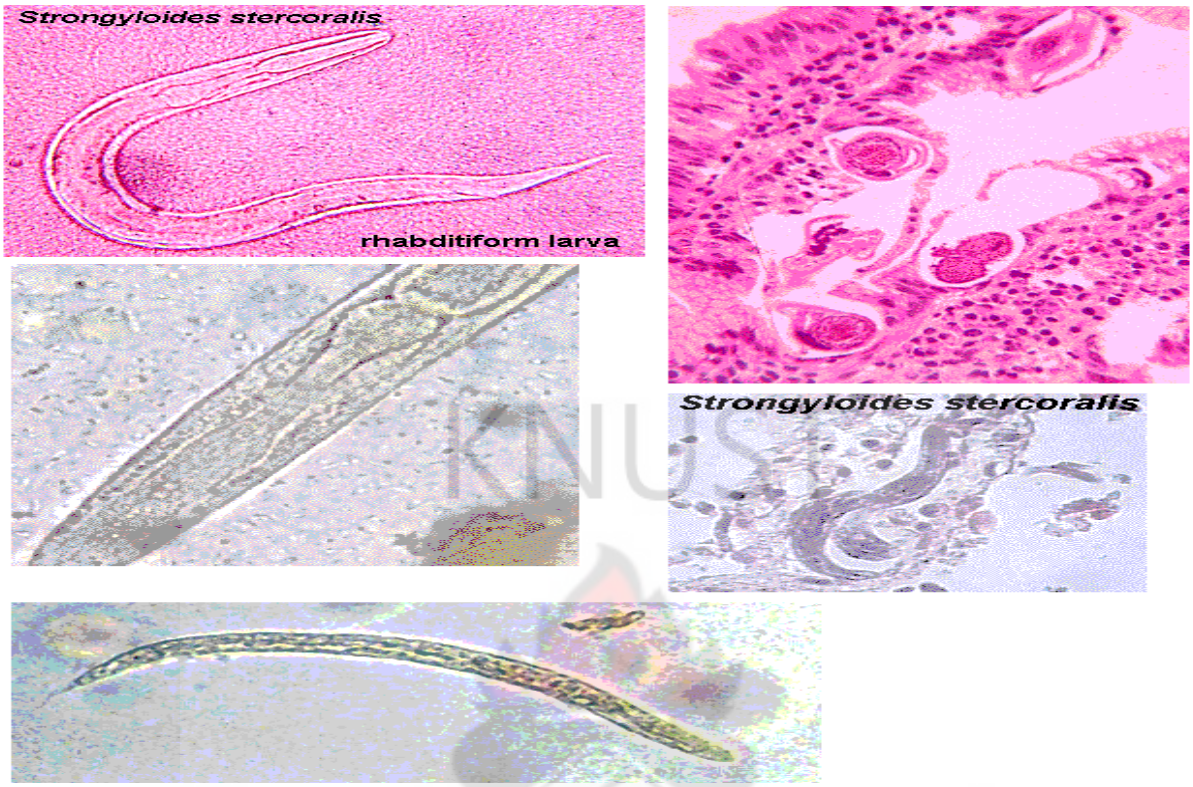


Figure 2.5 ***Strongyloides stercoralis*** **larvae**

Figure 2.6 ***Taenia*** **spp egg**

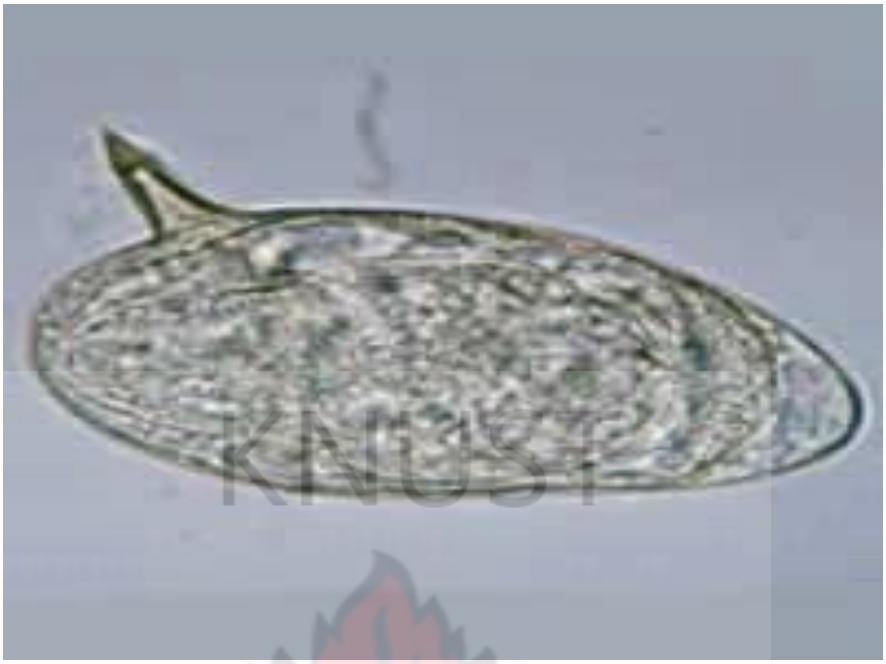


Figure 2.7 ***Schistosoma mansoni*** **ova**

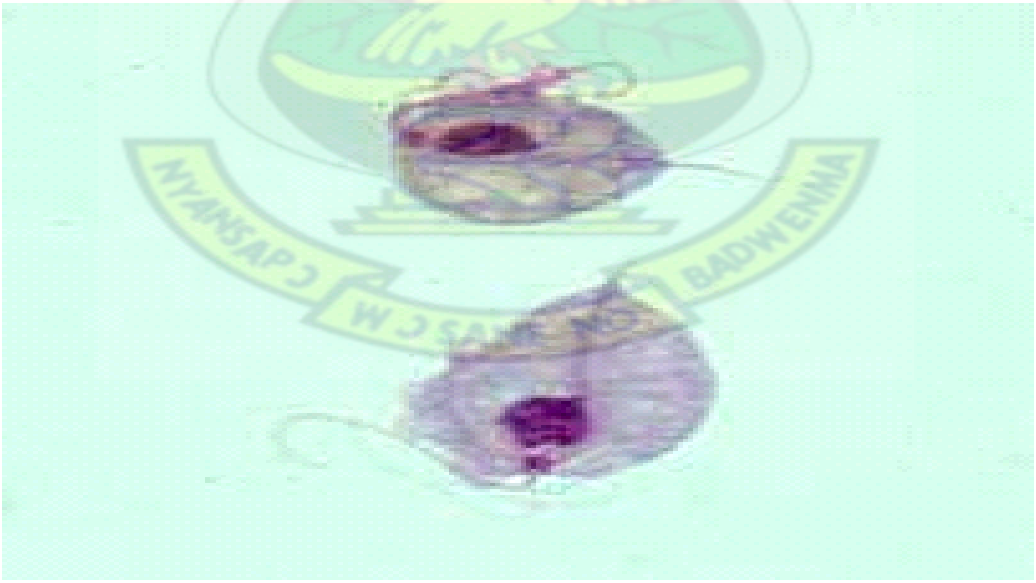


Figure 2.8 ***Trichomonas hominis*** **trophozoites**

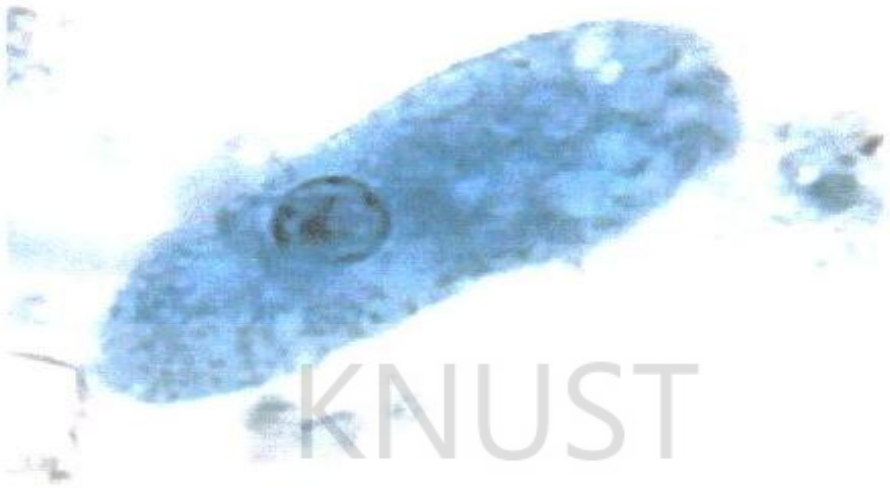


Figure 2.9 ***Entamoeba histolytica***

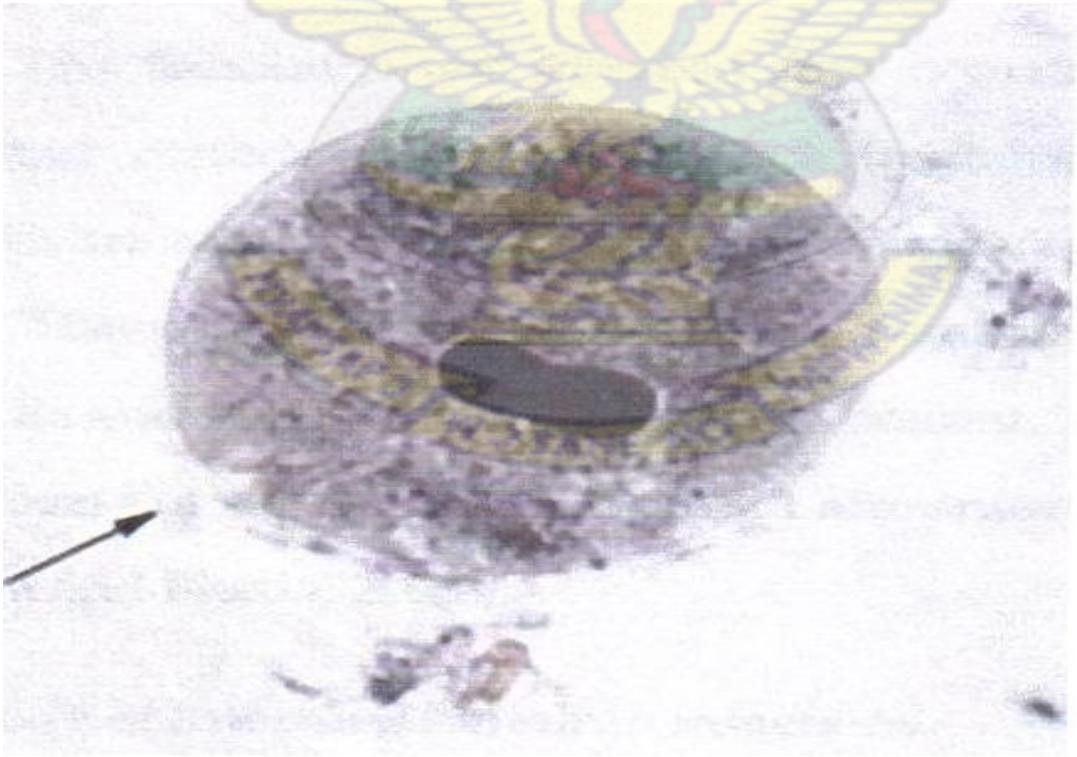


Figure 2.10 ***Balantidium coli*** **trophozoite**

2.7 EPIDEMIOLOGY AND GEOGRAPHICAL DISTRIBUTION OF PARASITES

In tropical and developing countries, certain factors contribute to the spread and increase in the incidence of parasitic infestation even though many important species of parasites have a worldwide distribution (Cheesbrough, 2005). These factors include inadequate sanitation, and unhygienic living conditions leading to faecal contamination of the environment, lack of health education, insufficient water and contaminated water supplies, failure to control vectors due to ineffective interventions, insecticide resistance due to lack of resources and suspension of surveillance and control measures (examples during war and conflicts). Others are poverty, malnutrition, and for some parasites increased susceptibility due to co-existing HIV infections, development of schemes introducing opportunities for vector breeding and infection of the workforce like poorly designed irrigation dam projects, failure of drugs to meet parasitic infections effectively, climatic factors like temperature and humidity. The rest are population immigration causing poor health, lack of natural immunity, exposure of new infections and people being forced to live and work close to vector habitats and reservoir hosts, often in overcrowded conditions like refugee camps. These factors are most favourable for the survival, larval development and transmission of parasites.

In Ghana, these infections are a huge challenge to the health sector due to unavailable policies, poor sanitation, and polluted water supplies (Ghana Health Service, 2007).

2.8 MODE OF TRANSMISSION AND LIFE CYCLE OF PARASITES

The mode of transmission of a parasite is the process by which the infective stage is introduced into the host for infection to start. This is done through the following ways:

- By ingesting the parasite in food, water or from hands that contain the infective form of the parasite. The mode of transmission is often referred to as oral-faecal route. Examples include *Entamoeba histolytica, Giardia lamblia,* and *Ascaris lumbricoides.*
- By ingesting the parasite in raw or undercooked meat. Examples include *Taenia species* and *Paragonimus westermani.*
- By the parasite penetrating the skin when in contact with faecally contaminated soil or water, as occurs with hookworms, *Strongyloides stercoralis,* and *Schistosoma mansoni.*

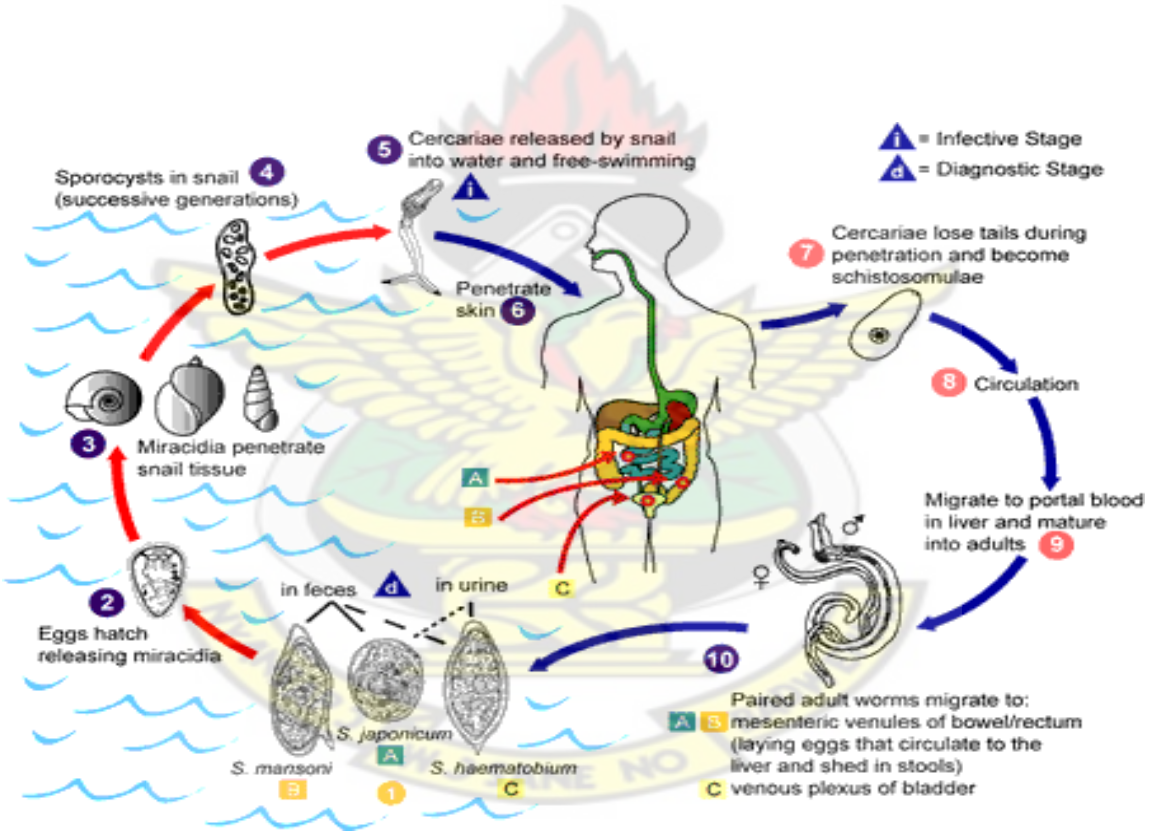


Figure 2.11 Life cycle of *Schistosoma.*

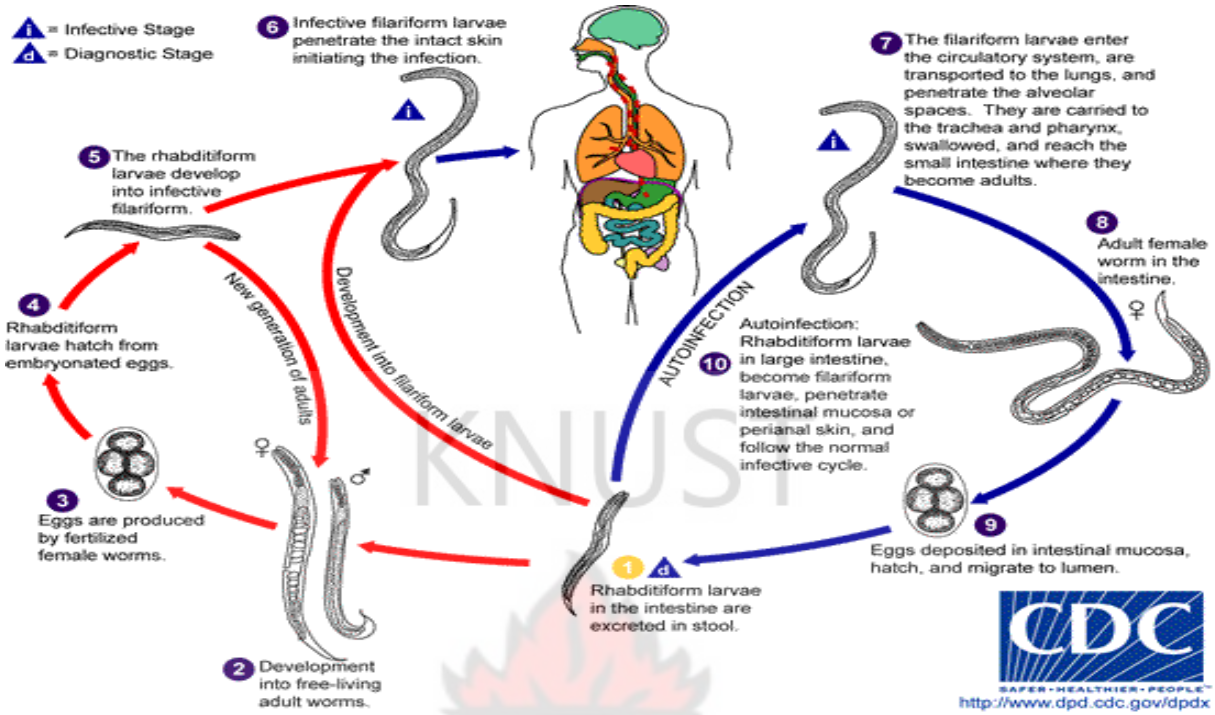


Figure 2.12 Life cycle of *Strongyloides stercoralis.*

The life cycle can be a direct or an indirect one. When parasites require only one host in which to complete its development, it is said to have a direct life cycle. The parasites that have a direct life cycle include *Entamoeba histolytica, Giardia lamblia, Ascaris lumbricoides,* and *Trichuris trichiura.* When two or more hosts are required, the cycle is referred to as indirect life cycle. Examples of parasites that have an indirect life cycle include *Schistosoma mansoni* and *Taenia saginata,* which require both a human host and a snail host respectively in order to complete their life cycle.

2.9 CLINICAL MANIFESTATIONS AND PATHOLOGY OF PARASITES

Parasitic infestations involve both parasitic and host factors to cause clinical manifestations. Parasites cause the following:

- Heart-lung migration of larvae results in inflammation and hypersensitivity.
- Reactions including pneumonia-like symptoms (coughing and bronchial asthma).
- Signs of toxaemia may develop. *Entamoeba histolytica* produces toxins, which have been demonstrated to be toxic to the heart and kidney.
- Diarrhoea, nausea, vomiting, abdominal pain and intestinal ulceration can occur. Examples of parasites that cause diarrhoea include *Ascaris lumbricoides,* and *Giardia lamblia.*
- Migrating worms often cause appendicitis and cholengitis. Examples include *Trichuris trichiura* and *Taenia saginata.*
- Invasion and destruction of host cells. Intracellular parasites of man produce several enzymes which cause digestion and necrosis of host cells, for example *Entamoeba histolytica* secretes many enzymes which digest intestinal tissues and help in the penetration and perforation of the large intestines. It also remains an important cause of diarrhoea in homosexual men suffering from AIDS.
- Rupture of hydatid cyst produces an anaphylactic reaction.
- Trauma: Attachment of adult worms such as *Strongyloides stercoralis,* hookworms, *Enterobius vermicularis* or *Taenia* species to intestinal wall produces traumatic damage to the villi, sometimes causing ulcers and oozing of blood at the site of attachment. Large numbers of adult worms can cause obstruction of the appendix and common bile duct.
- Dermatitis, eosinophilia and haemorrhage can occur. Deposition of eggs by some species such as *Schistosoma mansoni* inside the intestinal mucosa causes haemorrhage into the lumen of these organs.

2.10 PREVENTION AND CONTROL OF INTESTINAL PARASITIC INFECTION

According to WHO (2003), a comprehensive control strategy for helminth infection should usually include:

- Ensuring wide availability of antihelmintics for soil-transmitted helminth infections in all health services in endemic areas.
- Ensuring good case management of symptomatic cases.
- Regular treatment of all children at risk, including adolescent girls, through school and community based initiatives.
- Ensuring a safe water supply and adequate sanitation facilities in all schools.
- Ensuring provision of potable water and sanitation facilities at household/community level.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 STUDY SITE AND POPULATION

The study was conducted in the Pru and Atebubu Districts in the Brong Ahafo Region where ivermectin suboptimal response (SOR) has been reported (Osei-Atweneboana *et al.*, 2007). The study involved some selected school children from primary one up to Junior High School in the two districts. Twenty children per class were selected randomly in every school for snipping.

Permission was sought from the Ghana Education Service in the Districts as well as the school authorities. Written consent was also sought from all parents before the commencement of the study since the pupils were minors and therefore could not voluntarily give consent.

3.2 FIELD DATA COLLECTION TECHNIQUE

Face-to-face interview with respondents (parents, guardians, teachers, community leaders) was employed to collect the data. Since some of the respondents were illiterates, this method was thought to be appropriate and was approved by the ethical committee.

3.3.0 SAMPLING

3.3.1 SKIN SNIPPING

100µl of 0.98% normal saline was pipetted into a well labeled microtitre plate.

The skin (the iliac crest: left and right sides) was disinfected with 70% ethanol and the area allowed to dry. Using a sterile punch, a bloodless piece of the skin from the two sides was taken and the skin snip immersed into 0.98% saline in microtitre plates. The snipped area was dressed using a plaster and the pupils asked not to remove the plaster for 4 days after which the wound would be completely healed. The punch was sterilized using 4% concentration of Mucocit (4ml Mucocit topped up to 100ml with water).

The wells containing the snips were covered with a cellotape to avoid drying or spilling during transportation to the laboratory. The snips were incubated overnight at room temperature to allow any microfilaria to come out. Using the pipette the normal saline around the skin snip was collected and placed on a clean slide and examined microscopically for microfilaria using the x10 objective with the condenser iris closed sufficiently to give good contrast. With the aid of a tally counter, the number of microfilaria was counted and the results recorded. The skin snip from the microtitre well was removed and blotted with paper towel, weighed and the weight recorded and expressed as Mf/mg of skin.

3.4.0 STOOL ANALYSIS

Stool samples were obtained from each pupil to check for the presence of intestinal parasites. All the samples were transported to the Atebubu District Hospital for examination. The stool specimens were examined using the direct wet mount and formol ether concentration techniques and the ova quantified.

3.4.1 DIRECT WET MOUNT (WET PREPARATION)

Using an applicator stick, an estimated 1g of freshly voided faecal specimen was emulsified in a physiological saline bringing it to a suspension. A clean glass slide was labeled using a greased pencil or marker and a drop of the stool suspension placed on the slide. A separate cover slip was placed gently over each drop. The preparation was placed under a microscope and the condenser lowered to a low light intensity. The preparation was systematically examined, scanning the entire cover glass area with x10 objective and using the x40 objective for detailed morphology. The fields were then observed for trophozoites, ova, and larvae of helminths.

IODINE WET MOUNT

Using an applicator stick, an estimated 1g of fresh faecal material was emulsified in 1 drop of iodine bringing it to a suspension. A clean glass slide was labeled using a greased pencil or a marker. A drop of the stool suspension was placed on the slide and a separate cover slip placed gently over each drop. The preparation was placed under the microscope and the condenser lowered to a low light intensity. The preparation was systematically examined, scanning the entire cover glass area with x10 objective and using x40 objective for detailed morphology. The fields were then observed for cysts of intestinal protozoa.

3.4.2 FORMOL ETHER CONCENTRATION TECHNIQUE

Using an applicator stick an estimated 5g of faeces was emulsified in 4ml of 10% formol water confined in a test tube. A further 3ml of 10% formol water was added and mixed thoroughly. The emulsified faeces were sieved and the suspension collected in a beaker. The suspension was transferred into a conical (centrifuge) tube made of glass and 3ml of ether added to the suspension. The tube was stopped and the suspension mixed well for 30 seconds. With a tissue wrapped round the top of the tube the stopper was loosened (to release the considerable pressure that was built up inside the tube) and centrifuged immediately at 750-1000 rpm for 5 minutes.

Sedimentation of parasites after centrifugation formed four layers of the content; parasite sediment layer at the bottom, followed by formol water, faecal debris and the topmost layer, ether and dissolved fat. Using the stem of plastic bulb pipette, the layer of the faecal debris was loosened from the side of the tube and the tube rapidly invented to discard the ether, faecal debris and formol- water. The tube was then turned to its upright position so that fluid from the

side of the tube drains to the bottom of the tube. A Pasteur pipette was used to mix the sediment and a

drop of the sediment transferred to a slide and covered with a cover glass. The entire preparation was examined microscopically using x10 objective with the condenser iris closed sufficiently to give a good contrast. The x40 objective was used to identify small cysts and eggs. A drop of iodine was placed under the cover glass to enhance the identity of cysts (Cheesbrough, 2005).

3.5 REPORTING THE RESULTS

The number of ova, trophozoites and larvae found in the whole preparation was reported as follows:

Scanty ……1-3 per preparation

Few ……....4-10 per preparation

Moderate ……..... 11-20 per preparation

Many ……..21-40 per preparation

Very many ……. Over 40 per preparation

3.6 STATISTICAL ANALYSIS

Data were summarized into frequency distribution tables. Descriptive method of analysis such as charts and graphs were used to analyze and illustrate the occurrence of the various factors in the study.

Categorical data were analyzed using the Chi-square (X) or Fisher' exact t- test.

GraphPad Prism version 5.00 for windows was used for statistical analysis (GraphPad software, Sam Diego USA). A p-value of <0.05 was considered to be statistically significant.

CHAPTER FOUR

4.0 RESULTS

4.0 DEMOGRAPHIC DATA

This study was conducted in the Pru and Atebubu districts in the Brong Ahafo Region of Ghana. In all, 659 pupils from primary one up to Junior high school were involved. Table 4.1 shows the breakdown of the demographic data from the 2 districts. In the Atebubu district, 239 pupils comprising 118 males and 121 females took part in the study while in the Pru district, 420 pupils made up of 218 males and 202 females participated in the study. The ages of the pupils ranged from 1-20 years (Table 4.1). Out of the 239 children who took part in Atebubu

District, 99 were between the ages of 1-10 years while 140 of them were between the ages of 11-20 years (Table 4.1). In the Pru district, out of the 420 children who took part in the study, 93 were between the ages of 1-10 years while 327 of them were between the ages of 11-20years (Table 4.1). Two villages were chosen from the Atebubu district because of their nearness to the river which served as a breeding site for the Simulium. Also, four villages were chosen from the Pru District because of their closeness to the Black Volta basin which served as a breeding site for the black fly.

Table 4.1 Demographic data for the 2 districts

District	Sex		Age	
	Male	**Female**	**1-10**	**11-20**
Atebubu	118	121	99	140
Pru	218	202	93	327

Overall prevalences of the parasites in the two districts

From the Atebubu district, out of the 239 pupils examined, only one representing 0.42% had *O. volvulus* infection whiles 16 representing 6.7% had intestinal helminths and 31 representing 13.0% had intestinal protozoan infection (Table 4.2).

For Pru district, out of the 420 pupils examined, 6 representing 1.4% had *O. volvulus* infection whiles 25 representing 6.0% had intestinal helminths and 76 representing 18.4% had intestinal protozoan infection (Table 4.2).

There was no significant difference between Atebubu and Pru districts in the prevalences for *O. volvulus* (*P*=0.224), intestinal helminth infection (*P*=0.867) and intestinal protozoan infection (*P*=0.086).

Table 4.2 Prevalence of parasite infection stratified by District

District	**Total no. examined**	***Onchocerca volvulus* infection**		**Intestinal Helminth infection**		**Intestinal protozoan infection**	
			%		**%**		**%**
Atebubu	239	1	0.42	16	6.7	31	13.0
Pru	420	6	1.4	25	6.0	76	18.4
		P=0.224		*P*=0.867		*P*=0.086	

4.3 Prevalence of *Onchocerca volvulus* infection in the Atebubu District

Table 4.3 Prevalence of *Onchocerca volvulus* infection in the Atebubu District

Village	Total skin snips taken	Total positive	Percentage (%)
Nyomoase	100	1	1.0
Beposo	139	0	0.0

Out of 100 pupils examined in Nyomoase, only 1(1%) was positive while 0(0%) positivity was recorded in Beposo out of 139 pupils examined.

4.4 Prevalence of intestinal parasite infection in the Atebubu District

Table 4.4 Prevalence of intestinal parasite infection in the Atebubu District

Village	Total stool specimen collected	Total Intestinal Helminths	Percentage (%)	Total Intestinal Protozoa	Percentage (%)
Nyomoase	100	9	9	13	13.0
Beposo	139	7	5.0	18	12.9

The prevalence of intestinal helminths in Nyomoase was 9% and that of intestinal protozoa was 13%. In Beposo, prevalence of intestinal helminths was 5.0% while that of intestinal protozoa was 12.9%.

4.5 Prevalence of specific intestinal parasite infection in the selected schools in the Atebubu district

Table 4. 5 Prevalence of specific intestinal parasite infection in the selected schools in the Atebubu district

Specific parasite	**Beposo N=139**	**Percentage (%)**	**Nyomoase N=100**	**Percentage (%)**
G. lamblia	16	11.5	11	11.0
Hookworm	2	1.4	5	5.0
E. histolytica	2	1.4	2	2.0

H. nana	3	2.2	2	2.0
A.lumbricoides	0	0.0	2	1.0
S. stercoralis	0	0.0	2	1.0
Total	23	16.5	23	23.0

From table 4.5 above, *G. lamblia* recorded the highest prevalences of 11.5% in Beposo and 11.0% in Nyomoase whiles *A. lumbricoides* and *S. stercoralis* recorded 0.0% prevalence in Beposo and 2.0% prevalence each in Nyomoase. Hookworm infection was 1.4% in Beposo and 5.0% in Nyomoase. *H. nana* recorded 2.2% prevalence in Beposo and 2.0% prevalence in Nyomoase. *E. histolytica* on the other hand recorded a prevalence of 1.4% in Beposo and 2.0% in Nyomoase.

4.6 Prevalence of *Onchocerca volvulus* infection in the Pru district

Table 4. 6 Prevalence of *Onchocerca volvulus* infection in the Pru district

Village	Total skin snips taken	Total positive	Percentage (%)

Abua	140	5	3.6
Adjaragya	100	0	0.0
A-Beposo	100	0	0.0
Prang	80	1	1.3

From the Table 4.6 above, out of 140 pupils examined in Abua, 5 representing 3.6% were infected with *O. volvulus.* In Adjaragya, 100 pupils were examined and there was no *O. volvulus* infection (Table 4.6). Also, in A-Beposo there was no *O. volvulus* infection out of 100 pupils examined. Finally, at Prang, out of 80 pupils examined, 1 representing 1.3% was infected with *O. volvulus*.

4.7 Intestinal parasite infection in the Pru District

Table 4.7 Prevalence of intestinal parasite infection in the Pru District

Village	Total stool specimens collected	Total Intestinal Helminths	Percentage (%)	Total Intestinal Protozoa	Percentage (%)
Abua	140	7	5.0	24	17.1
Adjaragya	100	5	5.0	16	16.0
A-Beposo	100	7	7.0	19	19.0
Prang	80	5	7.5	17	21.3

From Table 4.7 above, out of the 140 pupils examined in Abua, 7 representing 5.0% were infected with intestinal helminths and 24 representing 17.1% were infected with intestinal protozoa. In Adjaragya, 100 pupils were examined with 5 pupils representing 5.0% having intestinal helminths and 16 representing 16.0% also having intestinal protozoa. Also, in A-Beposo, 7 pupils representing 7.0% were infected with intestinal helminths whiles 19 representing 19.0% were infected with intestinal protozoa out of 100 pupils examined (Table 4.7). Finally, at Prang, out of 80 pupils examined, 5 representing 6.3% were infected with intestinal helminths and 17 representing 21.3% were infected with intestinal protozoa (Table 4.7).

4.8 Distribution of specific intestinal parasites in the selected schools in the Pru district.

Table 4.8 Prevalence of specific intestinal parasite infection in the selected schools in the Pru district.

Specific parasite	**Abua N=140**	**%**	**Prang N=80**	**%**	**Adjaragya N=100**	**%**	**A-Beposo N=100**	**%**
G.lamblia	20	14.3	14	17.5	12	12.0	14	14.0
S.stercoralis	0	0.0	0	0.0	0	0.0	0	0.0
Hookworm	2	1.4	3	3.8	3	3.0	3	3.0
E.histolytica	4	2.9	3	3.8	4	4.0	5	5.0
H.nana	4	2.9	3	3.8	1	1.0	2	2.0
A. lumbricoides	0	0.0	1	1.3	0	0.0	2	2.0

From Table 4.8 above, *G. lamblia* recorded the highest prevalence of 17.5% in Prang followed by 14.3% in Abua. However, A-Beposo and Adjaragya recorded prevalences of 14.0% and 12.0% respectively for *G. lamblia*. On the other hand, *E. histolytica* recorded 2.9% prevalence in Abua, 3.8% in Prang, 4.0% in Adjaragya and 5.0% in A-Beposo. *S. stercoralis* however recorded 0.0% prevalence in all the four communities. *A. lumbricoides* recorded 0.0% prevalence in Abua, 1.3% in Prang, 0.0% in Adjaragya and 2.0% in A-Beposo. Also, Hookworm recorded 1.4% prevalence in Abua, 3.8% in Prang, 3.0% in Adjaragya and 3.0% in A-Beposo whiles *H. nana* recorded 2.9% prevalence in Abua, 3.8% in Prang, 1.0% in Adjaragya and 2.0% in A-Beposo.

4.9 SUMMARY OF PARASITE INFECTION STRATIFIED BY VILLAGE

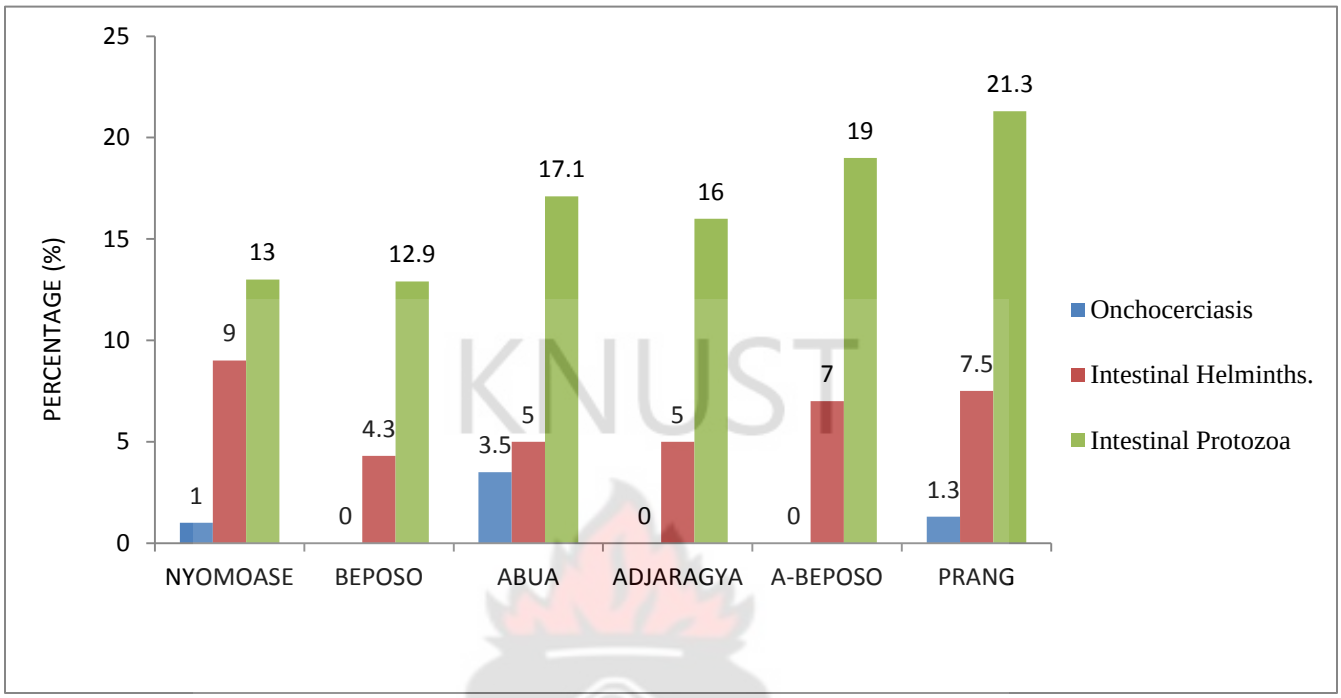


Figure 13: PREVALENCE OF PARASITES STRATIFIED BY VILLAGES

From the graph above, Abua recorded the highest prevalence for onchocerciasis. Beposo, Adjaragya and A-Beposo recorded zero (0) prevalence for Onchocerciasis. Intestinal parasites were present in all the villages with Prang recording the highest prevalence of intestinal protozoa.

4.10. OVERALL PREVALENCE STRATIFIED BY SEX

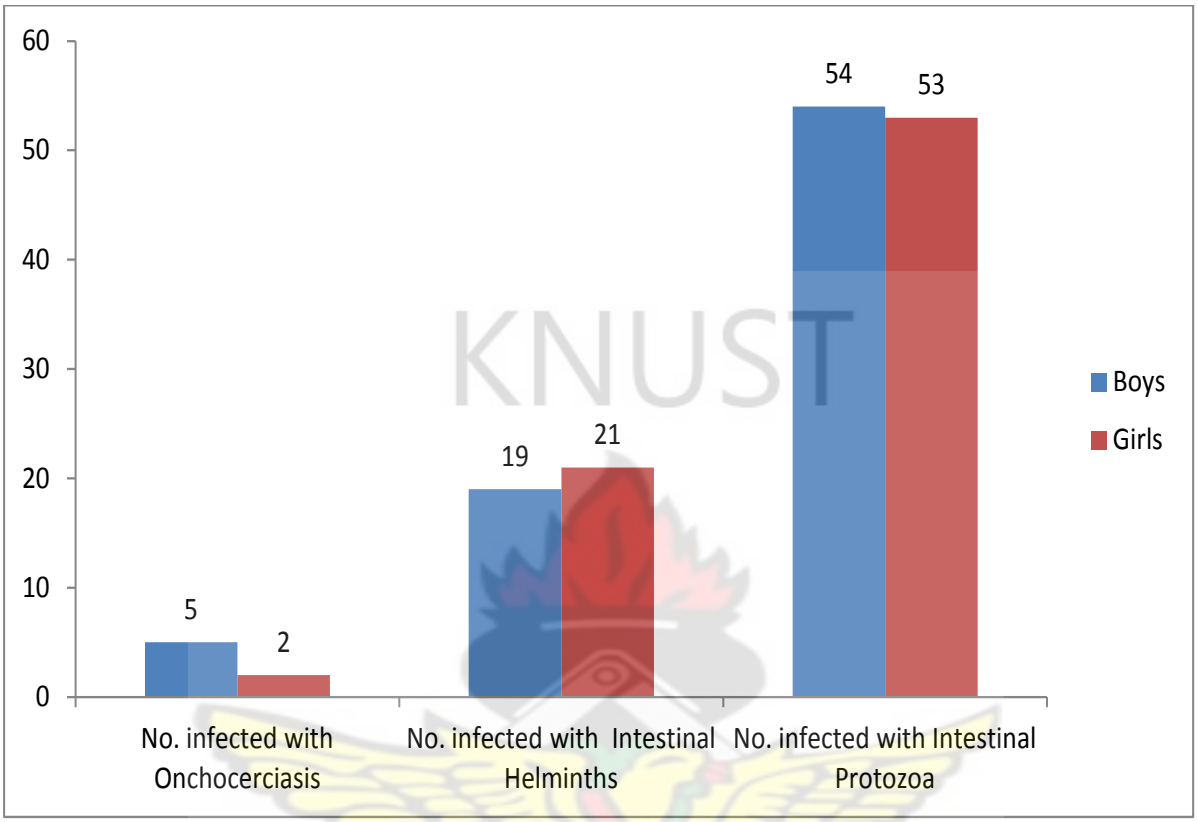


Figure 14: OVERALL PREVALENCE STRATIFIED BY SEX

Out of the 323 girls examined, 16.0% were infected with intestinal parasites. The number of boys examined was 336 and out of which, 16.0% were infected with intestinal parasites. Out of the 323 girls examined, 2 were infected with *Onchocerca volvulus*, 21 were infected with intestinal helminths and 53 were infected with intestinal protozoa. The number of boys examined was 336 out of which 5 were infected with *Onchocerca volvulus*, 19 were infected with intestinal helminths and 54 were infected with intestinal protozoa.

CHAPTER FIVE

DISCUSSION

Filarial infections belong to the major diseases in sub Saharan Africa and are strongly associated with poverty (Opoku, 2000; Osei-Atweneboana *et al*., 2007). Childhood parasitic infection is endemic in the Pru and Atebubu districts. Mass drug administration (MDA) with ivermectin has been going on in the Pru and Atebubu districts for the past 20 years. However, a suboptimal response to annual ivermectin treatment, defined as "a higher than normal rate of skin repopulation by *0. volvulus* microfilariae" was reported on several occasions in northern Ghana (Opoku, 2000; Osei-Atweneboana *et al*., 2007). This study was therefore undertaken to assess the prevalence of *Onchocerca volvulus* infection in the two districts.

Onchocerca volvulus prevalence was low in Atebubu district recording only 0.42%. However, intestinal helminth infection was higher in Atebubu district recording 6.7% and it was recorded in all age groups and gender. Intestinal protozoan infection was also higher in the district recording 13.0%. *Onchocerca volvulus* prevalence was relatively high in Pru district recording 1.43%. Intestinal helminth infection was lower in Pru district recording 6.0% and it was recorded in all age groups and gender. Intestinal protozoan infection was higher in the Pru district recording 18.4%. The Overall prevalence for onchocerciasis was 1.1 %. Beposo, Adjaragya and A-Beposo had zero (0%) prevalences for Onchocerciasis. Also, Prang and Nyomoase recorded 1.3% and 1.0% prevalences for onchocerciasis respectively. The low prevalences recorded could be due to adequate MDA coverage, and provision of potable drinking water in those communities. However, Abua, recorded 3.6% prevalence for onchocerciasis which is higher than the accepted level of 2% recommended by WHO. The high prevalence recorded in Abua could be due to low coverage of MDA or could be a

manifestation of the suboptimal response reported by Osei-Atweneboana *et al.*, (2007). Generally, the results of the study showed that mass treatment with ivermectin resulted in a major reduction in transmission of onchocerciasis.

Parasite infestation is worldwide in distribution. It remains one of the constant public health problems in almost all developing countries. It is widely recognized as a mirror of socioeconomic conditions and an indicator of poor sanitation (WHO, 2005). It has been estimated that more than a quarter of the world population is suffering from one or the other type of intestinal parasites. Despite its frequency, it ranks high as a neglected tropical disease (WHO, 2005). Helminths have worldwide distribution. They are particularly common in the tropics and subtropics where sanitation is inadequate and untreated human faeces are used as fertilizer (night soil) (WHO, 2005). Childhood intestinal parasitic infection is global though endemic in the tropics and subtropics for reasons attributable to mainly environmental conditions and poor hygiene causing significant morbidity such as anaemia, diarrhoea and dysentery, malnutrition, mental defect, poor growth and severe surgical conditions (Patel and Khandeker, 2006).

In all, 22.3% of the stool samples had intestinal parasites in the study. The average prevalence for intestinal helminths was 6.7% in the Atebubu district and 6.0% for the Pru district while that of intestinal protozoa was 13.0% for Atebubu District and 18.4% for Pru district. The prevalence of intestinal helminths in Nyomoase was 9.0% and that of intestinal protozoa was 13.0%. In Beposo, prevalence of intestinal helminths was 4.3% while that of intestinal protozoa was 12.9%. In Abua, 5% were infected with intestinal helminths and 17.1% were infected with intestinal protozoa. In Adjaragya, 16.0% had intestinal helminths and 16.0% also

had intestinal protozoa. Also, in A-Beposo, 7.0% were infected with intestinal helminths whiles 19.0% were infected with intestinal protozoa.

Finally, at Prang, 6.3% were infected with intestinal helminths and 21.3% were infected with intestinal protozoa. The highest prevalence of 21.3% for intestinal protozoa in Prang in the study may be due to open defaecation, and lack of toilet facilities. Out of 323 girls examined, 6.5% were infected with intestinal helminths and 16.4% were infected with intestinal protozoa. The number of boys examined was 336, out of which 5.7% were infected with intestinal helminths and 16.1% were infected with intestinal protozoa. The environmental conditions in the various schools in the study might be the cause of the differences in the prevalence of intestinal parasitic infections among the children in the selected schools. The prevalence rate of intestinal parasite infection in the 2 districts in this study was 22.3% with the overall prevalence for intestinal helminths being 6.4% and 15.7% for intestinal protozoa.

The 22.3% prevalence rate in this study differs from the 58.0% prevalence rate obtained in a study of parasitic infections and malnutrition in children in some parts of Greater Accra (Korebumi *et al*., 1987), in which 3,176 children from urban and rural parts of Greater Accra, Ghana were examined for malnutrition and parasitic infection. Undoubtedly, the lower prevalence rate in the study could be due to some interventional programs carried out by the Ministry of Health. These include the mass deworming exercise, health education and provision of sanitary latrines in the communities.

Anteson *et al* in 1981 observed in rural parts of Greater Accra, Ghana that 21.8% of stools examined were positive for intestinal parasites and this prevalence was almost the same as

mine (22.3%). The reasons for the same prevalences in these studies could be due to similar environmental and sanitary conditions.

Wurapa *et al* (1975), in a study on parasitic infections in the Danfa project area in southern Ghana also revealed that out of the 3,653 subjects studied, parasitic worms accounted for 51.2%. The difference in prevalence between this study and the current study could be as a result of the differences in locality and endemicity, time of survey, method used and geographical locations (Chigozie *et al*., 2007).

In this study, *S. stercoralis* however recorded 0.0% prevalence in five out of the six communities. This could be due to the MDA with ivermectin which is very effective against *S. stercoralis. A. lumbricoides* also recorded 0.0% prevalence in three out of the six communities in this study. This could be due to the use of albendazole during MDA since this drug is effective against *A. lumbricoides.*

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

CONCLUSION

Onchocerca volvulus prevalence was low in Atebubu district recording only 0.42%. Intestinal helminth infection was higher in Atebubu district recording 6.7% and it was recorded in all age groups and gender. Intestinal protozoan infection was low in the Atebubu district recording 13.0%. *Onchocerca volvulus* prevalence was relatively high in Pru district recording 1.43%. Intestinal helminth infection was lower in Pru district recording 6.0% and it was recorded in all age groups and gender. Intestinal protozoan infection was higher in the Pru district recording 18.4%.

RECOMMENDATION

- Atebubu and Pru districts are WHO onchocerciasis hotspots, so the MDA with ivermectin should be encouraged as the disease is still prevalent in the districts.
- Mass deworming exercises should be intensified in the schools and communities following the results of this study which indicate high intestinal parasite infection in the districts.
- Efforts should be made to reduce indiscriminate defaecation in the schools and communities to halt the transmission of the intestinal parasites.

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APPENDIX A

EQUIPMENT, REAGENTS AND MATERIALS

- Centrifuge
- Microscope
- Vortex mixer
- Timer
- Conical test tube (16x100ml)
- Glass slides
- Cover slips
- Reagents troughs
- Pasteur pipette
- Monowax containers
- Discard jars (biohazard containers)
- Cotton wool
- Disposable gloves
- Applicator sticks
- Stainer (400-450) in size (Gauze)
- Face mask
- Distilled water
- Formalin
- Diethyl ether
- Sodium chloride

- Lugol:s iodine solution
- 1% virkon solution (disinfectant)
- The Punch

APPENDIX B

PREPARATION OF REAGENTS

1. Physiological saline (W/V)

   Sodium chloride (NaCl)-8.5g

   Distilled water-100ml

   It was prepared by weighing 8.5g NaCl into 1 litre flat-bottom flask and 100ml distilled water added and mixed to dissolve.

2. 10% Formalin solution (W/V)

   Formaldehyde, analytical grade-100ml

   Distilled water-90ml

   The distilled water was measured in a 1 liter flat-bottom flask by the formalin and contents mixed, kept in a liter bottle with date.

3. Lugol:s iodine solution

   Iodine crystals 1-5g

   Potassium iodine (KI)-10g

   Distilled water-100ml

   I and KI were weighed into a 500ml conical flask and 100ml distilled water added to the salt to dissolve. After thorough mixing, it was kept into a brown bottle, labeled and dated. Working Lugol:s iodine was prepared by making 1:5 dilutions with distilled water.

APPENDIX C

CALCULATION OF PREVALENCE RATE

Prevalence rate = Number of patients recently infected x 100

Total number of patients

Strongyloides stercoralis - 5 x100%=2.5%

200

PATIENT'S CASE REPORT FORM

Protocol: Assessment of the impact of 20 Years of Mass Drug Administration With Ivermectin on The Prevalence of *Onchocerca volvulus* and other Soil-Transmitted Helminth Infections in Children in The Pru and Atebubu Districts in Ghana.

Name……

Individual No: ☐☐☐ - ☐☐☐

Sex: M☐ F☐ Age: ☐☐ years In endemic area since ☐☐ years

Date of examination: ☐☐ ☐☐ ☐☐

(dd/mm/yy)

Previous treatment:

Ivermectin: No. of rounds: ☐☐

Last intake (month/year): ☐☐ ☐☐☐☐

No. of tablets: ☐☐

Albendazole: No. of rounds: ☐☐

Last intake (month/year): ☐☐ ☐☐☐☐

No. of tablets: ☐☐

Adverse events after MDA:

Specify……

Duration of adverse events:……(days)

Other antihelminthics……